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Western Journal of *Emergency Medicine*:

Integrating Emergency Care with Population Health

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Emergency medicine is a specialty which closely reflects societal challenges and consequences of public policy decisions. The emergency department specifically deals with social injustice, health and economic disparities, violence, substance abuse, and disaster preparedness and response. This journal focuses on how emergency care affects the health of the community and population, and conversely, how these societal challenges affect the composition of the patient population who seek care in the emergency department. The development of better systems to provide emergency care, including technology solutions, is critical to enhancing population health.

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Recent Interventions for Acute Suicidality Delivered in the Emergency Department: A Scoping Review

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Introduction: Suicidality is a growing problem in the US, and the emergency department (ED) is often the front line for the management and effective treatment of acutely suicidal patients. There is a dearth of interventions that emergency physicians may use to manage and effectively treat acutely suicidal patients. To the extent that recently described interventions are available for ED personnel, no review has been conducted to identify them. This scoping review is intended to fill this gap by systematically reviewing the literature to identify recently described interventions that can be administered in the ED to reduce symptoms and stabilize patients.

Methods: We conducted a search of PubMed, SCOPUS, and CINAHL in January 2024 to identify papers published between 2013–2023 for original research trialing recent interventions for the effective treatment of suicidality in the ED. We assessed 16 full-text articles for eligibility, and nine met inclusion criteria. Included studies were evaluated for features and characteristics, the fit of the intervention to the ED environment, and interventional efficacy.

Results: Four studies assessed the efficacy of a single dose of the anesthetic/analgesic agent ketamine. Three studies assessed the efficacy of a brief psychosocial intervention delivered in the ED, two of which paired this intervention with the provision of follow-up care (postcard contact and referral assistance/case management, respectively). The remaining two studies trialed a brief, motivational interviewing-based intervention. Included studies had strong experimental designs (randomized controlled trials) but small sample sizes (average 57). Among the interventions represented across these nine studies, a single dose of ketamine and the brief psychosocial intervention Crisis Response Planning (CRP) show promise as ED-appropriate interventions for suicidality. Ketamine and CRP demonstrated the strongest fit to the ED environment and most robust efficacy findings.

Conclusion: This review identified one drug (ketamine) and four unique psychological/behavioral interventions that have been used to treat acute suicidality in the ED. There is currently insufficient evidence to suggest that these interventions will prove efficacious and well-suited to be delivered in the ED environment. Future studies should continue to test these interventions in the ED setting to determine their feasibility and efficacy. [West J Emerg Med. 2024;25(6)858–868.]

INTRODUCTION

Over the past two decades, the suicide rate in the US general population increased by over 33%.[1] Up to half of suicide decedents visit an emergency department (ED) during the year before their death, and approximately 25% visit in the month immediately prior.[2,3] The risk for death by suicide among ED patients presenting with suicidal thoughts and behaviors remains high for at least one year after discharge.[4,5] The ED is often the first medical access point for those with an acute deterioration in their mental health; approximately 10% of all ED visits are for mental health concerns.[5–7] New and innovative approaches are needed to stem the tide of suicides and to help mitigate the crisis of psychiatric boarding in EDs.[8,9]

Emergency department personnel have increasingly voiced concerns over a broken system of mental health care that has exacerbated conditions for ED patients with psychiatric emergencies.[10] Such serious system deficiencies may contribute to the perception of suicidal ED patients who describe ED personnel as lacking empathy, and being brusque, irritable, and even hostile.[11] Exacerbating the problem is that the number of state-funded inpatient psychiatric beds has dropped substantially, from 340 beds per 100,000 people in 1995 to under 12 beds per 100,000 by 2016.[8,9] Conversely, the number of ED visits for psychiatric complaints has risen by 50%.[8] This has led to a situation where many patients who require inpatient mental health care must wait in the ED until a psychiatric bed becomes available. This delay in transferring patients to an inpatient unit leads to "psychiatric ED boarding."[12]

The state-of-the-art interventions available to emergency physicians are oriented toward safely discharging patients home and connecting them to definitive mental health services.[13,14] Brief interventions or referral followed by discharge home are common for patients presenting with non-life-threatening suicidal thoughts and behaviors, whereas patients presenting with moderate to severe risk behaviors for suicide are usually kept in the ED until transfer to an inpatient psychiatric facility is possible.[15] This splitting of patients into categories of risk severity[16] means that the higher a patient's risk for suicide, the fewer interventions are available to address the patient's particular needs. Notably, no pharmacologic agent has been approved by the US Food and Drug Administration to treat suicidality in the ED; most medications administered to suicidal ED patients typically target only agitation, not the suicidal symptoms themselves.[16,17]

From a psychiatric perspective, most available interventions target suicidal thoughts and behaviors over the long term as opposed to the short- or medium term[17] and are therefore ill-suited to the acute care environment. Psychopharmacologic agents such as antidepressants, lithium, and antipsychotics generally require a course of weeks or months to take effect,[14] and beginning a course of antidepressant treatment can paradoxically increase suicidality in some populations.[18] Similar time scales are required for empirically supported psychotherapies such as cognitive behavioral therapy and others,[17,19] and even the most abbreviated standard interventions can take up to six weeks.[20]

While the importance of screening for suicidality is well understood,[21] there is growing need for evidence-based, rapidly acting, effective treatment options.[15] Many existing tools suited to the ED environment that target suicidality lack supporting evidence or, worse, are counterproductive.[22,23] One such intervention is the safety contract or no-suicide agreement. While at one time the gold standard for ED anti-suicidal interventions, the safety contract has been shown to produce worse outcomes than no intervention at all.[21,24] To the extent that more recent interventions for the effective treatment of acute suicidality have emerged, there has been no review created specifically to identify and describe potential interventions.

An analysis by Inagaki and colleagues[25] identified broad classes of interventions to prevent repeat suicide attempts in patients admitted to an ED but did not investigate which interventions would be best suited to the ED environment. Chang and colleagues provided a review of major depressive disorder and suicidality in the ED but did not offer an analysis of recently described interventions.[21] In a 2021 review, Mann and colleagues[26] surveyed the landscape for evidence-based therapies for suicidality in general, but they did not focus specifically on the ED. While other recent reviews have assessed the availability of clinician-oriented educational interventions,[23] or interventions for mental decompensation in general,[27] none have thoroughly assessed the literature for recently described tools that clinicians may use to treat acute suicidality in the context of the ED. Lengvenyte and colleagues[28] published a systematic review on the immediate and short-term efficacy of suicide-targeting interventions but did not focus on recent interventions used in the ED. We undertook this review to fill the gap and explore the literature to identify and describe recent, patient-centered interventions for the effective treatment of acute suicidality in the ED.

In this review we focused on recently described interventions that can be administered in the context of a patient's stay in the ED, namely, brief therapies and pharmacologic agents that fit with the standard medical model of treatment. State-of-the-art practice (ie, generally accepted care), defined as interventions for acute suicidality, are described in *Rosen's Emergency Medicine: Concepts and Clinical Practice*[29] or *Kaplan and Sadock's Comprehensive Textbook of Psychiatry*.[30] These include screening, joint safety planning, patient education, lethal means counseling, follow-up contacts, and the involvement of friends and family.[29,30] Interventions listed in or moderately modified from those described in these textbooks

were considered state-of-the-art and excluded from the search. The primary question of this review was as follows: What recently described interventions are available for use in reducing suicidality and stabilizing patients during a psychiatric crisis in the ED?

METHODS

We searched PubMed, SCOPUS, and CINAHL on January 15, 2024. This review was conducted in accordance with best-practice recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) extension for scoping reviews.[31] Inclusion criteria included the following: 1) study participant patients were presenting to the ED with suicidal ideation; 2) the study assessed the efficacy of one or more patient-centered intervention(s) aimed at reducing suicidal thoughts and behaviors; 3) the intervention being tested was administered to patients in the ED; 4) the intervention was administered by emergency physicians or personnel; 5) the study was available in English; and 6) the study had been published in the last 10 years.

Definition of Suicidality and Recent Interventions

We adopted the suicidality nomenclature proposed by Silverman and colleagues.[32] Studies implementing the broad term suicide-related thoughts and behaviors (SRTB), or any sub-category thereof, were considered eligible for inclusion. For a resource on research-validated scales for the measurement of suicidality we relied on the list compiled by Ghasemi, Shaghaghi, and Allahverdipour.[33] We sought to identify recently described, effective treatments for the prevention of suicidal behavior that are outside the state-of-the-art (current standards). To this end, we defined recent interventions as being patient-centered, delivered in the ED, described within the past 10 years, and not already part of recognized state-of-the-art practice.

Features of Eligible Studies

We assessed studies for characteristic features once they were included in the analysis, and we evaluated the comparative strengths and weaknesses of study design, sample size, etc. Studies considered identified a specific, recent intervention for acute suicidality in context of the ED in the previous 10 years, since earlier interventions were considered more likely to be consistent with state-of-the-art practice.

Search strategy

We used a three-step search strategy in consultation with a library scientist. In the first phase, we conducted a preliminary search of PubMed to ensure relevant results were retrieved from our search terms. In the second phase, the search terms were applied to PubMed, SCOPUS, and CINAHL. See Appendix A for the search terms used. In the third phase, we scanned the results from the search conducted in phase two for references included in study bibliographies that could have provided additional articles. The database search strategy is summarized in Appendix A. We conducted additional searches of Google to identify gray literature or publications not discovered via the above-described search process.

Study selection

Once search terms and keywords were narrowed down, we removed duplicates from the list of articles. Four independent reviewers screened the titles and abstracts for relevance of all remaining studies. Articles determined to be relevant at this stage were retrieved in full-text form and screened for relevance by two independent reviewers. A pre-selected arbiter settled inconsistencies between reviewers. We recorded and documented reasons for exclusion for any article. A visualization of this process is included in a PRISMA flow diagram[34] in Figure 1, which also provides a a summary of results in standard PRISMA format.

Data extraction

Data fields collected from included studies are summarized in the data extraction tool given in Appendix B. The primary author A.P.H. extracted data using the tool, and the data was checked for accuracy and completeness by an independent reviewer.

RESULTS

After duplicates were removed, we analyzed 1,197 studies. There are a few reasons for this large number of results. In keeping with best-practice guidelines, and to avoid the

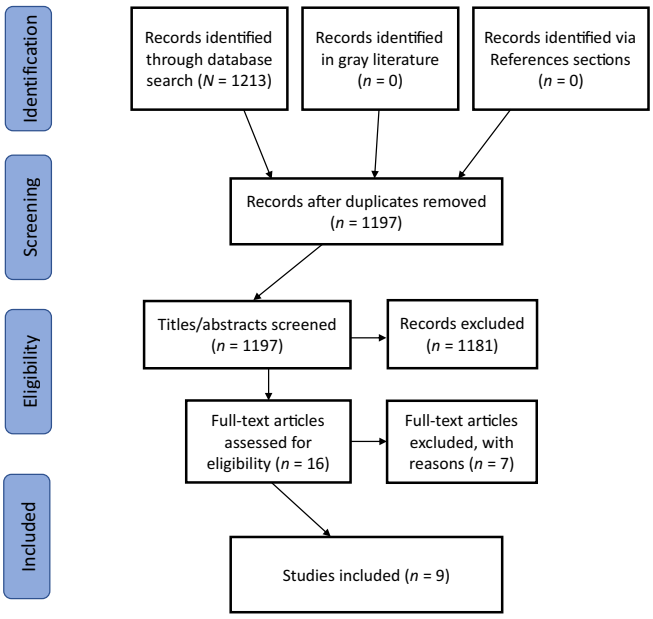

Figure. PRISMA flow diagram of study selection.

improper exclusion of any relevant articles, we used broad search terms to return the maximum number of potentially relevant articles. Additionally, no MeSH terms specifically aimed at excluding screening and risk assessment were used. The title/abstract review phase was, therefore, a critical stage for the isolation of relevant articles, and we removed 1,181 from further analysis.

In the next phase of eligibility screening, two independent reviewers retrieved and evaluated the full texts of 16 articles, of which seven were excluded. Disagreements were settled by an emergency physician with relevant expertise in acute care interventions for suicidality R.A.D. Of the excluded articles, two studies involved interventions that were tailored to the unique cultural practices of specific indigenous groups and were therefore deemed not generalizable to all suicidal patients presenting to EDs.[35,36] Two additional articles were excluded as they used a safety planning intervention operationally defined as part of state-of-the-art practice. One article was excluded because the study intervention did not occur in the ED setting.[37] Finally, we excluded two secondary analyses of articles that had already been included.[38,39] Of the nine articles included in the analysis, we extracted data using the tool given in Appendix A. An overview of relevant data from each study is presented in the Table.

Four included articles assessed the use of a single dose of the pharmacologic intervention ketamine, a N-methyl-D-aspartate antagonist commonly used as a sedative, analgesic, and anesthetic.[40–43] Three studies assessed the use of an intravenous (IV) infusion,[40,42,43] and one assessed the efficacy and tolerability of an intranasal administration.[41] Two of the selected articles assessed the efficacy of interventions centered on motivational interviewing (MI) embedded in an interventional framework with provisions for follow-up care or referral assistance.[44,45] Both Teen Options for Change (TOC)[45] and Suicidal Teens Accessing Treatment After an Emergency Department Visit (STAT-ED)[44] targeted adolescent samples.

The three remaining included articles studied various interventions centered on acute psychotherapy and/or behavioral management in the post-acute period. By far the largest sample among included articles was a study of assertive case management for those presenting to the ED after a suicide attempt.[46] While the lengthy (18+ months) intervention under study in this article largely took place following discharge from the ED, the intervention procedures began while patients were in the ED and were delivered by psychiatrists or other medical personnel.[46] Another study that met our criteria investigated the efficacy of the novel, manualized Problem Solving and Comprehensive Contact Intervention (PS-CCI), which uses a collaboratively completed worksheet aimed at enhancing self-efficacy and cognitive flexibility in suicidal ED patients paired with follow-up care.[47] Finally, a study of the Crisis Response Plan (CRP) intervention conducted by Bryan and colleagues in a military ED met inclusion criteria.[22] The CRP pairs a brief historical interview with a collaborative identification and documentation of coping strategies and resources available to patients.[22]

Study Features and Characteristics

Several measures of study features and characteristics were gathered in the process of data extraction. We used PRISMA guidelines to help define elements of quality[31] including sample size, study design, follow-up timeframe, and measures used.

Sample

The sample sizes of the majority of studies meeting inclusion criteria were small. Excluding the outlier of Kawanishi et al[46] with their robust sample of 914, the average sample size for included studies was 57, with the smallest sample (10) collected by Burger and colleagues.[40]

Design

Seven of nine studies conducted a randomized controlled trial (RCT), one was a quasi-experimental two-arm prospective longitudinal study,[47] and one was a non-experimental pilot study designed to evaluate the feasibility and efficacy of a single low dose of ketamine delivered via IV bolus.[43] Double-blinding and random assignment were consistently practiced among the RCTs assessing the efficacy of ketamine, and participants in the control conditions received an inactive placebo injection/atomization of normal saline.[40–42] Kawanishi and colleagues,[46] King et al,[45] and Grupp-Phelan et al[44] used single blinding and a comparator condition of enhanced usual care (EUC). In their three-arm RCT, Bryan and colleagues[22] compared two versions of CRP (standard and enhanced) to the control condition of a contract for safety, and participants were blinded to group assignment. Although the contract for safety was previously a standard intervention, it has many noteworthy shortcomings[22] making it a less-than-ideal comparison condition to CRP.[24]

Follow-up measures and timeframe

Seven of the nine studies included in this review used standard, well-subscribed, psychometrically validated measures of suicidality to assess outcome variables of interest, as well as evaluations of repeated hospitalizations and healthcare utilization. The most common scales used were the Columbia Suicide Severity Rating Scale, the Beck Scale for Suicidal Ideation, and the Montgomery-Asberg Depression Rating Scale. However, two studies evaluated only post-discharge suicide attempts, suicide deaths, and psychiatric hospitalization recidivism without making use of psychometric measures.[46,47] The follow-up timeframes

Table. Summary of individual studies.

Authors	Year	Country	Objective(s)	Intervention	Methods	N	Length of time	Discipline	Materials	Follow-up	Findings	Conclusion
Dana Alonzo	2014	USA	To determine the feasibility and acceptability of a novel, manualized problem-solving and comprehensive contact intervention (PS–CCI) aimed at improving treatment engagement of suicidal individuals.	Manualized problem-solving and comprehensive contact intervention	Longitudinal design	44	3 mos	"Clinician" not otherwise defined	Structured worksheet manualized	3 mos	Did not have the sample for statistical significance, but they appeared to find that this intervention was feasible as measured by acceptability, engagement, fidelity, subject retention, and lack of AEs.	PS-CCI is feasible as an intervention for suicide in the ED
Kawashini et al	2014	Japan	To determine if assertive case management can reduce repeated suicide attempts in people with mental health problems who had attempted suicide and were admitted to EDs	Assertive case management	Two-armed RCT	914	18 mos to 5 years	Psychiatrist, nurses, clinical psychologists, etc	Case management manual, phone	18 mos-5 yrs	Lower recurrent suicidal behavior at 1, 3, and 6 mos; but at 18 mos there was no significant difference in rates of attempted or completed suicides	Intervention somewhat effective short term and among women, but overall assertive case management did not outperform control condition
Grupp-Phelan et al	2019	USA	To examine whether motivational interviewing (MI) increases linkage of adolescents to outpatient mental health services for depression and suicide risk	MI plus linking to follow up services	Two-armed RCT	159	2 mos total	Licensed social worker	None	6 mos	MI was not better than enhanced usual care	Brief MI was not useful in this context
Bryan et al	2017	USA	To evaluate the effectiveness of crisis response planning (CRP) for the prevention of suicide attempts	CRP	Three-armed RCT	97	1 hr	Clinician not defined	Index card	6 mos	Standard CRP and reasons for living CRP were both more effective than a contract for safety in reducing suicide attempts and inpatient hospitalization. No difference between two versions of CRP	CRP is highly effective for use in the acute care setting for acutely suicidal patients
Domany and McCullums Smith	2020	USA	To assess the safety, feasibility, tolerability, and efficacy of a single low-dose intravenous (IV) ketamine in reducing suicidal ideation	Ketamine IV	Placebo-controlled double blind RCT	18	5 mins	Board-certified ED physician	IV bag, drug, 10ml syringe, vital sign monitoring equipment	Two weeks	Significant differences in suicidality scores 90–180 mins after IV ketamine infusion. Safety and tolerability were excellent.	IV ketamine appears to be feasible and effective in the short term

(*Continued on next page*)

Table. Continued.

Authors	Year	Country	Objective(s)	Intervention	Methods	N	Length of time	Discipline	Materials	Follow-up	Findings	Conclusion
Burger et al	2016	USA	To compare IV ketamine to placebo among acutely suicidal patients in a military setting	Ketamine IV	Double-blind RCT	10	5 mins	Trained nurse	IV bag, vital sign monitoring equipment	Two weeks	Groups varied significantly in the short-term during hospitalization; however, discrepancies in scores on the rating scales diminished at the two-week follow-up point.	Ketamine shows promise as an acute care treatment modality, but further research is needed to validate the effects of this very small trial.
King et al	2015	USA	This randomized trial examined the effectiveness of Teen Options for Change (TOC), an intervention for adolescents seeking medical emergency services who screen positive for suicide	Teen Options for Change (TOC)	RCT with enhanced TAU as control condition	49	45 mins of MI, 5 days of follow up	Trained mental health professional with minimum of 40 hrs of specialized training	Handwritten follow up note	2 mos	Large effect for the lowing of depression scores, moderate effect for hopelessness, and insignificant effects for suicidal ideation and alcohol use (though the study wasn't quite large enough to statistically verify the latter findings	This intervention appears to be promising but will need to be tested in a larger sample
Kashani et al	2014	Iran	This study was conducted to examine the effects of a single intravenous bolus of ketamine on patients with suicidal ideation in the ED.	Ketamine IV bolus	Uncontrolled pre-test/post-test	49	5 mins	Nurse or attending doctor	IV bag, vital sign-monitoring equipment	10 days	The ketamine infusion was associated with a bringing down the MADRS and SSI scores by a statistically significant margin, but the authors note that, for their purposes, the reduction in scores was not clinically meaningful (e.g., below the threshold set for the purposes of the study of a MADRS score of ≤4). The largest reduction in self-reported suicidality occurred within 40 mins of ketamine administration.	The authors note that ketamine did not show itself as a promising tool to mitigate acute suicidality in the ED context, as the reductions in suicidality scores were not clinically meaningful. However, they do note that more research is needed and that this result is far from definitive (given the sample size and lack of control group).

(*Continued on next page*)

Table. Continued.

Authors	Year	Country	Objective(s)	Intervention	Methods	N	Length of time	Discipline	Materials	Follow-up	Findings	Conclusion
Domany and McCullum Smith	2022	USA	Evaluation of single, fixed-dosed intranasal ketamine for acute suicidal ideation in the ED	Ketamine intranasal	Double-blind RCT	30	40 mins to 1 hr	Psychiatrist	Intranasal atomizer	4 weeks	Participants who were administered ketamine had not only a much higher rate of remission (roughly 80% of the sample), but also typically shorter lengths of hospitalization. Ketamine was generally safe; minor side effects were transient and resolved within 1–2 hours post-administration. However, the linear mixed statistical model did not show significance on random group by time interaction.	While the sample is comparatively small and the overall results are far from conclusive, this study importantly echoes previous findings demonstrating that a low dose of ketamine does appear to transiently reduce suicidal ideation in those at high acute risk for suicide. In addition, it provides promising evidence that a single, fixed dose of ketamine may have the potential to reduce hospital lengths of stay, and that intranasal is a feasible route of administration for the acute care setting.

AEs, adverse events; *ED*, emergency department; *IV*, intravenous; *MADRS*, Montgomery Asberg depression rating scale; *RCT*, randomized, controlled trial; *SSI*, Beck Scale for Suicidal Ideation; *TAU*, treatment as usual.

varied significantly depending on the intervention under study and added to the heterogeneity of the sample.

Fit of Intervention to Emergency Department Environment

Since we intended to analyze recently described tools available to emergency physicians for use in the acute care setting, attention was paid to the usability of each intervention in the ED setting. We defined usability as ease of use and fit to the ED environment, and these were evaluated along the dimensions of total time required to administer, the required training or credentials of the administering practitioner, and the tools and materials required to deliver the intervention.

Time to administer

By far the briefest interventional modality among the articles reviewed was a single dose of ketamine delivered IV, which, at the modest doses used, averaged 5–10 minutes.[40,42,43] When administered intranasally, the interval required to complete the intervention, although brief (40–60 minutes), was somewhat longer.[41] Not included in the intervention duration was the monitoring time required for ketamine administration, which depending on local protocol can exceed several hours. Equivalently brief is CRP, which requires 30–60 minutes to administer, making it well-suited to the demands of the fast-paced ED environment.[22] The studies assessing MI-based interventions for adolescents had brief ED-delivered components, requiring approximately 45 minutes to deliver.[44,45] The time required to administer the ED-based problem-solving component of the Problem-Solving and Comprehensive Contact Intervention (PS-CCI) intervention was not specified.[47] Finally, Kawanishi and colleagues did not specify the time course of the ED-based portion of assertive case management, but they did note the intervention involved regular follow-up appointments outside the ED over the course of 18 months.[46]

Training required to administer

Due in part to variability in hospital practices in different regions and countries, the credentials of the healthcare professionals administering ketamine varied slightly across the four studies that investigated its use.[40–43] Intravenous administration was conducted by either a nurse or a physician,[40,42,43] whereas the study using intranasal ketamine required significant input from a pharmacist.[41] Both the PS-CCI[47] and CRP[22] stated only that the intervention was delivered by a "clinician," not otherwise specified. The STAT-ED described by Grupp-Phelan et al[44] and TOC studied by King et al[45] were administered by a social worker and trained mental health professional, respectively, with the latter specifying that interventionalists were required to have a minimum of 40 hours of specialized training. Finally, the assertive case management intervention described by Kawanishi and colleagues[46] was conducted by case managers at various levels of training, including nurses, emergency physicians, psychiatrists, and clinical psychologists.

Tools and materials

For most psychosocial interventions under study in the present review, few specialized materials were required for administration. Specifically, the STAT-ED intervention,[44] CRP,[22] and TOC[45] require basic office equipment such as copy paper and notecards. The PS-CCI intervention requires the availability of a structured worksheet,[47] and the assertive case management intervention requires a standardized manual,[46] making their resource demands minimal. As with all novel pharmacologic interventions, the studies assessing a single dose of ketamine required the availability of equipment to monitor vital signs.[40–43] Those assessing IV ketamine required IV bags, pumps, lines, and hanging apparatuses, which are usually available in ED environments,[40,42,43] while the study of intranasal ketamine required a specialized atomizer prepared by a pharmacy team.[41]

Efficacy Findings

The interpretation of findings for articles described in the present review should be moderated by limitations regarding sample size, methodological discrepancies, and evidentiary quality. Two promising interventions we identified are the various administration routes of a single, low dose of ketamine,[40–43] and a single meeting to develop a CRP.[22] For a single dose of ketamine, three articles reported positive findings on the short-term reduction of self-reported suicidality and depression,[40–42] and one reported inconclusive results.[43] Bryan and colleagues[22] found that participants randomized to either CRP condition (standard or enhanced) showed significant reductions in acute suicidal ideation, fewer suicide attempts, and lower rates of inpatient hospitalization post-discharge than those in the comparator group.

Two other interventions that were evaluated, PS-CCI and MI, show promise, but there is insufficient evidence to support their efficacy. The PS-CCI trial[47] was not statistically powered to determine efficacy, but the authors note that the intervention is feasible to administer in the ED setting given its high tolerability. The TOC study[45] and the STAT-ED study[44] trialed similar MI-based treatments in comparable adolescent samples but returned conflicting results. The study of assertive case management by Kawanishi and colleagues[46] had a large sample size but demonstrated no significant difference between groups over the course of the study.

DISCUSSION

The preliminary results from the four ketamine studies included in this review echo findings of the use of ketamine

for suicidal ideation in outpatient settings.[48] There are a number of advantages to this interventional modality.[43] First, ketamine, when administered IV over 5–10 minutes, is by far the briefest intervention not considering the post-infusion monitoring time. Intravenous ketamine is well suited to the fast-paced environment of the ED. The intranasal administration route is almost as brief. Intramuscular (IM) ketamine is another option but relatively unstudied; however, it may be familiar to emergency clinicians. If confirmed in fully powered RCTs, such a rapid-acting intervention may give emergency physicians additional options for the placement or even discharge of patients who present with acutely elevated suicide risk and could serve as a bridge to definitive mental health care that circumvents the need for a lengthy detention in the ED. Furthermore, a dose of generic ketamine is relatively inexpensive[49] and regularly stocked in most EDs. The intranasal form of ketamine, esketamine, in contrast, is more expensive and less widely stocked. Additional research on the efficacy of ketamine for acutely suicidal ED patients is warranted.

This review found evidence that CRP shows promise as an intervention well suited to combat acute suicidality in the ED environment. While there is limited evidence in support of the efficacy of CRP in the ED, this intervention has several features that make it well suited to the specific demands on emergency medical personnel. First, similar to a single dose of ketamine, CRP is an interventional modality that is brief in administration and appears to rapidly diminish acute suicidality and improve patient mood.[38] Additionally, CRP is maximally portable to a variety of environments, requires comparatively little specialized training, tools or materials to administer, and, as a psychosocial intervention, is not contraindicated for use with any concomitant medications. Despite its advantages, the literature to date on the use of CRP in the ED context is limited to one study.[22] While the evidence for interventions such as the PS-CCI[47] and TOC[45] is mixed, ED-delivered interventions targeting constructs of cognitive flexibility and adaptive problem-solving appear to be a recipe with some promise (similar to CRP).

Future Directions

This study identified two promising interventions suited to the ED environment: CRP and ketamine. The evidentiary basis for these interventions, particularly in broad-based populations of emergently suicidal ED patients, is not fully developed. Further study is required to ascertain the extent to which these interventions serve as effective treatments across presenting psychiatric symptoms, especially given the high incidence of SRTB among patients with serious mental illness or acute intoxication with a substance, which may complicate effective treatment.[50] Given the crisis of boarding in EDs, additional funding and study in general should be a national priority. Future studies should also investigate ketamine delivered via alternative routes of administration such as orally and IM. While CRP has demonstrated preliminary efficacy,[24] future research should compare CRP to validated current standard practice interventions to properly evaluate its effectiveness against treatment as usual or EUC. Future studies should also validate use of the intervention outside the military context with participants of various backgrounds, ability levels, and ages. Given that brief MI- and CBT-based interventions show promise, future studies may consider continuing to hone interventions that approximately adhere to this model.

LIMITATIONS

Although the present study has many notable strengths, some shortcomings should be delineated. First, we focused on interventions with evidence supporting the ability to be performed in the challenging ED environment. It is possible that recent interventions under study in other clinical environments may hold promise for adaptation to the ED setting. Second, as is the case with any review, it is possible that certain interventions extant in the literature were erroneously excluded from our analysis given the limitations of our MeSH search terms. Finally, to limit our analysis to only the most recent interventions with an evidentiary basis in the current literature, we assessed only articles published in the previous 10 years. It is possible that there are promising, ED-based interventions described more than 10 years ago that have received no further study in the intervening time or have been studied exclusively outside the ED context since their initial description.

CONCLUSION

The recently described interventions identified for emergency physicians to treat acute suicidality are limited to one drug (ketamine) and four unique psychological/behavioral interventions. Two of the five interventional modalities have preliminary evidence and may hold promise in mitigating acute suicide risk in the ED: a single, low dose of ketamine and crisis response planning. However, there is insufficient evidence to support their widespread adoption. Future research should extend the preliminary findings summarized in this review.

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Buprenorphine-Naloxone for Opioid Use Disorder: Reduction in Mortality and Increased Remission

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Introduction: As fentanyl has become more readily available, opioid-related morbidity and mortality in the United States has increased dramatically. Preliminary studies suggest that high-affinity, partial mu-opioid receptor agonists such as the combination product buprenorphine-naloxone may reduce mortality from overdose and promote remission. With the escalating prevalence of opioid use disorder (OUD), it is essential to evaluate the effectiveness of opioid agonists like buprenorphine-naloxone. This study examines mortality and remission rates for OUD patients prescribed buprenorphine-naloxone to determine the efficacy of this treatment toward these outcomes.

Methods: We carried out a retrospective analysis using the US Collaborative Network database in TriNetX, examining de-identified medical records from nearly 92 million patients across 56 healthcare organizations. The study spanned the years from January 1, 2017–May 13, 2022. Cohort 1 included OUD patients who began buprenorphine-naloxone treatment within one-year post-diagnosis, while Cohort 2, the control group, consisted of OUD patients who were not administered buprenorphine. The study measured mortality and remission rates within a year of the index event, incorporating propensity score matching for age, gender, and race/ethnicity.

Results: Prior to propensity matching, we identified a total of 221,967 patients with OUD. Following exclusions, 61,656 patients treated with buprenorphine-naloxone showed 34% fewer deaths within one year of diagnosis compared to 159,061 patients who did not receive buprenorphine (2.6% vs 4.0%; relative risk [RR] 0.661; 95% confidence interval [CI] 0.627–0.698; $P < 0.001$). The remission rate was approximately 1.9 times higher in the buprenorphine-naloxone group compared to the control group (18.8% vs 10.1%; RR 1.862; 95% CI 1.812–1.914; $P < 0.001$). After propensity matching, the effect on mortality decreased but remained statistically significant (2.6% vs 3.0%; RR 0.868; 95% CI 0.813–0.927; $P < 0.001$) and the remission rate remained consistent (18.8% vs 10.4%; RR 1.812; 95% CI 1.750–1.876; $P < 0.001$). Number needed to treat for benefit was 249 for death and 12 for remission.

Conclusion: Buprenorphine-naloxone was associated with significantly reduced mortality and increased remission rates for patients with opioid use disorder and should be used as a primary treatment. The recognition and implementation of treatment options like buprenorphine-naloxone is vital in alleviating the impact of OUD. [West J Emerg Med. 2024;25(6)869–874.]

INTRODUCTION

Background

The incidence and prevalence of opioid use disorder (OUD) is increasing both in the United States and globally. The recent proliferation of the illicit drug fentanyl has only intensified the potential for opioid abuse and raised the mortality rate.[1] Opioid-related deaths have surged nearly four-fold since 1999, and mortality rates have continued their upward trajectory with the advent of synthetic opioids.[2–4] Fentanyl has notably become the primary driver of drug-related overdoses, with an almost 7.5-fold increase in overdose-related deaths from 2015 to 2021.[2] However, there is a range of US Food and Drug Administration-approved medications available for OUD that can reduce overdose-related mortality and promote remission.

Partial opioid agonist medications, such as buprenorphine, which can be found as a mono-product form or combined with naloxone (such as brand name Suboxone), have demonstrated efficacy in reducing the risk of overdose-related death compared to pure opioid antagonists like naltrexone.[5–8] Buprenorphine is a partial opioid agonist that functions by binding to the mu-opioid receptor with particularly high affinity when the receptor is empty, thereby blocking the binding of other opioids with abuse potential while also alleviating withdrawal symptoms and cravings.[9] However, when the receptor is occupied, buprenorphine dislodges the opioid from the receptor, thus precipitating withdrawal.

Buprenorphine-naloxone is distinctive in that when given as a combination, it can be used to mitigate possible inappropriate usage of buprenorphine alone. When administered sublingually, the naloxone component has little to no effect due to high first-pass hepatic metabolism. However, if buprenorphine-naloxone were to be used intravenously or intranasally, the naloxone can precipitate withdrawal as well as diminish any perceived euphoria.[9] This unique characteristic of buprenorphine-naloxone greatly enhances its potential to reduce opioid-related overdoses. A study conducted over a 22-year period, published in 2020, revealed that the relative risk of overdose-related death was up to 3.2 times higher in the absence of opioid agonist therapy with buprenorphine.[8] Moreover, prior research demonstrates potential in decreasing future illicit opioid use following initiation of treatment with buprenorphine-naloxone.[1] A 2021 study found that buprenorphine-naloxone therapy was associated with significantly lower odds of fentanyl exposure over time compared to methadone or slow-release morphine treatment.[1] This positions buprenorphine-naloxone as a uniquely effective combination of drugs used in the treatment of OUD.

Importance

As the prevalence of OUD continues to rise, it is essential to identify a treatment that effectively reduces overdose-related mortality and increases remission rates.

Population Health Research Capsule

What do we already know about this issue?
Opioid-related morbidity and mortality has increased in the US, along with fentanyl use. Studies show buprenorphine-naloxone to be an effective treatment for opioid use disorder (OUD).

What was the research question?
How are the mortality and remission rates of OUD patients affected by the prescription of buprenorphine-naloxone?

What was the major finding of the study?
Patients prescribed buprenorphine-naloxone had 34% fewer deaths (CI 0.63–0.70; $P < 0.001$) and 1.9 times more remission (CI 1.81–1.91; $P < 0.001$).

How does this improve population health?
As the incidence of OUD and the availability of fentanyl increases, healthcare interventions are essential. Buprenorphine-naloxone is an effective treatment option.

Goals of Investigation

In this study we used electronic health records (EHR) from the United States Collaborative Network in TriNetX to perform an analysis comparing patients prescribed buprenorphine-naloxone within one year of their OUD diagnosis with those who did not use opioid agonist therapy. The investigation examined mortality and remission rates between these two patient cohorts.

METHODS

Study Design

TriNetX is a global collaborative network consisting of de-identified patient EHR data from around the world. All cohort and outcome definitions were based on the International Classification of Diseases, 10th Rev, Procedure Coding System, Clinical Modification (ICD-10-CM) entered into the health record systems. We identified medications prescribed using RxNorm codes (Table 1). RxNorm is a standardized nomenclature for clinical drugs and drug delivery devices in the US, developed and maintained by the National Library of Medicine. Using the US Collaborative Network of TriNetX, which contains approximately 92 million patients from 56 healthcare organizations (HCO) in the US, we established two cohorts.

Table 1. International Classification of Diseases and RxNorm codes for buprenorphine-naloxone and opioid use disorder.

Type	Name	Coding system	Code
Diagnosis	Opioid dependence, uncomplicated	ICD-10-CM	F11.20
Diagnosis	Opioid dependence, in remission	ICD-10-CM	F11.21
Diagnosis	Opioid abuse, in remission	ICD-10-CM	F11.11
Diagnosis	Other long-term (current) drug therapy	ICD-10-CM	Z79.899
Medication	Buprenorphine	RxNorm	1819
Medication	Naloxone	RxNorm	7242

ICD-10-CM, International Classification of Diseases; 10th Rev, Clinical Modification; *OUD*, opioid use disorder.

Cohort Definition

Cohort 1 included all patients diagnosed with uncomplicated opioid dependence (ICD-10-CM: F11.20) who were given a prescription of buprenorphine-naloxone (buprenorphine - RxNorm:1819 + naloxone -RxNorm:7242) within one year of any F11.20 diagnosis input into the health record system. Cohort 2 (control) consisted of patients diagnosed with uncomplicated opioid dependence with no current or prior prescription of buprenorphine. This was considered the starting event or "index event." Individuals who had never been prescribed buprenorphine were selected as the control group, because defining the control group as those not having buprenorphine-naloxone listed in the TriNetX database could inadvertently have excluded patients who had been treated solely with naloxone following an overdose episode. For both cohorts, the time window was established between January 1, 2017–May 13, 2022. This time frame was chosen as buprenorphine-naloxone became widely accessible and prescribed from 2017 onward, and the end date of 2022 ensured there was at least one year between the date the patient was seen for OUD and one year of follow-up for outcomes.

Outcomes

The two outcomes measured in these cohorts were mortality and remission. Remission was defined by the diagnosis of remission from opioid dependence (ICD-10-CM:F11.21), remission from opioid abuse (ICD-10-CM: F11.11), or the use of other long-term drug therapy (ICD-10-CM:Z79.899). The time window for these outcomes ranged from one day to one year following the index event, which was defined as the usage of buprenorphine-naloxone or non-usage of buprenorphine for OUD. We excluded from the study patients with remission prior to the index event. Mortality data within the TriNetX platform was obtained from EHR data and HCOs, in conjunction with the national death registries. There is potential for missed death events when a patient is treated at an HCO not affiliated with the TriNetX network and subsequently experiences a fatal outcome outside this network. However, this represents only a minor issue, as currently, 94% of HCOs within the TriNetX network are also linked to the US death registries. This percentage is steadily increasing as more HCOs continue to be linked with the registries.

Secondary Analysis on Socioeconomic Status

We performed a secondary analysis to evaluate the impact of socioeconomic status on the prescription of buprenorphine-naloxone and outcomes in OUD patients. The presence of the ICD-10-codes Z56.0 (Unemployment, unspecified) or Z59 (Problems related to housing and economic circumstances) was used as a marker for prior history of lower socioeconomic status and was extracted from each cohort.

A post-hoc analysis was performed from June 2, 2004 to June 2, 2023, in which we evaluated OUD patients who were prescribed suboxone within one month of the OUD diagnosis and excluded those on methadone or naltrexone. The OUD definition was expanded to include additional ICD 09/10-codes associated with opioid abuse and opioid use as well (Supplementary Table 1). Propensity matching was slightly more robust, including additional covariates such as social determinants, disorders related to drugs of abuse, and nicotine (Supplementary Table 2).

Statistical Analysis

A 1:1 propensity score match was produced via TriNetX, using logistic and linear regression. We used greedy nearest-neighbor matching with a tolerance of 0.1 and a difference between propensity scores less than or equal to 0.1.[10] Propensity matching was performed for demographics including age at the index event, race, ethnicity, and gender, using the Balance Cohorts tool in TriNetX. All demographic data was self-reported by patients and recorded by HCOs to HL7 administrative standards. We used the Measure of Association Analysis tool in TriNetX to calculate risk ratio (RR), 95% confidence interval (CI), and *P*-values (P) for outcome comparisons through univariate analysis. We calculated the number needed to treat for benefit (NNTB) manually for each outcome. Patients who met the outcome prior to the visit were excluded from their respective cohorts

for the outcome analysis to ensure that patients who had the outcome prior to the index event were excluded. The final data was obtained and analysis conducted on May 13, 2023. Statistical significance was determined at a two-sided alpha <0.05. Because we used de-identified data from TriNetX, this study was determined to be exempt by the University of Texas Medical Branch (UTMB) IRB. The UTMB IRB determined that this project did not involve intervention or interaction with human subjects, and the data was de-identified per the de-identification standard defined in Section §164.514(a) of the HIPAA Privacy Rule. This formal determination by a qualified expert refreshed on December 2020.[10]

RESULTS

In this analysis, there were a total of 221,967 patients prior to propensity matching, with 62,041 patients in Cohort 1 and 159,926 patients in Cohort 2. Regarding the outcome of mortality, after exclusions, Cohort 1 consisted of 61,656 patients, and Cohort 2 comprised 159,061 patients. For the outcome of remission, there were a much larger number of patients excluded because of prior history of remission. Cohort 1 included 37,199 patients, and Cohort 2 contained 110,726 patients. After propensity matching, Cohort 1 maintained the same number of patients for both outcomes. When propensity matching was applied, Cohort 2 included 61,746 and 44,284 patients for the outcomes of death and remission, respectively, after exclusions. (Table 2).

After propensity matching, OUD patients experienced 13% less deaths (2.6% vs 3.0%, RR 0.87, 95% CI 0.81–0.93, $P < 0.001$) and 81% greater remissions rates (18.8% vs 10.4%, RR 1.81, 95% CI 1.75–1.88, $P < 0.001$) in the year following prescription of buprenorphine-naloxone when compared to those who were not prescribed buprenorphine. Before propensity matching, trends were similar; however, the effect of mortality was more pronounced (RR 0.66) (Table 3). The NNTB was 249 for death and 12 for remission within one year of index event.

The secondary analysis for the impact of socioeconomic status showed patients prescribed buprenorphine-naloxone were more likely to have a history of unemployment than those not prescribed buprenorphine (6.36% vs 2.54%, $P < 0.001$). Similarly, patients prescribed buprenorphine-naloxone were more likely to have had problems related to housing and economic circumstances than those not prescribed buprenorphine (13.93% vs 7.82%, $P < 0.001$). The post hoc analysis showed that after propensity matching for social determinants of health and other substance-related disorders, the relative risk of death in one year was 0.78 (95% CI 0.74–0.83; $P < 0.001$) and remission was 2.15 (95% CI 2.09–2.22; $P < 0.001$) for the patients prescribed buprenorphine-naloxone within one month of OUD diagnosis (Supplementary Table 3). Trends were similar before propensity matching. NNTB was 137 for death and 12 for remission.

DISCUSSION

This multicenter, retrospective study has demonstrated that buprenorphine-naloxone use was assocaited with significantly lower mortality rates and higher remission rates in comparison to no treatment in patients with OUD. The utilization of the United States Collaborative Network in

Table 2. Demographics before and after propensity score matching with Cohort 1 buprenorphine-naloxone and Cohort 2 opioid use disorder controls.

	Before propensity score matching				After propensity score matching			
Demographics	**Cohort 1 (n = 62,041)**	**Cohort 2 (n = 159,926)**	***P*-value**	**Std. Diff**	**Cohort 1 (n = 62,041)**	**Cohort 2 (n = 62,041)**	***P*-value**	**Std. Diff**
Mean age at index ± SD	39.5 ± 12.3	45.8 ± 16.5	<0.001	0.43	39.5 ± 12.3	39.5 ± 12.4	=0.80	<0.01
Female	27,979 (45.1%)	78,641 (49.2%)	<0.001	0.08	27,979 (45.1%)	27,975 (45.1%)	=0.98	<0.01
Male	34,057 (54.9%)	81,271 (50.8%)	<0.001	0.08	34,057 (54.9%)	34,064 (54.9%)	=0.97	<0.01
White	46,370 (74.7%)	110,815 (69.3%)	<0.001	0.12	46,370 (74.7%)	46,536 (75.0%)	=0.28	<0.01
AI/AN	564 (0.91%)	807 (0.51%)	<0.001	0.05	564 (0.91%)	412 (0.66%)	<0.001	0.03
NHPI	42 (0.07%)	140 (0.09%)	=0.14	0.01	42 (0.07%)	15 (0.02%)	<0.001	0.02
Unknown ethnicity	10,945 (17.6%)	49,014 (30.6%)	<0.001	0.31	10,945 (17.6%)	10,922 (17.6%)	=0.86	<0.01
Not Hispanic or Latino	47,161 (76.0%)	101,782 (63.6%)	<0.001	0.27	47,161 (76.0%)	47,249 (76.2%)	=0.56	<0.01
Hispanic or Latino	3,935 (6.34%)	9,130 (5.71%)	<0.001	0.03	3,935 (6.34%)	3,870 (6.24%)	=0.45	<0.01
Black	6,999 (11.3%)	22,711 (14.2%)	<0.001	0.09	6,999 (11.3%)	6,993 (11.3%)	=0.96	<0.01
Asian	193 (0.31%)	810 (0.51%)	<0.001	0.03	193 (0.31%)	169 (0.27%)	=0.21	<0.01
Unknown race	7,873 (12.7%)	24,643 (15.4%)	<0.001	0.08	7,873 (12.7%)	7,916 (12.8%)	=0.71	<0.01

OUD, opioid use disorder; *AI/AN*, American Indian or Alaskan Native; *NHPI*, Native Hawaiian or other Pacific Islander.

Table 3. Outcomes before and after propensity score matching with Cohort 1 buprenorphine-naloxone and Cohort 2 opioid use disorder controls.

	Cohort 1	Cohort 2	RR (95% CI)	*P*-value
Mortality before PSM	1,628 (2.64%)	6,352 (3.99%)	0.66 (0.63–0.70)	P < 0.001
Mortality after PSM	1,628 (2.64%)	1,878 (3.04%)	0.87 (0.81–0.93)	P < 0.001
Remission before PSM	6,984 (18.78%)	11,163 (10.08%)	1.86 (1.81–1.91)	P < 0.001
Remission after PSM	6,984 (18.78%)	4,589 (10.36%)	1.81 (1.75–1.88)	P < 0.001

OUD, opioid use disorder; *PSM*, propensity score matching; *RR*, relative risk; *CI*, confidence interval.

TriNetX provides the largest sample size in the current literature (221,967 before propensity matching) comparing buprenorphine-naloxone to no intervention. This large-dataset approach has mitigated potential confounding variables, including social determinants, that might have influenced the findings of previous research.

The findings of our study are consistent with other literature examining outcomes of medications for OUD. The Prescription Opioid Addiction Treatment Study trial demonstrated more successful outcomes (abstinence or near-abstinence from opioids) in prescription opioid users maintained on buprenorphine-naloxone than in those who were tapered off buprenorphine-naloxone.[11] Only 7% of study participants who were tapered off buprenorphine-naloxone achieved successful outcomes compared to 49% who were maintained on buprenorphine-naloxone.[11] This population of prescription opioid users is slightly different from our population of patients with OUD. Other studies have compared the use of buprenorphine-naloxone with other methods, such as extended-release naltrexone, or methadone, and have found either intervention to be equally safe and effective.[12–14] Patients were even found to have greater short-term success in treatment with buprenorphine-naloxone compared to clonidine in a small, multicenter, randomized trial.[15]

Another study considered no treatment, inpatient detoxification, behavioral health, buprenorphine or methadone, naltrexone, and non-intensive behavioral health interventions in individuals with OUD. Only treatment with buprenorphine or methadone demonstrated a significantly reduced risk of overdose and opioid-related acute care at 3- and 12-month follow-ups.[16] Our study further strengthens the argument for medication use in treating OUD and demonstrates the effectiveness of buprenorphine-naloxone.

The findings of this study carry significant implications for the acute management of OUD. With the global rise in OUD, exacerbated by the increased availability of fentanyl, mitigating mortality rates for individuals with OUD remains a major public health challenge.[17] These individuals may require medical interventions for the treatment of complications of OUD such as autonomic instability, hypoxia, endocarditis, ischemia, or cardiac arrest.[18] Proactive pharmacologic management is a key component in preventing the life-threatening consequences of OUD.

LIMITATIONS

It is important to acknowledge the inherent limitations of a retrospective study, especially in that causation cannot be established. This study included a sample of 221,967 patients from 56 HCOs before propensity matching, which is more extensive than previous studies, thereby providing increased statistical power. The large sample size and use of propensity matching help mitigate some of these limitations. Propensity matching was performed for covariates including age, gender, race, and ethnicity, but there may be other unaccounted variables that could have influenced the mortality rates or remission in this group. Due to de-identification and privacy policies inherent to the TriNetX database, granular and non-codable data such as social determinants are limited, while geographic identifiers such as ZIP codes are unobtainable. Moreover, this study did not take into account comorbid medical conditions or psychiatric illnesses, which might also have impacted the outcomes.

The database records prescriptions in the health records but does not report the dosages of buprenorphine-naloxone, exact timing of this adjunct therapy, or patient adherence to regimen. This omission is significant because different medication dosages and compliance may affect the efficacy of buprenorphine-naloxone. For the control group, alternative methods for managing OUD may have been present but were not considered in the analysis. Additionally, without knowing how long a patient was drug free, we could not rule out potential relapses as a cause for the index visit in the excluded group. Furthermore, the parameter of the data collected restricts the generalization of the study for international populations and long-term results beyond a year.

Finally, the study evaluated the parameters of mortality rate and remission, but other measures weren't included. We did not consider quality of life measures, which could provide a more comprehensive understanding of the effects of buprenorphine-naloxone on lifestyle in those with OUD. Future research should focus on other life outcome measures,

social determinants, and the long-term impacts of buprenorphine-naloxone on the individual.

CONCLUSION

This multicenter retrospective analysis shows that buprenorphine-naloxone use is associated with significantly improved mortality rates compared to no intervention in patients with opioid use disorder. Furthermore, the study highlights an association with higher remission rates in this population. While these findings, along with previous studies, suggest that buprenorphine-naloxone is an effective treatment option for OUD, further prospective studies comparing to other treatment modalities should be considered to confirm efficacy.

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Opioid Treatment Is Associated with Recurrent Healthcare Visits, Increased Side Effects, and Pain

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Introduction: Pain is a major driver of visits to the emergency department (ED). Clinicians must consider not only the efficacy of treatment options but also subsequent healthcare utilization and patient-centered outcomes such as side effects from prescribed medications. Our goal in this study was to determine whether there was an association between acute pain treatment regimen (opioids, intranasal non-steroidal anti-inflammatory drugs [NSAIDs], or both) and unscheduled healthcare visits following ED discharge.

Methods: This study was a secondary analysis of the Acute Management of Pain from the Emergency Department (AMPED) prospective, observational cohort study. We used Cox proportional hazards analysis to assess the relationship between treatment regimen and time to first unscheduled healthcare visit. Repeated measures logistic regression analyses were used to determine the relationship between treatment regimen and any unscheduled visits, and to evaluate whether this relationship was mediated by pain severity and/or medication side effects.

Results: Of 831 total enrolled participants, 141 (16.9%) experienced an unplanned healthcare visit within five days of ED discharge. A majority of these visits happened one day after the ED visit. Those who were treated with intranasal NSAIDs only were less likely to have an unscheduled healthcare visit compared to those who received opioids only, with an adjusted odds ratio (AOR) of 0.63. The higher odds of unscheduled healthcare visits with opioids were mediated by both the presence of side effects and higher pain levels, with AORs of 2.24 and 1.33, respectively.

Conclusion: Opioid treatment for acute pain is associated with increased unscheduled healthcare visits compared to those treated with intranasal ketorolac. This difference can be explained by higher levels of ongoing pain and greater medication side effects. [West J Emerg Med. 2024;25(6)875–882.]

INTRODUCTION

Acute pain is the most frequent chief complaint for emergency department (ED) visits in the United States.[1] Inadequate treatment of pain contributes to the evolution from acute to chronic pain, which can inflict excessive personal and economic burdens on patients.[2–4] Outside the limited number of recommendations guiding treatment of a few specific acute conditions, such as lower back pain,[5] there

are no evidence-based guidelines that address the management of acute pain, resulting in wide variability in practice.[6–8]

In particular, the number of opioid prescriptions increased during the late 1990s to early 2010s, yet opioids were not found to correlate with improved pain-related outcomes or patient satisfaction.[9–11] Moreover, the advent of the current opioid crisis and rise in opioid-related deaths motivated new guidelines discouraging the use of opioids for acute and chronic pain management.[12–14] While opioid-prescribing rates subsequently began to decline from 21.5% of patients discharged from an ED in 2011 to 8.1% in 2019, this rate remains comparatively high.[15] In addition, opioid reductions have not appeared to be matched by sufficient increases in non-opioid prescribing.[16]

In particular, ongoing concerns about the side effects of alternatives to opioids such as non-steroidal anti-inflammatory drugs (NSAID) have hindered their use.[17] However, data shows that even in high-risk patients, those prescribed NSAIDs did not experience higher rates of serious adverse events.[18,19] Specifically, intranasal ketorolac has been found to be an effective, well-tolerated, and satisfactory medication for adults presenting to the ED with acute pain, with only minor side effects such as nasal burning that resolves within several minutes.[20,21] By comparison, the adverse effects of opioids outside opioid use disorder-related morbidity have received relatively little attention, with only recent data suggesting greater side effects with opioids than with NSAIDs.[19,22] Thus, more studies are needed to better understand the risk-benefit comparison between opioids and NSAIDs for pain treatment.

Meanwhile, there has been a focus on preventing recurrent visits to the ED[23–25] for pain as well as other complaints. Revisits substantially impact both the patient and healthcare system and often reflect unmet patient needs. Recent data suggests opioid prescriptions in the outpatient setting are associated with an increased number of subsequent healthcare visits.[26–29] Unplanned visits can result in missed days of work,[30–32] disrupting the daily lives of patients, as well as increased costs, often higher with the repeat than the initial ED visit.[33] Failure to address the initial presenting problem or its sequelae, as well as lack of communication with patients regarding the therapeutic plan and recommended follow-up, contribute to ED recidivism.[32,34,35] Emergency physicians must understand how the treatment they provide in the ED may affect downstream healthcare utilization to fully consider the impact of their care on both patients and healthcare systems.

In this secondary analysis, we sought to determine whether there was an association between treatment regimen (opioid only, intranasal NSAID only, or intranasal NSAID + opioid) following an ED visit for acute pain and subsequent daily healthcare utilization. We further characterized this association by whether medication side effects or ongoing pain severity mediated the effect on healthcare utilization.

Population Health Research Capsule

What do we already know about this issue?
Wide variability in pain treatment in acute care settings is due in part to limited evidence on patient experiences related to choice of medication.

What was the research question?
What is the association between choice of acute pain treatment and unscheduled healthcare visits after ED discharge?

What was the major finding of the study?
Compared to opioids, NSAIDs had a lower adjusted odds ratio of 0.63 for post-ED unscheduled healthcare visits (P = 0.03, 95% CI 0.42–0.95, 33.3% of patients vs. 39.7%).

How does this improve population health?
Our study further underscores and contextualizes the wider complexity of the impact of treatment decisions (eg, medication side effects, comparative efficacy) on patient outcomes.

METHODS

Study Setting and Population

This was a secondary analysis of data obtained from a multisite, prospective, observational cohort study, Acute Management of Pain from the Emergency Department (AMPED).[36] The original study was approved by the institutional review boards at all enrollment sites. A convenience sample of adult participants ≥18 years old with acute musculoskeletal or visceral pain not requiring admission were recruited from 13 EDs in the US between September 2012–February 2014. Patients were prescribed one of three treatment regimens following ED discharge: NSAID (intranasal ketorolac) only; oral opioid only; or both (intranasal ketorolac with opioid as a rescue therapy). Treatment regimen was at the discretion of the treating clinician.

Data Collection

Data collection included patient demographics, employment status, pain type (visceral or musculoskeletal) and location, pain scores (0–10 numeric rating scale) at ED triage and ED discharge, medications given during the ED

visit, and discharge medication regimen. Patients were contacted daily for four days following ED discharge for follow-up outcomes including unplanned healthcare visits, medication use, daily highest and lowest pain scores, adverse events and symptoms, overall quality of life, and overall satisfaction with the prescribed pain medication. Details of the unplanned healthcare visits were not recorded, including reason for the visit.

Statistical Analysis

All 831 patients were included for analysis. We used descriptive statistics to summarize patient demographics for those with or without unplanned healthcare visits after ED discharge. Categorical variables were reported as frequencies, and continuous variables were reported as median values with interquartile ranges (25^{th}, 75^{th}). Fewer than five patients had missing demographic data. The missing data on categorical variables were imputed to the highest frequency category, and continuous variables were imputed tomedian values.

We performed statistical analyses to investigate whether treatment regimen impacted the time to a subsequent unscheduled healthcare utilization following ED discharge and the number of any unscheduled visits, and to evaluate possible mediating factors. Those who received opioid-only treatments were used as the reference category for treatment regimen. We adjusted all models for age, gender, race, primary ED diagnosis, initial pain score, and discharge pain score. A two-tailed *P*-value of 0.05 was used for statistical significance. We performed all analyses using SAS 9.4 (SAS Institute Inc, Cary, NC).

To evaluate the relationship between treatment regimen and time to first unscheduled visit following ED discharge, we used a Cox proportional hazards model. Unscheduled visit (UV) data was collected over the four-day follow-up period. The first occurrence of an unscheduled visit (UV = YES) was used as the day of the unscheduled visit, regardless of UV = MISSING or UV = NO values in prior days. If the UV data was missing for all four days, the patient was censored at day 4. We generated a Kaplan-Meier curve of unscheduled visit with log-rank *P*-value. To evaluate the relationship between treatment regimen and any unscheduled visits following ED discharge, we used a repeated measures logistic regression model. Missing data on unscheduled visits over the four-day period were imputed as UV = NO value. Additionally, we performed a sensitivity analysis where all missing data on unscheduled visits were imputed as UV = YES value.

To evaluate for mediation of the association between treatment regimen and any unscheduled visits, we performed three separate repeated measures logistic regression models to assess the effect of 1) any medication side effect; 2) daily maximum pain scores; or 3) both side effects and pain scores.

RESULTS

Participant Characteristics

A total of 831 participants were included in the original AMPED study. As participants had to complete at least three of the four follow-up calls to be included in the original analysis, we did not exclude any patients from this secondary analysis. The distribution of participants in each discharge treatment regimen group was uneven in the original study, with combination therapy (intranasal ketorolac with opioid rescue) being the least prescribed regimen.[36] As reported in the parent study, characteristics of participants in each discharge treatment group were comparable, except that participants in the opioid-only group were slightly older and more likely to have a chronic pain history; participants who had fractures or visceral pain were more likely to receive opioids as part of their regimen; and participants in the intranasal ketorolac-only group had slightly lower average pain scores at initial ED presentation.[36] Overall, 141 (16.9%) participants had at least one unscheduled visit over the four-day follow-up time period. Baseline and demographic characteristics of participants in this sub-analysis are shown by attendance to unscheduled visits (none vs at least one visit) in Table 1.

Model Results

Across all treatment regimens, the highest number of unscheduled visits occurred on the first day of the four-day follow-up period (Figure 1). However, after adjustment of the hazard ratios ($P > 0.05$), there did not appear to be a statistically significant association between pain medication prescribed and time to first unscheduled visit (Table 2). Kaplan-Meier curve of unscheduled visit with log-rank *P*-value is provided in Figure 2.

When we consider all unscheduled visits over the four-day follow-up period, participants who were treated with intranasal ketorolac only were less likely to have an unscheduled healthcare visit compared to those who received opioids only, with an adjusted odds ratio of 0.63 (Table 3). The sensitivity analysis showed that model effects were not meaningfully altered by missing data. The mediation analysis demonstrated that the association between treatment regimen and unscheduled healthcare visits is completely explained by both the presence of side effects and the severity of pain, with odds ratios of 2.24 and 1.33, respectively ($P = <0.001$), and side effects contributing the larger impact (Table 4).

DISCUSSION

In this study evaluating the relationship between treatment regimens (opioids, rapidly acting intranasal NSAIDs, or both) following an ED visit for acute pain and subsequent daily healthcare utilization, we found that treatment with opioids only was associated with increased subsequent unscheduled healthcare visits during the

Table 1. Baseline characteristics of the AMPED* participants by unscheduled visits.

			Unscheduled visit	
	Level	**Overall (N = 831)**	**No unscheduled visit (n = 690)**	**At least one unscheduled visit (n = 141)**
Age (median, IQR)		37.0 (27.0, 48.0)	36.0 (27.0, 49.0)	39.0 (31.0, 48.0)
	Missing, n (%)	1 (0.1)	1 (0.1)	0 (0.0)
Treatment regimen, n (%)	Intranasal ketorolac only	353 (42.5)	306 (44.3)	47 (33.3)
	Intranasal ketorolac + opioid	201 (24.2)	163 (23.6)	38 (27.0)
	Opioid Only	277 (33.3)	221 (32.0)	56 (39.7)
	Missing, n (%)	0 (0.0)	0 (0.0)	0 (0.0)
Employment status, n (%)	Other	92 (11.1)	78 (11.3)	14 (9.9)
	Unemployed	128 (15.4)	109 (15.8)	19 (13.5)
	Part time	129 (15.5)	103 (14.9)	26 (18.4)
	Full time	481 (57.9)	399 (57.8)	82 (58.2)
	Missing, n (%)	1 (0.1)	1 (0.1)	0 (0.0)
Gender, n (%)	Male	434 (52.2)	373 (54.1)	61 (43.3)
	Female	396 (47.7)	316 (45.8)	80 (56.7)
	Missing, n (%)	1 (0.1)	1 (0.1)	0 (0.0)
Race, n (%)	Other	169 (20.3)	148 (21.4)	21 (14.9)
	Caucasian	251 (30.2)	193 (28.0)	58 (41.1)
	Black	407 (49.0)	345 (50.0)	62 (44.0)
	Missing, n (%)	4 (0.5)	4 (0.6)	0 (0.0)
Primary ED diagnosis, n (%)	Musculoskeletal	707 (85.1)	593 (85.9)	114 (80.9)
	Visceral	124 (14.9)	97 (14.1)	27 (19.1)
	Missing, n (%)	0 (0.0)	0 (0.0)	0 (0.0)
Pain score in ED (median, IQR)		8.0 (7.0, 10.0)	8.0 (7.0, 10.0)	8.0 (7.0, 10.0)
	Missing, n (%)	1 (0.1)	1 (0.1)	0 (0.0)
Pain score at discharge (median, IQR)		5.0 (3.0, 8.0)	5.0 (3.0, 8.0)	5.0 (3.0, 8.0)
	Missing, n (%)	1 (0.1)	1 (0.1)	0 (0.0)
4-day any side effect, n (%)	Yes	621 (74.7)	493 (71.4)	128 (90.8)
	No	210 (25.3)	197 (28.6)	13 (9.2)
	Missing, n (%)	0 (0.0)	0 (0.0)	0 (0.0)
4-day nausea, n (%)	Yes	284 (34.2)	215 (31.2)	69 (48.9)
	No	542 (65.2)	470 (68.1)	72 (51.1)
	Missing, n (%)	5 (0.6)	5 (0.7)	0 (0.0)
4-day vomited, n (%)	Yes	82 (9.9)	57 (8.3)	25 (17.7)
	No	744 (89.5)	628 (91.0)	116 (82.3)
	Missing, n (%)	5 (0.6)	5 (0.7)	0 (0.0)
4-day constipation, n (%)	Yes	272 (32.7)	215 (31.2)	57 (40.4)
	No	554 (66.7)	470 (68.1)	84 (59.6)
	Missing, n (%)	5 (0.6)	5 (0.7)	0 (0.0)
4-day nasal irritation, n (%)	Yes	208 (25.0)	168 (24.3)	40 (28.4)
	No	618 (74.4)	517 (74.9)	101 (71.6)
	Missing, n (%)	5 (0.6)	5 (0.7)	0 (0.0)

(*Continued on next page*)

Table 1. Continued.

			Unscheduled visit	
	Level	Overall (N = 831)	No unscheduled visit (n = 690)	At least one unscheduled visit (n = 141)
4-day rash/hives, n (%)	Yes	33 (4.0)	17 (2.5)	16 (11.3)
	No	793 (95.4)	668 (96.8)	125 (88.7)
	Missing, n (%)	5 (0.6)	5 (0.7)	0 (0.0)
4-day abdominal pain, n (%)	Yes	167 (20.1)	122 (17.7)	45 (31.9)
	No	659 (79.3)	563 (81.6)	96 (68.1)
	Missing, n (%)	5 (0.6)	5 (0.7)	0 (0.0)
4-day drowsiness, n (%)	Yes	412 (49.6)	323 (46.8)	89 (63.1)
	No	414 (49.8)	362 (52.5)	52 (36.9)
	Missing, n (%)	5 (0.6)	5 (0.7)	0 (0.0)

*AMPED, Acute Pain Management from the Emergency Department; *IQR*, interquartile range; *ED*, emergency department.

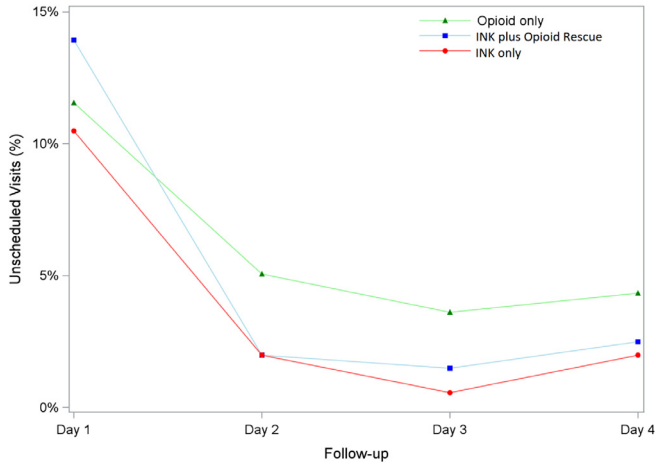

Figure 1. Daily unscheduled visit rates by discharge treatment regimen.

immediate post-ED discharge period compared to treatment with intranasal ketorolac. Similar associations have been reported previously between opioid treatment for chronic pain and increased frequency of ED visits, opioid prescriptions and recurrent ED visits for lower back pain, as well as opioid use and increased healthcare utilization following elective spine surgery.[26–29] Despite this recent attention on the relationship between treatment choice and healthcare utilization, there is a disconcerting paucity of literature investigating possible mediating factors. In particular, several recent systematic reviews have shown both lower pain treatment efficacy and higher rates of adverse events with opioids compared with NSAIDs, emphasizing the importance of these factors when weighing the risks and benefits of treatment choice for acute pain management.[19,22,37]

Our study is an important contribution to the literature, as it is the first to our knowledge to demonstrate that the association between pain treatment regimens and subsequent healthcare utilization post-ED discharge is mediated by both the presence of medication side effects and ongoing, poorly controlled pain. These findings highlight additional risks and benefits related to these acute pain treatment regimens that may impact patient outcomes. Considering previous research demonstrating the greater financial burden of recurrent healthcare utilization on the patient compared to the initial visit[33] as well as the reasons patients return to the ED—which range from lack of symptomatic improvement to additional questions or concerns[32,34,35]—our study serves to further contextualize and demonstrate the wider complexity of the impact of treatment decisions on patient outcomes. Thus, when choosing a pain management plan, it is important to consider the impact it may have on multiple aspects

Table 2. Unadjusted and adjusted hazard ratios of time to first unscheduled visit.

Outcome	Parameter	Unadjusted HR	Unadjusted *P*-value	Adjusted HR*	Adjusted *P*-value
Unscheduled visits	Opioid only (reference)				
	Intranasal ketorolac + opioid rescue	0.9 (0.6, 1.4)	0.75	0.9 (0.6–1.4)	0.74
	Intranasal ketorolac only	0.7 (0.4, 1.0)	0.03	0.7 (0.5–1.0)	0.07

HR, hazard ratios (95% confidence intervals).
*Adjusted for age, gender, race, primary ED diagnosis, pain score prior to treatment and pain score at discharge.

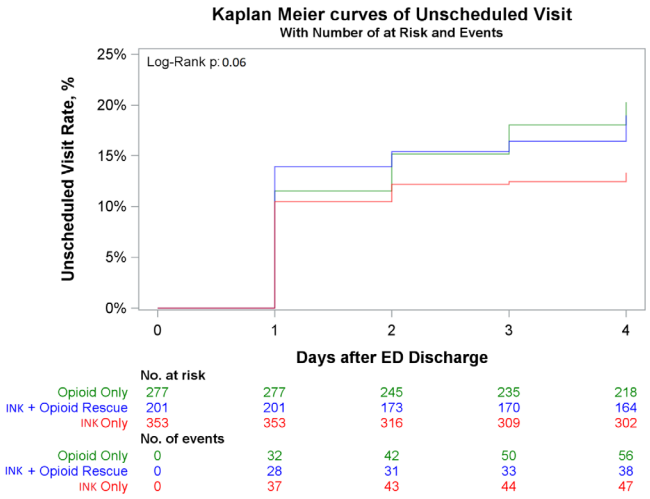

Figure 2. Kaplan-Meier curve of unscheduled visits for treatment regimen with number of events and at risk.

of the patient's quality of life in conjunction with treatment efficacy.

LIMITATIONS

Study limitations include that this was a secondary analysis of observational data and, therefore, not all potential confounders may have been measured or controlled for. Additionally, the study was not randomized, which may had led to selection bias with confounding factors that impacted choice of treatment regimen, which may have affected the likelihood of unscheduled visits. Further, the data collection occurred between the years 2012–2014, which may limit the applicability of these findings, as pain treatment regimens and opioid use have since evolved.

Despite the fact that overall rate of opioid prescriptions issued at discharge from the ED decreased from 14.6% in 2017 to 8.1% in 2020, there are still a large overall number of people who are receiving opioids.[15] In addition, prescribing patterns should not change the underlying side-effect profile or their inherent associations with unscheduled visits. It is also important to note that while our findings support a strong association between treatment regimen and unscheduled healthcare visits mediated by the presence of side effects and degree of pain relief, the reasons for unscheduled visits were not confirmed by patient report. Thus, it is possible that patients sought healthcare for reasons unrelated to their acute pain, current treatment plan, or side effects. Finally, the treatment regimen was not standardized across all groups apart from the intranasal ketorolac; thus, the reported side effects and complications may also be related to differences in opioid type or dosing.

CONCLUSION

Outpatient treatment with opioids only for acute pain after an ED visit is associated with increased unscheduled healthcare visits compared to those treated with intranasal NSAIDs alone. This difference can be explained by higher levels of ongoing pain and the presence of medication side effects. Understanding the impact that pain medication choice has on recurrent healthcare utilization and the factors

Table 3. Unadjusted and adjusted odds ratios of any unscheduled visit.

Outcome	Parameter	Unadjusted OR	Unadjusted *P*-value	Adjusted OR*	Adjusted *P*-value
Unscheduled visits	Opioid only (reference)				
	Intranasal ketorolac + opioid rescue	0.81 (0.53, 1.25)	0.348	0.79 (0.51–1.22)	0.29
	Intranasal ketorolac only	0.60 (0.41, 0.89)	0.012	0.63 (0.42–0.95)	0.03

OR, odds ratios (95% confidence intervals).
*Adjusted for age, gender, race, primary ED diagnosis, pain score prior to treatment and pain score at discharge.

Table 4. Odds ratio for mediators – any side effect and maximum pain score.

Outcome	Parameter	Odds ratio	*P*-value
Unscheduled visits	Any side effect	2.24 (1.55, 3.24)	<.001
	Maximum pain score	1.33 (1.22, 1.44)	<.001
	Opioid only (reference)		
	Intranasal ketorolac + opioid rescue	1.01 (0.65, 1.57)	0.95
	Intranasal ketorolac only	0.96 (0.64, 1.45)	0.86

that mediate this relationship adds to the body of knowledge regarding risks and benefits of these treatments, allowing emergency physicians to make better informed decisions.

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Impact of COVID-19 Pandemic on Emergency Department Visits for Opioid Use Disorder Across University of California Health Centers

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Introduction: Coronavirus 2019 (COVID-19) has had a devastating impact on mental health and access to addiction treatment in the United States, including in California, which resulted in the highest rates of emergency department visits (ED) for opioid poisoning in 2020. As California slowly returns to pre-pandemic normalcy, it remains uncertain whether the rates of opioid-related events have slowed down over time. We hypothesized that the number of opioid-related ED visits were exacerbated after the period of the COVID-19 pandemic and continue at a high rate in the present.

Methods: In this analysis we searched the University of California (UC) Health Data Warehouse—a database of electronic health records from six academic medical centers—for opioid related ED visits, identifiying using the following International Classification of Diseases, 10th Ed, Clinical Modification codes: F11 codes, and T40.0*, T40.1*, T40.2*, T40.3*, T40.4*, T40.6*. Opioid overdose-associated visits were classified by types of opioids involved: heroin (T40.1*); prescription opioids (T40.2* or T40.3*); and synthetic opioids (T40.4*). We performed interrupted time analysis to estimate the immediate (level) change and change-in-time trend (trend change), from before (January 2018–October 2019) and during the pandemic (April 2020–December 2022). Monthly visit rates were evaluated with negative binomial regression adjusted for first-order autoregression and using all-cause ED counts as the offset. We present effect sizes as rate ratios (RR) and 95% confidence intervals (CI), tested at $\alpha = .05$.

Results: We observed a decrease in overall ED visits from 28,426 to 25,121 visits in December 2019 and June 2021, respectively across all six UC Health Centers. Before COVID-19, we found that ED visit rates steadily increased for all outcomes ($P < 0.05$) except synthetic opioids. Total opioid-related ED visit rates increased by 15% (RR 1.15, 95% CI 1.02–1.29, $P = 0.20$) immediately after March 2020 before decreasing by 0.5% every month, albeit without statistical significance (RR .995, 95% CI .991–1.00, $P = 0.06$). Opioid-related events across the six academic medical centers increase from 232 in December 2019, representing a single month's total, and peaked at 315 in June 2021. Similar trends were observed with prescription opioid overdoses, with a step increase of 44% (RR 1.44, 95% CI 1.10–1.89, $P = .008$) before plateauing after March 2020 (RR 1.01, 95% CI .998–1.02, $P = 0.12$). Specifically, the total number of prescription opioid-related ED visits more than doubled between December 2019 (22 visits) and June 2021 (49 visits). After March 2020, ED visit rates for synthetic opioid overdoses were increasing steadily by 4% every month (RR 1.04, 95% CI 1.02–1.06, $P = .001$), unlike with heroin, which was observed with an 8% monthly reduction (RR .92, 95% CI .90–.93, $P < .001$). No immediate increase in visit rates was observed for either opioid.

Conclusion: While opioid-related ED admissions among the UC health centers showed an overall decrease, prescription and synthetic opioid overdoses remained significantly higher than pre-pandemic trends as of December 2022. A multilevel approach to improve awareness of new opioid health policies could ameliorate these alarming rises in the post-pandemic era. [West J Emerg Med. 2024;25(6)883–889.]

INTRODUCTION

Opioids play a major role in healthcare as an important prescription medication for pain relief. Opioid analgesics are a beneficial intervention when properly administered,[1] thus creating challenges when regulating their use as they have the potential for long-term adverse effects. Although earlier phases of the opioid crisis were characterized by the misuse of prescription opioids (first wave), recent trends reveal that heroin (second wave) and illicit synthetic opioids (third wave) have become crucial to characterizing the opioid epidemic.[2] Synthetic opioids such as fentanyl have been shown to be the most devastating contributors to the current rising opioid-related cases due to its associated positive supply shock, allowing for its price to reduce significantly.[3] Predicted trends overlaying scatterplots.

Beginning in early 2020, the advent of the coronavirus 2019 (COVID-19) pandemic led to an abrupt, worldwide disruption to societal functions and typical daily life as stay-at-home orders were implemented to curb the spread of the virus and preserve medical facilities and equipment for the most severe infections. The subsequent rise in unemployment rates and social isolation led to increased psychological distress,[4] which was postulated to have caused a nationwide increase in opioid overdose cases across multiple states in 2020.[5–8] As society slowly began to return to pre-pandemic normalcy in 2021 and 2022, it remains uncertain whether the rates of opioid-related events have slowed over time, given the challenges of weaning off chronic opioid use. Thus, a deeper exploration into the trends related to opioid-related events in 2021 and 2022 and a review of current interventions and solutions is necessary to allocate resources for enhancing our management of the opioid epidemic.

In this paper we report our findings for emergency department (ED) visit rates associated with opioid-related cases from 2018–2022 across the six University of California (UC) health centers. We compared the rates from the period before the pandemic (January 2018–December 2019) with those during the pandemic (April 2020–December 2022). A washout period between January–March 2020 was implemented due to widespread public uncertainty regarding the nature of the pandemic during that timeframe. These dates take reference from the US's first confirmed laboratory case on January 20, 2020, and California's statewide stay-at-home order on March 19, 2020.[9] We hypothesized that opioid-related ED visit rates continued to worsen after 2021 and remained higher than pre-pandemic rates as of December 2022.

Population Health Research Capsule

What do we already know about this issue?
The opioid use disorder (OUD) epidemic and COVID-19 pandemic are two public health crises that significantly increased ED visits in the US.

What was the research question?
How did the COVID-19 pandemic affect opioid-related ED visits in California?

What was the major finding of the study?
Opioid prescriptions and heroin-related ED visits increased after the pandemic across UC hospitals.

How does this improve population health?
Our findings show trends of opioid use in California and identify key community elements that could contribute to OUD interventions through future research.

MATERIALS AND METHODS

Data Source

For this analysis we used the UC Health Data Warehouse (UCHDW), a database of electronic health records from the six UC academic health centers: UC Davis; UC Irvine; UC Los Angeles; UC Riverside; UC San Diego; and UC San Francisco. The UCHDW contains clinical data of 8.7 million patients seen at a UC facility, totaling approximately 378 million encounters including office visits, inpatient admissions, and ED visits.[10] All data is organized based on the Observational Medical Outcomes Partnership (OMOP) common data model (CDM), an open community data standard for standardizing the structure of real-world clinical data across institutions despite differences in the underlying clinical data infrastructure.[11] Adopting the OMOP CDM facilitates efficient, multicentered studies and generation of

reproducible evidence. Institutional review board (IRB) review was not required for this data analysis as we de-identified all accessed data elements prior to receipt.[12] All data queries were completed on February 8, 2023.

Emergency Department Visits

Following the structure of the OMOP CDM, we identified ED visits from the "visit occurrence" domain using visit concept identifications (IDs) of "9203 – Emergency Room Visit" or "262 – Emergency Room and Inpatient Visit."[13]

Opioid-related Events

The ED visits associated with opioid-related events, labelled as "all opioid-related visits," were identified if they had at least one of the following International Classification of Diseases, 10th ed, Clinical Modification: F11 codes, and T40.0*, T40.1*, T40.2*, T40.3*, T40.4*, T40.6*. Opioid overdose-associated visits were then further classified by types of opioids involved: heroin (T40.1*); prescription opioids (T40.2* or T40.3*); and synthetic opioids other than methadone (T40.4*).[14]

Outcomes Measures

We summarized and analyzed the outcomes as monthly ED visit rates of opioid-related disorders and overdoses (per 100,000 all-cause ED visits). This was justified by the lower all-cause ED visit rates across the US during the COVID-19 pandemic[15] and was implemented in previously published studies.[8,16] We also plotted monthly ED visit counts across the UC health centers from 2018–2022 to verify this trend. Actual ED visit counts for opioid-related visits were also masked as per institutional policy.

Statistical Analysis

We performed interrupted time analysis to estimate the immediate (level) change and change-in-time trend (trend change) with negative binomial regression with robust standard errors (Huber-White sandwich estimator) for over-dispersed outcomes. The model was further adjusted for first-order autoregression using a lag-1 variable (outcome value from the previous month), with all-cause ED visit counts as the offset variable. The model specification is as follows:

$$\log(E(y_t)) = \beta_0 + \beta_1 \cdot covid_t + \beta_2 \cdot time_t + \beta_3 \cdot posttime_t + \beta_4 \cdot lag1_t + \log(offset_t) + \varepsilon_t$$

- y_t was the count outcome of interest in month t.
- $covid_t$ was a binary dummy variable indicating whether month t was before (January 2018–December 2019, assigned with a value "0"), or during (April 2020–December 2022, assigned with a value "1") the COVID-19 pandemic. A washout period between January–March 2020 was implemented due to widespread uncertainty regarding the nature of the pandemic during that timeframe.
- $time_t$ was a discrete time variable counting months starting from January 2018, taking the values of 1, 2, 3, etc.
- $posttime_t$ was coded "0" for time points before the COVID-19 pandemic (January 2018–December 2019) and then become a discrete time variable counting months during the COVID-19 pandemic (April 2020–December 2022), taking the values of 1, 2, 3, etc.
- $lag1_t$ was the count outcome of interest in the month prior (ie, y_{t-1}). This allows control of autocorrelation in a time-series dataset.
- $offset_t$ takes the number of all-cause ED visits in month t. This variable was excluded for the trend analysis of all-cause ED visit counts.
- The key coefficients of interest include the following:
  - β_1, which represents the immediate (level) change in $\log(E(y_t))$ due to the COVID-19 pandemic.
  - β_2, which represents the monthly change in $\log(E(y_t))$ before the COVID-19 pandemic (January 2018–December 2019).
  - $\beta_2 + \beta_3$, which represents the monthly change in $\log(E(y_t))$ during the COVID-19 pandemic (April 2020–December 2022).

Effect sizes for count and rate outcomes are presented as ratios and 95% confidence intervals (CI) via exponentiating the coefficients. Predicted trends overlaying scatterplots were plotted to illustrate the trends in the count and rate outcomes per month. All analyses were tested with $\alpha = .05$ and completed with Stata v16.1 (StataCorp LLC, College Station, TX).

RESULTS

All-Cause ED Visits

At the baseline of December 2019 the total number of ED visits was 28,426 across the six health centers, whereas it fell slightly to 25,121 visits in June 2021. Monthly all-cause ED visit counts remained relatively constant before the COVID-19 pandemic ($P = 0.30$). During the pandemic, there was a sudden decline by 34% compared to pre-pandemic trends (95% CI 15–49%, $P = 0.002$) before increasing by 1.5% per month (95% CI 0.5–2.5%, $P = 0.002$) (Figure 1).

All Opioid-related Events

At the baseline of December 2019 the number of total opioid-related ED visits was 232 across the six health centers, whereas it jumped to 315 visits in June 2021. The ED visit rates of all opioid-related visits increased by 1% per month during the pre-COVID-19 period (95% CI 0.6–2.0%, $P < 0.001$). This was followed by a 15% immediate increase during the pandemic, compared to pre-pandemic levels (95% CI 2–29%, $P = 0.020$), and a statistically non-significant monthly decline by 0.5% (95% CI −0.9 to 0.0%, $P = 0.06$) (Figure 2A).

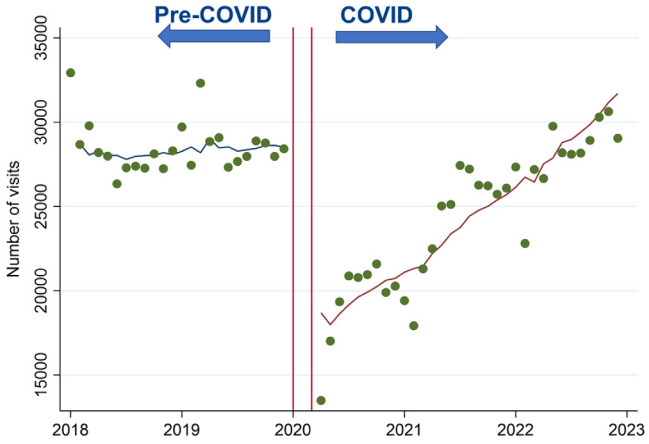

Figure 1. Monthly counts of all-cause emergency (ED) visits from 2018–2022 across six University of California health centers. The period from January 2018–December 2019 was designated as "pre-COVID," while the period from April 2020–December 2022 was designated as "COVID." A washout period from January–March 2020 is represented by the red lines in the graph.

Prescription Opioid Overdoses

At the baseline of December 2019 the number of prescription opioid-related ED visits was 22 across the six health centers, whereas it jumped to 49 visits in June 2021. The ED visit rates of prescription opioid overdoses increased by 1% every month before the COVID-19 pandemic (95% CI 0.2–2.0%, $P = 0.02$). During COVID-19, there was an immediate increase in visit rates of 44% (95% CI 10–89%, $P = 0.008$) and a statistically non-significant increase of 1% every month (95% CI −0.2 to 2.0%, $P = 0.12$) (Figure 2B).

Synthetic Opioid Overdoses

At the baseline of December 2019 the number of synthetic opioid-related ED visits was less than 11 across the six health centers, whereas it jumped slightly to 14 visits in June 2021. Counts less than 11 are masked following the UC Center for Data-driven Insights and Innovation (CDI2) policy on limited research uses using the UCHDW. The ED visit rates of synthetic opioid overdoses increased 5% every month, albeit without statistical significance (95% CI 0.2–11.0%, $P = 0.06$), before the pandemic. During COVID-19, there was a statistically non-significant increase of 69% (95% CI −32 to 316%, $P = 0.26$) compared to pre-pandemic trends, followed by a monthly increase of 4% (95% CI 2–6%, $P = 0.001$) (Figure 2C).

Heroin Overdoses

At the baseline of December 2019 the number of heroin-related ED visits was 18 across the six health centers, whereas it fell slightly to less than 11 visits in June 2021. As with the counts of synthetic opioid-related ED visits, counts less than 11 are masked per CDI2 policy. Monthly ED visit rates for

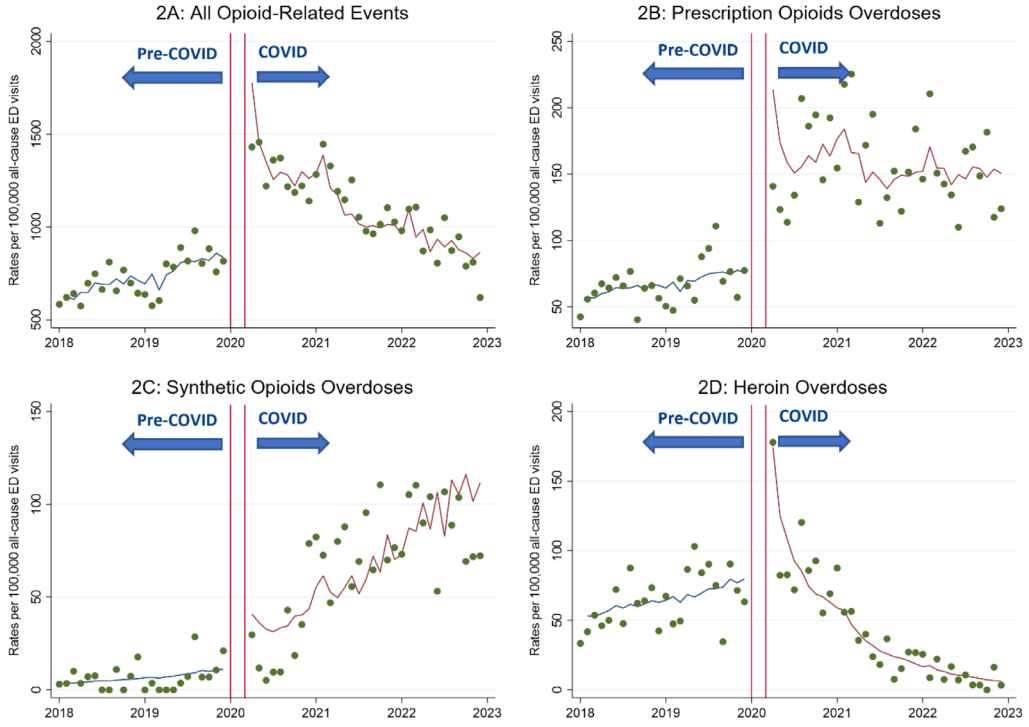

Figure 2. Monthly emergency department (ED) visit rates of opioid-related disorders and overdoses (per 100,000 all-cause ED visits) from 2018–2022 across six University of California Health centers. The period from January 2018– December 2019 was designated as "pre-COVID," while the period from April 2020–December 2022 was designated as "COVID." A washout period from January–March 2020 was implemented and is represented by the red lines in the graph.

heroin overdoses increased by 2% monthly during the pre-COVID-19 period (95% CI 0.6–3.0%, $P = 0.006$). Subsequently, the pandemic led to an immediate but statistically non-significant increase by 20% (95% CI −14 to 67%, $P = 0.28$) compared to the pre-COVID-19 period. This was followed by a monthly decline of 8% (95% CI −10 to −7%, $P < 0.001$) (Figure 2D).

DISCUSSION

The COVID-19 pandemic brought light to the urgent need for multilevel innovative approaches to aid against the opioid epidemic in California. In particular, the pandemic has facilitated the worsening of trends related to prescription and synthetic opioid overdoses across the UC health centers, with little signs of improvement as recent as December 2022. Considering that past research on the same subject was only updated as of 2020 and that our findings were similar to those papers,[5–8] our study may provide the most recent outlook of the current opioid crisis across the US and reflect that more could be done to arrest the problem.

Interestingly, we saw a decreasing trend, albeit non-statistically significant, in ED visit rates related to all types of opioid-related events after an initial spike in April 2020, which contrasted with the trends we saw with opioid overdoses. While the key reasons could not be determined based on the available data, we hypothesize that this decreasing trend could be an artifact of a recovery in numbers of all-cause ED visits. Additionally, this trend possibly reflects a paradigm shift in the seeking of treatment for opioid use disorder from EDs during the pandemic. A key consideration is that opioid-related events comprise not only opioid overdose complications but also opioid withdrawal episodes, and both can be treated at the ED with lifesaving naloxone and buprenorphine, respectively.[17]

The ED also provides these medications for opioid use disorder (MOUD) on discharge as stand-by medications for use as required and connects patients with follow-up OUD management in the community.[18,19] In California, the CA Bridge program has spearheaded the coordinated implementation of low-threshold buprenorphine treatment for opioid withdrawals (an approach that reduces as many barriers as possible regarding access to buprenorphine[20]) at EDs of 52 hospitals, including four UC health centers, since 2018.[21] Unfortunately, the program reported a steep decline in ED-initiated buprenorphine during the first months of the pandemic.[22] Our study may provide preliminary evidence that the lower rates of OUD treatment at EDs, especially for withdrawal episodes, have continued into 2021 and 2022. Further research, such as examining rates of administration and prescription of different MOUD at the ED, will be required to confirm this hypothesis.

At the initial stages of the pandemic, Currie et al reported that opioid prescriptions across the US were generally maintained among existing opioid users but decreased briefly for new users.[23] Another study by Zheng et al reported a decline in opioid prescriptions and prescribers before and during the COVID-19 pandemic period in California.[24] There were little to no signs of a sudden increase in opioid prescriptions that could explain the higher rates of prescription opioid overdose rates seen in our study. A multisite report studying drug use behaviors during the pandemic found that COVID-19-related stressors, such as job loss, increased housing insecurity, and loneliness, were commonly cited reasons for increasing drug use behaviors.[25] The same study further reported that synthetic opioids, particularly fentanyl, had saturated the illicit drug market during this time due to its inexpensive nature and high accessibility compared to methamphetamine and heroin.[25] These trends were further verified in the *California Health Care Almanac* feature on California substance use.[26] Other than strategizing to reduce the supply of illicit fentanyl and fentanyl-laced pills, improving the mental health of opioid users, and thereby reducing demand for both prescription and synthetic opioids, will also help to mitigate the opioid epidemic more effectively.

Recent policy changes have been made to purposefully bring MOUD closer to patients and prevent deaths from fatal opioid withdrawals and overdoses: 1) the removal of the X-waiver (issued by the Substance Abuse and Mental Health Services Administration and the Drug Enforcement Administration) enabled physicians to prescribe buprenorphine in clinics without administrative barriers and extensive certification[27,28]; and 2) the approval by the Food and Drug Administration of Narcan, the first over-the-counter naloxone nasal spray.[29] However, with the emergence of the fourth wave of the opioid crisis characterized by opioid and stimulant co-use,[30] the war against the opioid epidemic is not yet won, and effective policy changes will necessitate key changes in current practices and operations.

Varisco et al identified legacy barriers in state-level regulations and wholesaler policy that could limit buprenorphine supplies and dispensing at pharmacies.[31] Education and the intentional distribution to the community will be required to ensure that Narcan is always available to respond to an opioid overdose event. Finally, there remains evidence of high-risk opioid prescribing and dispensing behaviors associated with a younger and less educated demographic, which may precipitate greater rates of opioid-related cases.[32] There is still much to do as clinicians, researchers, and community advocates to ensure the effective management of the opioid epidemic, given our available resources.

STRENGTHS AND LIMITATIONS

One limitation of the study is the use of deidentified data, which prevented us from evaluating individual-level characteristics that are predictive of higher opioid-related

admissions or readmissions. Such data will need to be navigated around existing and new regulatory frameworks from multisite IRBs across multiple UC health centers. To our knowledge, this is a hurdle that has yet to be tackled at the UC-wide level, and we suspect that more time will be needed to establish the process. Once established, we will strive to determine sociodemographic and geolocation features that could help with advising the optimal allocation of resources in this war against the opioid epidemic.

Regardless, the strength of this current study lies in the use of real-world ED data to rapidly assess the changes in opioid-related ED trends during the COVID-19 crisis when research data collection had been halted due to lockdown measures. Our study has also demonstrated the feasibility of using this methodology to create a real-time OUD dashboard[33] to facilitate the timely dissemination of trend data in opioid-related ED visits and admissions in the everchanging, opioid use landscape in California. Additionally, we sought to include community-based programs, such as OUD-based harm reduction organizations, as a beneficial intervention to reduce the number of opioid-related ED visits. However, the UC HDW did not include data that was relevant to these programs, and there is yet to be a robust study displaying their significance.

CONCLUSION

Our data provides support that opioid-related ED visit rates in California have exceeded pre-pandemic rates and have continued to worsen after 2021. Although the COVID-19 pandemic saw an overall decreasing trend in the number of opioid-related ED visits in all the UC Health centers, the number of visits due to prescription and synthetic opioids-related overdose remains high. More significantly, this increasing trend provides a great public health concern, especially as the US enters the fourth wave of the opioid epidemic, characterized by polysubstance use. Not only must we reduce the supply of illicit opioids, we should also aim to reduce the demand for prescription and synthetic opioids, which is likely the function of worsening mental health during the COVID-19 pandemic. While the COVID-19 pandemic continues to become less notable to the public, the consequential changing landscape of the opioid epidemic remains an uphill battle that calls for multilevel, proactive, innovative, and collaborative approaches across the US.

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An Assessment of the Presence of *Clostridium tetani* in the Soil and on Other Surfaces

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Introduction: Standard emergency medicine practice includes tetanus vaccine administration as part of wound care management for patients who are not fully immunized. Since there have been no available studies in the United States reaffirming the prevalence of *Clostridium tetani (C tetani)* since 1926, we sought to identify its prevalence in a major urban county in the US.

Methods: We sampled soil, rusted metal, concrete, and dog feces to determine the prevalence of *C tetani* in a single metropolitan county in the United States. Soil samples and swabs were collected from four locations: the soil of a public park and an elementary school; dog feces from a single public dog park; and rusted surfaces (metal and concrete) in common student areas of a university campus. The presence of *C tetani* in each sample was determined using a quantitative polymerase chain reaction.

Results: In total, 200 samples were collected, of which 37 (18.5%) tested positive for *C tetani* DNA. Among the 140 samples taken from the soil, just one (0.7%) tested positive for *C tetani* DNA. Of the 40 samples of rusted metal and concrete surfaces, 30 (75%) tested positive for *C tetani*, and six (30%) of the 20 samples from dog feces tested positive for *C tetani*.

Conclusion: We found that *C tetani* is frequently present on rusted metal and concrete surfaces but rarely in soil samples. Minor wounds contaminated with soil may be considered low risk for tetanus. However, future studies should assess the burden of *C tetani* in other similar urban, suburban, and rural environments to help determine the threat of *C tetani* more exactly. [West J Emerg Med. 2024;25(6)890–893.]

INTRODUCTION

Background

Clostridium tetani (*C tetani*), a Gram-positive obligate anaerobe, is the causative agent of tetanus, a disorder that induces uncontrollable muscle spasms (known as tetany) and carries high mortality.[1] It is prevented by a commonly administered toxoid vaccine.[1] *C tetani* is thought to inhabit soil, most often in the spore form, through which it can withstand extreme temperatures and volatile environments.[2] After inoculation of contaminated wounds, the spores proliferate and spawn vegetative bacteria, which release toxins that precipitate the disease's characteristic symptoms of tetany.[1]

Tetanus poses a considerable risk in developing countries with little access to vaccination. In 2015 there were nearly 57,000 cases of tetanus reported worldwide, with 79% originating in South Asia and sub-Saharan Africa.[3] The annual incidence of tetanus in the United States, in contrast, is very low. Since the introduction of the tetanus toxoid vaccine in the 1930s, the rate of infection has steadily

declined from a peak of 500 in 1950 to no more than 30 cases yearly.[4] Documented cases are typically in injection drug users and the elderly, who have a higher risk of insufficient antibody titers despite updated vaccination status.[1,4]

The US Centers for Disease Control and Prevention Advisory Committee on Immunization Practices (ACIP) recommends tetanus vaccination as part of "routine wound care management" for patients who are not up to date with their vaccination after sustaining a wound.[5] Protocols for wound characteristics (ie, abrasion vs laceration) are not specified by the ACIP.[6] However, the American College of Emergency Physicians guidelines differentiate between "minor wounds and superficial burns" and "other wounds": minor wounds require a booster within 10 years, while "other wounds" require a booster within five years.[7] Thus, tetanus toxoid is administered liberally in US emergency departments (ED) as part of routine wound care, whether for simple abrasions or more complex wounds.

The prevalence of *C tetani* in the soil has not been measured in the US since 1926, when Damon et al fed cultured soil specimens obtained mostly from farmland to pigs and subsequently monitored them for signs of disease.[8] More recently in 2008, Bukar et al sampled soil in Nigeria, and via incubation of specimens they demonstrated a 60% incidence of *C tetani*.[9] However, these studies may not be generalizable to modern US populations. Newer, more robust methods for determining the presence of *C tetani* exist today; furthermore, 83% of people in the US today reside in urban environments[10] where the burden of *C tetani* in the environment may differ. Thus, the true prevalence of *C tetani* in the modern, urban US environment has yet to be elucidated.

We sought to determine the frequency with which *C tetani* is present in the soil as compared to concrete, metal, and dog feces in a single, major urban county in the US.

Population Health Research Capsule

What do we already know about this issue?
Clostridium tetani is assumed to be widely present within the soil. The last soil sample study performed in the United States was in 1926, which only showed one positive sample of 62 collected.

What was the research question?
What is the prevalence of C. tetani in the soil, in dog feces, and on concrete and metal surfaces within a single urban county?

What was the major finding of the study?
Among the 140 samples taken from the soil, just 1 (0.7%) tested positive for C. tetani DNA. Of the 40 samples of rusted metal and concrete surfaces, 30 (75%) tested positive, as did 6 (30%) of 20 samples from dog feces.

How does this improve population health?
Certain wound types (ie, soil contamination) may carry a lower risk for C tetani, and the elevated cost of tetanus toxoid administration in the emergency department may be forgone for outpatient vaccination which is much cheaper.

MATERIALS AND METHODS

We assessed environmental samples for the presence of *C tetani* DNA in Miami-Dade County, Florida, which has a population of approximately 2.7 million people.[11] This study did not include human subjects and thus was exempt from review by the institutional review board. This research received no outside funding.

Eighty soil samples were collected in sterilized Whirl-Pak bags (Filtration Group Corp, Madison, WI) from an urban public park and an elementary school. These sites were chosen based on their distance from each other and their likelihood to represent isolated soil flora within the same county, but not within close enough proximity to be expected to share similar flora. Each soil-sample bag contained three separate samples from within a few inches of soil using three separate plastic spoons that were disposed of after each use. We collected samples this way such that each bag was large enough and that one individual spoon might not "contaminate" the other two samples within the same bag. The other samples, collected by DRYSWAB brush (Medical Wire & Equipment Ltd, Corsham, UK), included 20 samples of dog feces from one dog park, and 60 combined samples of concrete and rusted metal surfaces (such as metal signs and railings, and concrete walkways) at a single public university. A subsequent set of 60 soil samples, also collected by dry swab, were again taken from the same locations as the original soil samples in the sterilized bags. Samples were immediately taken to the processing laboratory after collection.

Samples were analyzed in a university microbiology lab using quantitative polymerase chain reaction (qPCR) following a standardized previously described method (Akbulut et al).[12] This assay amplifies a 160-base pair fragment of the teNT gene (tetanus toxin) of *C tetani* (GenBank Accession Number X06214, X04436). The tip of each swab was removed and placed into a 1.5 milliliter Eppendorf tube containing 50 microliters (μl) PrepMan Ultra Sample Preparation Reagent (Thermo Fisher Scientific, Waltham, MA). The tube was then incubated for

10 minutes at 100°C in a dry bath, after which it was centrifuged at 13,000 revolutions per minute for three minutes. The initial 80 soil samples were analyzed with 500 milligrams of mixed soil, while the dry swabs were mixed with a reagent in the absence of significant amounts of soil in the sample.

Five μl of DNA was then extracted from the tube and transferred to a 0.6-milliliter (mL) qPCR tube containing 45 μl of 1/10 TE buffer. After mixing, 5 μl of this diluted DNA product was added to a new qPCR tube along with 20 μl of a 62.5:35.5:1:1 mixture of SYBR Green master mix (Thermo Fisher Scientific, Waltham, MA): purified water: forward primer TeNT-F (CCTAGTTTCAAAACTTAT TGGCTTATGTAA): reverse primer TeNT-R (CATAATTCTCCTCCTAAATCTGTTAATGAT). The qPCR was performed on a QuantStudioTM 3 Real-Time PCR Instrument (96-well 0.1 mL Block) (Applied Biosystems Inc, Foster City, CA) as follows: two minutes at 50°C, followed by two minutes at 90°C, followed by 51 cycles of 15 seconds at 95°C/1 minute at 56°C, followed by a final 15 seconds at 95°C. Our qPCR was specified for the first 160 base pair fragments of the teNT gene of *C tetani*.

The plate included three distilled water negative controls, one PrepMan negative control, and three serial dilutions of double-stranded, synthetic DNA (gBlock, Integrated DNA Technologies Inc, Coralville, IA) of the teNT gene of *C tetani* (GenBank Accession Number X06214, X04436). Results were analyzed in QuantStudio Design and Analysis Software v1.5.1 (Applied Biosystems Inc, Foster City, CA). No power calculation was performed. With no external funding, the investigators determined we had funds for three plates. The maximum number of samples per plate was 82. We analyzed 200 total samples from the environment to assess for the presence of *C tetani* DNA. In the laboratory setting, the assay we used has nearly 100% sensitivity and specificity for *C tetani* DNA, but it is possible that in environmental samples the presence of additional substances may interfere with it. Therefore, we tagged 42 soil samples with *C tetani* to assess the accuracy of our assay (the control group). We calculated the number (%) of samples that were positive for *C tetani* overall, for each type of environmental sample, and for the control group. We compared the three groups (soil, concrete and metal, and dog feces) in a pairwise fashion with regard to the percentage of samples with *C tetani* DNA using Fisher exact tests.

RESULTS

Overall, of the 200 samples collected for analysis, 37 (18.5%) tested positive for *C tetani* DNA (Table). The first 80 samples consisted of soil collection in plastic bags from public parks. These 80 samples were all negative for *C tetani* DNA by our analysis. However, given the possibility of interference of soil humic acid with qPCR analysis,[13] another 60 soil samples were obtained via dry swabs from the same locations (urban park and elementary school) as the original 80. Repeat analysis of the 60 dry swabs of the soil revealed one positive for *C tetani* DNA. Therefore, among the 140 analyzed soil samples (with two different methods of collection), one (0.7%) was found to have *C tetani* DNA. To assess the sensitivity of our assay, we tagged 22 samples of soil in sterilized plastic bags with *C tetani* DNA, and 16 were identified as positives (72.7%). We tagged 20 dry swabs of soil with *C tetani* DNA, and 11 (55%) were positive.

Table. Swabs and soil sample results for presence of *Clostridium tetani*.

Sample location and type	Positive samples
All soil:	1/140 (0.7%)
• Park samples	• 0/20 (0%)
• Elementary school samples	• 0/60 (0%)
• Park swabs	• 1/15 (1.7%)
• Elementary school swabs	• 0/45 (0%)
Dog park feces swabs	6/20 (30%)
Undergraduate campus, oxidized metal and concrete swabs	30/40 (75%)

We collected 40 swabs of combined public oxidized concrete and metal surfaces from a university campus, as well as 20 swabs of dog feces at a single public dog park. Of these, six (30%) of 20 dog feces samples were positive for *C tetani* DNA, and 30 (75%) of 40 swabs of oxidized concrete and metal were positive. A control was created and evaluated by tagging 20 of the metal and concrete samples with *C tetani* DNA. Of the 20 control samples, 15 were positive (75%).

There was a statistically significant difference in the percentage of samples with *C tetani* DNA from the concrete and metal group (75%) as compared to the soil group (0.7%), $P < 0.001$. Additionally, there was a statistically significant difference in the percentage of samples with *C tetani* DNA from the dog feces group (30%) as compared to the soil group (0.7%), $P < 0.001$. Finally, there was a statistically significant difference in the percentage of samples with *C tetani* DNA in the concrete and metal group (75%) as compared to the dog feces groups (30%), $P < 0.001$.

DISCUSSION

We undertook this study to help ascertain the frequency with which *C tetani* is found in the soil and on other substances in the environment in an urban area in the US. Our results suggest that *C tetani* is much more common on oxidized metal and concrete, as well as dog feces than it is in soil. Our results are consistent with the last assessment of US soil from 1926, which did not strongly suggest that *C tetani* was present. With the paucity of *C tetani* isolated in this

sample of US soil from a single county, it is suggested that further investigation into the prevalence of the bacterium is needed. There are broader implications to identifying *C tetani*. For one, this study found that non-soil media may provide a more favorable growth environment for *C tetani*, and soil itself may not be an abundant source. Education efforts for exposure may need to be concentrated on injuries due to rusted metal, concrete, dog feces, and potentially other sources of *C tetani*. Given that our study sample was small, we do not believe that this data alone merits a change in ED vaccination guidelines, especially since the tetanus toxoid vaccine also provides immunization against diphtheria and pertussis, both of which are also significant public health threats. Rather, more data from similar studies is required.

LIMITATIONS

There are some limitations to this small single-US county study. Firstly, *C tetani* DNA samples were tested via qPCR analysis, rather than incubated, and reagents, such as humic acid, within the soil may have interfered with PCR analysis.[13] Repeat analysis of dry swabs aimed to mitigate such error, and similar results were produced. Furthermore, the prevalence of *C tetani* should be studied in other urban areas before public health conclusions are made. Farmland and non-urban areas were not studied and, therefore, this cannot be generalized. Oxidized metal and concrete surfaces were analyzed together, and thus the extent to which *C tetani* is present on either surface was not fully assessed in this study. Lastly, while this study contains more data samples than previous similar undertakings, 200 soil samples from only a few separate sites in a single, urban county likely do not fully represent the true extent of the presence of *C tetani* in other environments, such as other sites from within the same urban county and other urban, suburban, and rural environments.

CONCLUSION

Tetanus poses a significant public health threat. Yet its presence in the soil may not be as significant as is currently assumed, at least not in urban areas, as our findings suggest. In our study, we tested soil, concrete, metal, and dog feces for *C tetani* in a single urban county. The results suggest that *C tetani* is more abundant in oxidized metal and concrete, as well as in dog feces than it is in soil. However, several questions about the prevalence and virulence of *C tetani* remain. Further studies should elucidate the prevalence of *C tetani* in other urban, suburban, and rural sites.

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External Validation of the RESCUE-IHCA Score as a Predictor for In-Hospital Cardiac Arrest Patients Receiving Extracorporeal Cardiopulmonary Resuscitation

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Background: Extracorporeal cardiopulmonary resuscitation (ECPR) improves the prognosis of in-hospital cardiac arrest (IHCA). The six-factor RESCUE-IHCA score (resuscitation using ECPR during IHCA) was developed to predict outcomes of post-IHCA ECPR-treated adult patients. Our goal was to validate the score in an Asian medical center with a high volume and experience of ECPR performance and to compare the differences in patient characteristics between the current study and the original cohort in a 2022 observational study.

Method: For this single-center, retrospective cohort study we enrolled 324 ECPR-treated adult IHCA patients. The primary outcome was in-hospital mortality. We used the area under the receiver operating curve (AUROC) to externally validate the RESCUE-IHCA score. The calibration of the model was tested by the decile calibration plot as well as Hosmer–Lemeshow goodness-of-fit with an associated *P*-value.

Results: Of the 324 participants, 231 (71%) died before hospital discharge. The discriminative performance of the RESCUE-IHCA score was comparable with the originally validated cohort, with an AUC of 0.63. A prolonged duration of cardiac arrest was associated with an increased risk of mortality (odds ratio [OR] 1.02, 95% confidence interval [CI] 1.01–1.03, $P = .006$). An initial rhythm of ventricular tachycardia (OR 0.14, 95% CI 0.04–0.51, $P = .003$), ventricular fibrillation (OR 0.11, 95% CI 0.03–0.46, $P = .003$), and palpable pulse (OR 0.26, 95% CI 0.07–0.92, $P = 0.04$) were associated with a reduced mortality risk compared to asystole or pulseless electrical activity. In contrast to the original study, age ($P = 0.28$), resuscitation timing ($P = 0.14$), disease category ($P = 0.18$), and pre-existing renal insufficiency ($P = 0.12$) were not associated with in-hospital death.

Conclusion: In external validation, the RESCUE-IHCA score exhibited performance comparable to its original validation within the single-center population. Further investigation on hospital experience, time-of-day effect, and specific disease categories is warranted to improve the selection criteria for ECPR candidates during IHCA. [West J Emerg Med. 2024;25(6)894–902.]

INTRODUCTION

Extracorporeal cardiopulmonary resuscitation (ECPR) is a promising modality that combines extracorporeal membrane oxygenation (ECMO) with traditional CPR techniques for improving the outcome after cardiac arrest. Prediction models developed to estimate the survival likelihood of patients with refractory cardiogenic shock or cardiac arrest who received ECPR have rarely focused on patients who have sustained an in-hospital cardiac arrest (IHCA),[1,2] A 2010 observational study showed that ECPR leads to more favorable outcomes in IHCA than in out-of-hospital cardiac arrest (OHCA),[3] possibly owing to the shorter no-flow and low-flow duration. Other observational studies have attempted to ascertain strong predictors that can help identify IHCA patients who would benefit most from ECPR.[4,5]

The RESCUE-IHCA scoring system (resuscitation using ECPR during IHCA) was developed to predict outcomes of ECPR-treated adult IHCA patients and was externally validated using patient data from the Extracorporeal Life Support Organization (ELSO) Registry.[6] RESCUE-IHCA is a simplified score that comprises six variables: 1) age; 2) pre-existing renal insufficiency; 3) time of the day (7 AM – 2:59 PM); 4) disease category (cardiac, or non-cardiac, surgical or medical, as per the Current Procedural Terminology and International Classification of Diseases); 5) initial rhythm; and 6) the duration of arrest, all of which can be easily collected upon hospital arrival. However, in the validation group, the RESCUE-IHCA scoring system only demonstrated acceptable discrimination.

Despite its modest clinical performance, the RESCUE-IHCA is the only model available for predicting outcomes of ECPR-treated IHCA patients. Therefore, further evaluation of the RESCUE-IHCA's reproducibility by using external datasets is warranted for wider application of this scoring system. Our objective was to validate the RESCUE-IHCA score using data from a different population and to identify potential predictors that may differ from those in the original study. We aimed to enhance clinical decision-making by providing more accurate outcome predictions for ECPR initiation in IHCA patients.

Population Health Research Capsule

What do we already know about this issue?
Extracorporeal cardiopulmonary resuscitation improves the prognosis of in-hospital cardiac arrest. The RESCUE-IHCA score predicts outcomes for these patients.

What was the research question?
We aimed to validate the RESCUE-IHCA score and to compare differences in patient characteristics between our study and a 2010 observational study.

What was the major finding of the study?
The RESCUE-IHCA score showed compromised discrimination compared to the original study, with an AUC of 0.63 (95% CI 0.56–0.70).

How does this improve population health?
The RESCUE-IHCA score did not predict outcomes better than the originally validated cohort. Method of disease categorization may have influenced outcomes.

METHODS

Study Design and Setting

This retrospective cohort study was conducted over a seven-year period (January 2012–December 2019) at a tertiary, extracorporeal life-support referral medical center in Taiwan, one of the largest medical centers in Asia with 2,600 beds, including 220 beds in intensive care units. Most patients are Taiwanese residents, with foreigners occasionally admitted through international transfer. Over the past decade, the medical center has performed more than 100 ECPR procedures annually under the guidance of cardiac surgeons.[7] This study, approved by the institutional review board [202306052RIND], demonstrates a robust adherence to methodological standards in health record review studies.[8] The requirement of informed consent was waived due to the retrospective nature of the research. The sampling patients were identified through chart review of electronic health records (EHR) by medical and emergency physicians who collected covariate data and defined the post-IHCA outcome.

Case Selection

Between January 2012–December 2019, study participants were enrolled based on these selection criteria: 1) patients had undergone ECPR following IHCA; 2) were aged ≥18 years; and (3) had no history of OHCA prior to admission. We used a critical screening process to exclude ineligible patients based on the following criteria: 1) transfer to another hospital after return of spontaneous circulation; 2) traumatic arrest; 3) history of OHCA; and 4) missing outcomes in the EHR.

Data Collection and Processing

Covariate data from each medical chart were defined clearly and reviewed by independent physicians, and monthly meetings were held to ensure consistency of the collected data. To minimize potential biases or errors, the

study design and data analysis were undertaken by a physician who was blinded to the data collection process. We discussed any disputes or ambiguous records with cardiologists and emergency physicians, and decisions were made regarding each controversial health record. Individuals who lacked outcome variables were excluded initially. The only missing data in the current cohorts was the pre-arrest laboratory data, which was not included in the RESCUE-IHCA score or the final analysis.

Variables

We categorized the study variables into demographics, pre-existing diseases, intra-arrest characteristics, and presumed etiology of cardiac arrest. Demographics included age, gender, body weight, and body mass index (BMI). Pre-existing diseases included hypertension, diabetes mellitus, chronic obstructive pulmonary disease, coronary artery disease, congestive heart failure, chronic kidney disease, cerebral vascular disease, and cancer, and the diagnoses were confirmed from the EHR based on regular medication prescriptions, treatment, and outpatient follow-up. Intra-arrest characteristics included initial cardiac rhythm defined as asystole, pulseless electrical activity, ventricular tachycardia (VT), ventricular fibrillation (VF), or with a palpable pulse initially; time of day, duration of cardiac arrest; and intra-arrest treatments including defibrillation and medications administered. The presumed etiology of IHCA was determined by reviewing the EHR. We categorized participants into four groups based on whether the IHCA was cardiogenic or non-cardiogenic and was related to a surgical or medical illness (Supplementary Table 1).

Outcomes

As with the outcome of the original RESCUE-IHCA study, the primary outcome in this study was in-hospital death. We calculated the RESCUE-IHCA score in our datasets for the external validation process.

Statistical Analysis

Continuous data were assessed for normality using the Kolmogorov–Smirnov test and were expressed as the mean (standard deviation) if normally distributed or median (interquartile range [IQR]) if non-normally distributed. We presented dichotomous and categorical variables as the frequency (percentage). We compared continuous variables using the Mann-Whitney *U* test, whereas dichotomous and categorical variables were examined using the chi-square test. We used the Hosmer-Lemeshow test to show the goodness of fit.

The external validation of the RESCUE-IHCA score was performed in the study cohort, and we assessed discriminatory performance using the area under the receiver operating characteristic curve (AUROC) with 95% confidence interval (CI). The model calibration was tested using a calibration plot based on 10 deciles, as well as the Hosmer–Lemeshow goodness-of-fit test with an associated *P*-value. We tested individual variables with a binary logistic regression model and adjusted them in the multivariate regression model using the force-entry method. The results were presented as adjusted odds ratio and 95% CI.

We performed statistical analysis using the Statistical Package for the Social Sciences version 26.0 (IBM Corp, Armonk, NY) and R 4.3.0 (R Foundation for Statistical Computing, Vienna, Austria). A two-sided *P*-value less than 0.05 was considered statistically significant.

RESULTS

Patient Characteristics

During the study period (January 2012–December 2019), 324 eligible patients who received ECPR after IHCA were enrolled in this study, and among them 231 (71%) died before hospital discharge (Figure 1). Table 1 presents the baseline characteristics of the participants. In the overall cohort, 121 patients (37.3%) had an initial shockable rhythm, and 265 patients (82%) were presumed to have a medical illness. Patients who survived to discharge after receiving ECPR for IHCA, when compared with the non-survivors, had a higher frequency of hypertension (62/93 [66.7%] vs 121/231 [52.3%], $P = 0.03$), presented more frequently with an initial shockable rhythm (50/93 [53.8%] vs 71/231 [30.7%], $P < 0.001$), had a shorter low flow duration (28 minutes vs 38 minutes, $P < 0.001$), and the cardiac arrest was more frequently presumed to be of a medical cardiogenic or surgical cardiogenic origin (62/93 [66.7%] vs 125/231 [54.1%]; 7/93 [7.5%] vs 16/231 [6.9%], $P = 0.03$). The duration of ECMO support was shorter (2 days vs 4 days, $P = .002$), and the total hospital length of stay was longer (15 days vs 3 days, $P < .001$) in the survival group. No significant intergroup differences between survivors and non-survivors were detected in terms of age, gender, body weight, BMI, history of comorbidities besides hypertension, witnessed arrest, or time of day.

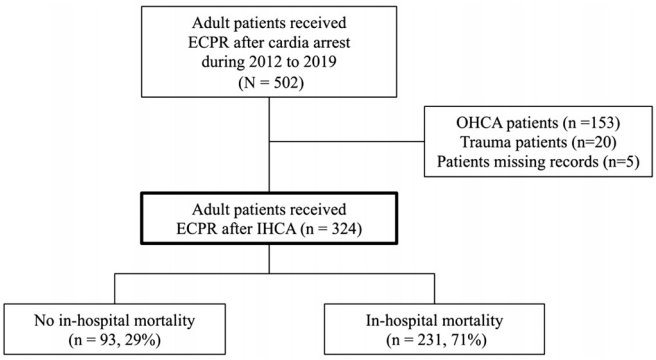

Figure 1. Study enrollment flowchart.

Table 1. Comparison of basic characteristics of in-hospital cardiac arrest patients receiving extracorporeal cardiopulmonary resuscitation with or without survival to discharge.

	Patients died before discharge (n = 231)	Patients survived to discharge (n = 93)	*P*
	N (%) / median (IQR)	N (%) / median (IQR)	
Male	158 (69.6)	69 (30.4)	0.35
Age (year)	63.20 (50.40–70.00)	59.90 (50.35–66.85)	0.17
BW (kg)	67.40 (24.92–27.49)	65.00 (59.55–75.55)	0.88
BMI (kg/m^2)	24.92 (21.98–27.49)	24.28 (22.44–26.70)	0.53
Past comorbidities			
HTN	121 (66.1)	62 (33.9)	0.03
DM	91 (67.9)	43 (32.1)	0.27
COPD	6 (85.7)	1 (14.3)	0.68
CAD	79 (66.9)	39 (33.1)	0.20
CHF	50 (75.8)	16 (24.2)	0.46
Renal insufficiency	50 (79.4)	13 (20.6)	0.12
CVA	13 (81.2)	3 (18.8)	0.57
Cancer	25 (86.2)	4 (13.8)	0.08
CPR			
Witnessed arrest	213 (70.8)	88 (29.2)	0.63
Initial shockable rhythm	71 (58.7)	50 (41.3)	<0.001
Time of day			
07:00–14:59	99 (66.9)	49 (33.1)	0.27
15:00–10:59	81 (74.3)	28 (25.7)	
23:00–06:59	51 (76.1)	16 (23.9)	
Low-flow duration (min)	38 (26–51)	28 (20.5–39)	<0.001
Presumed disease category			
Medical noncardiogenic	57 (73.1)	21 (26.9)	0.03
Medical cardiogenic	125 (66.8)	62 (33.2)	
Surgical cardiogenic	16 (69.6)	7 (30.4)	
Surgical noncardiogenic	33 (91.7)	3 (8.3)	
Duration of ECMO support (day)	4 (3–6)	2 (1–5)	0.002
Hospital length of stay (day)	3 (1–14)	15 (8–27)	<0.001

Dichotomous variables were reported as number (percentage) while continuous variables were reported as median (interquartile range). *BMI*, body mass index; *BW*, body weight; *CAD*, coronary artery disease; *CHF*, congestive heart failure; *CPR*, cardiopulmonary resuscitation; *CVA*, cerebrovascular event; *DM*, diabetes mellitus; *ECMO*, extracorporeal membrane oxygenation; *ECPR*, extracorporeal cardiopulmonary resuscitation; *IHCA*, in-hospital cardiac arrest; *IQR*, interquartile range; *kg*, kilograms.

External Validation of the RESCUE-IHCA Score

The RESCUE-IHCA predictive model was externally validated among the 324 participants. The model discrimination was poor to acceptable (area under the curve 0.63 [95% CI 0.56–0.70]). The predicted probability of mortality ranged from 38–93% according to the RESCUE-ICHA score (Figure 2). Model calibration indicated good fit with the Hosmer-Lemeshow goodness-of-fit test ($P = 0.91$). The observed mortality in the study cohort vs the predicted mortality calculated from the RESCUE-IHCA score is presented in Figure 3. Other bin sizes were likewise tested without further improvement in fit.

Significant Factors Associated with In-Hospital Death in the Current Cohort

To assess potential predictive factors in our cohort and compare them with the original RESCUE-IHCA score, we conducted univariate logistic regression for all variables, followed by multivariate regression for those variables with $P < 0.1$ (Table 2). The result showed that the mortality risk

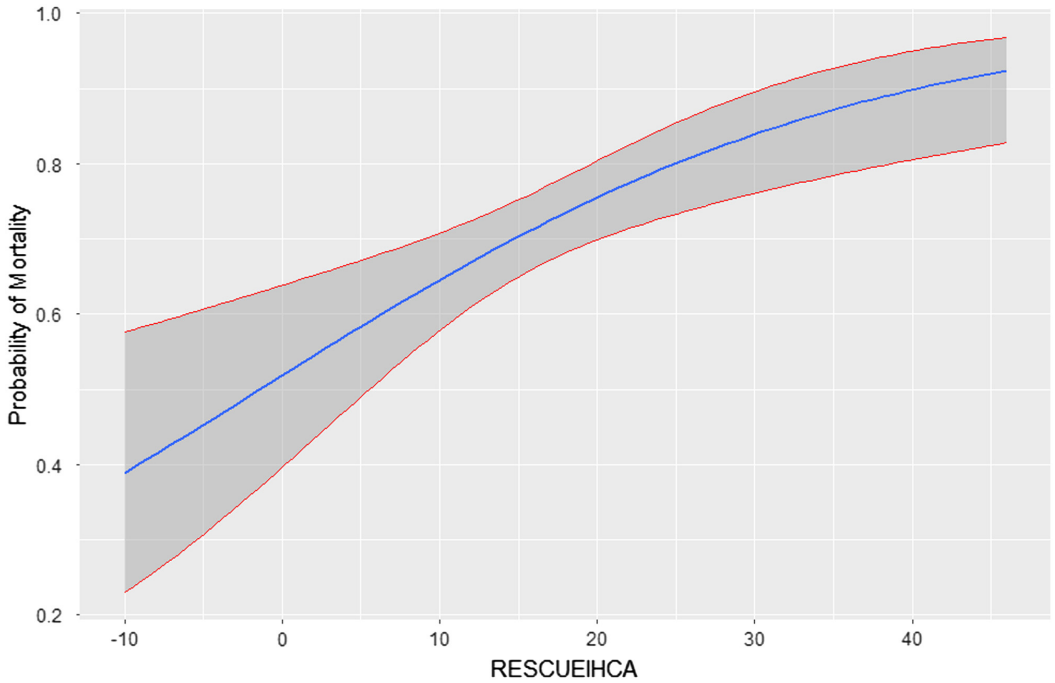

Figure 2. Predicted probability of death across RESCUE-IHCA score.

was positively associated with longer low-flow duration (odds ratio [OR] 1.02, 95% CI 1.01–1.03, $P = .006$), and negatively associated with an initial cardiac rhythm of VT (OR 0.14, 95% CI 0.04–0.51, $P = .003$), VF (OR 0.11, 95% CI 0.03–0.46, $P = .003$), or palpable pulse (OR 0.26, 95% CI 0.07–0.92, $P = 0.04$). Patient's age, pre-existing renal insufficiency, timing of resuscitation, and disease category did not show significant associations with mortality. The Hosmer-Lemeshow test results showed a good fit ($P = 0.66$).

DISCUSSION

Validation of the RESCUE-ICHA Score

In the present study, we performed temporal and geographical external validation of the RESCUE-IHCA scoring system in an Asian medical center equipped with standardized protocols for ECMO initiation. The performance of model discrimination (AUC 0.63) modestly decreased as compared with the original derivation and validation cohorts (AUC 0.72 [95% CI 0.68–0.76] and 0.68

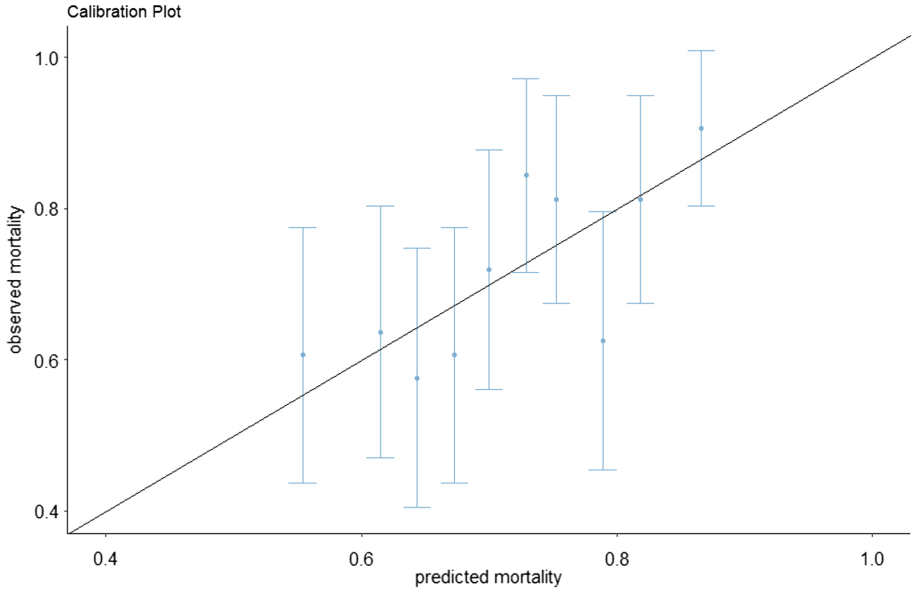

Figure 3. Calibration plot of observed vs predicted mortality from validated dataset.

Table 2. Logistic regression model of risk factors associated with in-hospital death.

	N (%) / median (IQR)	Crude OR (95% CI)	*P*	Adjusted OR (95% CI)	*P*
Male	227 (70.1)	0.75 (0.44–1.29)	0.30		
Age (year)	59.7 (45.7–73.7)	1.01 (0.99–1.03)	0.28		
BW (kg)	66.55 (57.60–76.45)	1.00 (0.99–1.02)	0.94		
BMI (kg/m2)	24.64 (22.20–27.36)	1.01 (0.96–1.06)	0.80		
Past comorbidities					
HTN	183 (56.5)	0.55 (0.33–0.91)	0.02	0.70 (0.41–1.20)	0.19
DM	134 (41.4)	0.76 (0.47–1.23)	0.26		
COPD	7 (2.2)	2.45 (0.29–20.66)	0.41		
CAD	118 (36.4)	0.72 (0.44–1.18)	0.19		
CHF	66 (20.4)	1.23 (0.76–1.99)	0.41		
Renal insufficiency	63 (19.4)	1.70 (0.88–3.30)	0.12		
CVA	16 (4.9)	1.79 (0.50–6.43)	0.37		
Cancer	29 (9)	2.70 (0.91–7.99)	0.07		
CPR					
Witnessed arrest	301 (92.9)	0.67 (0.24–1.87)	0.45		
Presenting rhythm					
Asystole	42 (13)	reference		reference	
PEA	19 (5.9)	0.29 (0.06–1.45)	0.13	0.32 (0.06–1.70)	0.18
VT	83 (25.6)	0.11 (0.03–0.37)	<0.001	0.14 (0.04–0.51)	.003
VF	34 (10.5)	0.10 (0.03–0.38)	0.001	0.11 (0.03–0.46)	.003
Pulse (+)	146 (45)	0.24 (0.07–0.81)	0.02	0.26 (0.07–0.92)	0.04
Time of day					
07:00–14:59	148 (45.7)	reference			
15:00–10:59	109 (33.6)	0.69 (0.37–1.29)	0.24		
23:00–06:59	67 (20.7)	1.19 (0.60–2.35)	0.63		
Low flow duration (min)	37.6 (17.0–58.3)	1.03 (1.01–1.04)	0.001	1.02 (1.01–1.03)	.006
Presumed disease category					
Medical noncardiac	78 (24.1)	reference		reference	
Medical cardiac	187 (57.7)	0.74 (0.41–1.33)	0.32	1.23 (0.63–2.38)	0.55
Surgical cardiac	23 (7.1)	0.84 (0.30–2.33)	0.74	1.28 (0.43–3.75)	0.66
Surgical noncardiac	36 (11.1)	4.05 (1.12–14.63)	0.03	4.39 (1.17–16.46)	0.03

Dichotomous variables were reported as number (percentage) while continuous variables were reported as median (interquartile range). Variables with $P < 0.1$ in univariable logistic regression were adjusted.
BMI, body mass index; *BW*, body weight; *CAD*, coronary artery disease; *CHF*, congestive heart failure; *CPR*, cardiopulmonary resuscitation; *CVA*, cerebrovascular event; *DM*, diabetes mellitus; *IQR*, interquartile range; *kg*, kilograms; *N*, case number; *OR*, odds ratio; *PEA*, pulseless electrical activity; *VF*, ventricular fibrillation; *VT*, ventricular tachycardia.

[95% CI 0.61–0.75], respectively). The model's performance may be attributed to the lack of significance of certain variables, including age, timing of resuscitation, the presumed disease category, and pre-existing renal insufficiency. We found that the low flow duration and the initial cardiac rhythm serve as significant predictors for the outcome, consistent with findings from previous observational studies and meta-analyses.[5,9–12,19] Despite the single-center focus, the hospital is globally recognized as the second-largest facility for ECPR procedures, managing hundreds of cases each year. This study provides novel insights within a unique ethnic context.

Individual Predictors of In-Hospital Death

Age was not a significant predictor in our study, possibly attributable to the small sample size. When comparing patient characteristics between studies, we observed a similar age distribution among non-survivors and survivors in the

two cohorts (study cohort: 63.2 vs 59.9; RESCUE-IHCA cohort: 61 vs 58).

In contrast to the notable finding from the RESCUE-IHCA study, the influence of time of day on survival no longer persisted. During late night and early morning from 11 PM – 5 AM, fewer survivors were observed in the RESCUE-IHCA cohort compared to the current cohort (study cohort: 16/93 [17.2%]; RESCUE-IHCA cohort: 27/306 [8.8%]). The current study was conducted at a tertiary medical center where ECPR initiation was protocolized regardless of timing. When a cardiac arrest occurs, a standardized hospital-wide emergency call activates a rapid response team of medical cardiologists, surgeons, and emergency physicians who promptly determine the need for ECPR.

A comprehensive discussion on ECPR implementation was provided by a prospective observational study conducted in Taiwan.[7] Experienced surgeons and team members subsequently establish ECMO cannulation at the bedside if indicated. Despite reduced ward staffing during the night, survival rates were not significantly affected. A prior study conducted at a medical center in Taiwan revealed that the time of day had no impact on the survival outcome following an in-hospital cardiac arrest.[13] Our study suggests that an experienced healthcare system with trained crew members operating in an established system can effectively mitigate the increased workload from decreased staffing during off-hours. Further studies are warranted to determine the impact of hospital caseload and experience while focusing on the outcomes of cardiac arrest patients who receive ECPR.

The RESCUE-IHCA study found that surgical cardiac, surgical non-cardiac, and medical-cardiac diseases were predictive factors for survival. However, the results of the current study only observed a relationship between surgical non-cardiac disease and in-hospital mortality, although this association did not reach statistical significance (Table 1). The surgical non-cardiac diseases in our study included aortic dissection, hypovolemia or hemorrhage, and intracranial hemorrhage, which may potentially derive less benefit from ECPR (Supplementary Table 1). The 2010 RESCUE-IHCA study included a higher proportion of surgical patients (610/1,075 [56.7%]), whereas the current study comprised a lower percentage of patients with surgical illnesses (59/324 [18.2%]). The disease category in the original RESCUE-IHCA study was automatically retrieved from Current Procedure Terminology (CPT) and International Classification of Diseases (ICD) codes, whereas in this study we manually reviewed the health charts to assess the ultimate etiology of the cardiac arrest.

Previous studies have identified "cardiac origin" or "presumed reversible cardiogenic etiology" as critical selection criteria for IHCA patients receiving ECPR, without specifying the diagnostic process or disease-categorization method.[7–9,15,16–18] These divergent findings highlight the complexity of the presumed etiology of arrest. Concerns persist regarding the potential misinterpretation of diagnoses, which could result in the inappropriate initiation of ECPR in acute scenarios. Establishing and validating a standardized disease-categorization system for IHCA patients receiving ECPR is a crucial challenge that may significantly improve outcomes in the future.

Renal insufficiency was not identified as a significant predictor for mortality in this study. Our study included fewer patients with pre-existing renal insufficiency in both the mortality and survival groups (non-survivors vs survivors in the study cohort: 50/231 [21.6%] vs 13/93 [14.0%]; RESCUE-IHCA cohort: 193/769 [25.1%] vs 49/306 [16.0%]). Previous studies conducted in an East Asian population exhibited similar proportion of patients with renal insufficiency to our study.[20,21] The proportion of patients with renal disease influences the results; however, renal function still plays a crucial role in prognostication.

Application of the RESCUE-IHCA score in real-world scenarios

The overall survival rate of IHCA patients treated with ECPR was 28.7% in the study, which approximates to real-world conditions according to recent observational studies and systemic reviews wherein reported survival rates ranged from 23.1–40%.[22–25] In conclusion, the performance of the RESCUE-IHCA score was modestly compromised in this single-center cohort. Although a suboptimal validation of RESCUE-IHCA score in this cohort might not indicate its prognostic performance in other populations with different characteristics, suggestions were made for personalized decisions considering the patient's arrest etiology, clinical status, and the institutional capacity and experiences.

LIMITATIONS

There were several limitations to this study. Firstly, missing data is a common issue in retrospectively collected variables, and this study was no exception. Patients with missing outcomes were excluded from the beginning, compromising the size of the cohort. Secondly, the small sample size may have led to higher variability, which might not accurately reflect the real-world situation. Thirdly, neurological outcomes were not assessed due to a considerable amount of missing data. Further large-scale validation studies should be performed to conducted to assess the universal applicability of this score.

CONCLUSION

In the current study cohort, the RESCUE-IHCA score did not predict outcomes better than the originally validated cohort, with low flow duration and initial rhythms persisting as consistent predictive factors. The method of disease categorization in IHCA patients and the differences in hospital experience may have influenced these outcomes.

Although the six-factor score carried some advantages, significant limitations were present. Further research is needed to explore the impact of hospital experience and standardized diagnostic criteria for cardiac origin IHCA on the ECPR outcomes.

Ethics committee approval: This research is approved by the Institutional Review Board (202306052RIND). The requirement for informed consent was waived because of the retrospective nature.

Availability of data and materials: The datasets used or analyzed during the current study are available from the corresponding author on reasonable request.

Acknowledgments: Not applicable.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Teaching the New Ways: Improving Resident Documentation for the New 2023 Coding Requirements

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BACKGROUND

In January 2023, significant changes to the structure of the Current Procedural Terminology CPT(R) evaluation and management (E/M) codes (here forward called the 2023 E/M changes) were implemented for emergency department (ED) encounters. These modifications aim to lessen administrative workload and accurately match coding with contemporary patient care practices.[1] They are anticipated to impact roughly 85% of the relative value units of ED care[2] and, thus, also have significant financial implications for EDs. Residents provide front-line care and documentation for millions of patients seen in United States EDs annually. The Model of Clinical Practice of Emergency Medicine[3] identifies financial principles, such as billing and coding, to be required core content for board certification. Furthermore, the Accreditation Council for Graduate Medical Education (ACGME) includes quality clinical documentation to be one of the milestones that determine advancement in residency training.[4] Interventions that alleviate documentation burden are also associated with improved physician well-being per the existing literature.[5] However, research suggests that most emergency medicine (EM) residents do not receive formal training in billing and coding and have knowledge gaps in this area.[6–8]

Historically, documentation of encounters in the ED focused on the number of elements within history of present illness (HPI), review of systems (ROS), physical exam (PE), and medical decision-making (MDM). These new coding guidelines shift the focus almost entirely to MDM. They emphasize documentation of differential diagnoses; independent interpretation of medical testing; justification of testing not pursued; social determinants of health; chronic diseases; histories; communication with consultants, ancillary staff, and primary care; and review of external records.

OBJECTIVES

We sought to improve resident understanding of and compliance with the 2023 E/M changes. Objectives included identification of the key elements required at each E/M level, charting and receiving feedback of sample encounters, and appreciation for the importance of accurate and high-quality documentation. We secondarily sought to investigate whether our intervention improved resident wellness specifically via benefits in confidence to perform accurate and expeditious documentation and completion of charting in a timely manner.

CURRICULAR DESIGN

Our curriculum was developed using Kern's six-step approach to curriculum design[9] as a part of the educational quality improvement process at a single EM residency program based at a single, large, tertiary-care, urban hospital with an approximate annual ED patient census of 110,000 from October 1, 2022–February 28, 2023. Prior to study initiation a needs assessment was performed. Key stakeholders in departmental billing and coding were identified and interviewed, and relevant literature was reviewed.[1–10] This included the hospital chief medical information officer, ED vice chair, and billing and coding leadership. The interviews revealed a shared opinion that often the documentation to reach the appropriate expected level of service (4 or 5) was lacking to support that level of billing and most of that documentation should be captured in the MDM portion of the note. Thus, the MDM portion of the note was targeted for the intervention.

Our educational methods primarily used in-person, flipped-classroom sessions. We decided to use a flipped-classroom approach for several reasons: 1) to allow residents to gain exposure to the new billing criteria prior to the in-person sessions; 2) as a mechanism to assess resident understanding and skills, both individually with homework responses as well as in a group setting; and 3) to use faculty's in-person time for oversight and feedback.[11] We also applied a spaced learning approach to maximize knowledge acquisition and retention.[12] The sessions were held on December 14, 21, and 28, 2022.

For pre-session homework each week, all residents were provided a sample patient HPI, ROS, and PE components. All learners were provided the same case, and cases were changed each week. Cases were formulated to include elements that could be expanded upon in the MDM, Residents were also provided with the "CPT Evaluation and Management (E/M) Code and Guideline Changes" document.[10] They were then asked to create an MDM section in accordance with the above document. Homework responses were reviewed by faculty, and feedback was given individually via email. Written feedback for residents was generated using a template based largely on the 2023 E/M guidelines changes.[10] An ideally documented sample MDM section was also supplied for reference (Supplement 1).[13]

During each 30-minute session, residents were divided into small groups of four and provided an example patient case, which included only the HPI, ROS, and PE components. Residents then collaboratively wrote an MDM section for the case. All groups were provided the same case, and cases were changed each week to focus on different aspects of the MDM section. Each small group of residents shared their response with the larger group and were provided peer feedback under the guidance of a faculty facilitator selected for their advanced knowledge in either education or operations. Facilitators were provided in advance with an example of an ideally documented MDM section, which residents were also provided with at the conclusion of the exercise.

IMPACT/EFFECTIVENESS

We employed a pre-post interventional study design using a convenience sample of residents, in which group assignment was based on the number of trainings each resident could attend due to scheduling factors outside the scope of this study. This study was determined to be exempt by the institutional review board of Maimonides Medical Center. Participation was voluntary and anonymous. We evaluated the impact of our brief educational intervention on subjective measures of EM resident knowledge, skills, and attitudes via survey and on objective measures of skills and behaviors by assessing aggregate chart data.

Surveys were developed through a group iterative process that included one author (ASC) with expertise in survey design methodology. RedCap,[14,15] hosted at [Maimonides Medical Center] was used to anonymously distribute both pre- and post-intervention surveys. Both surveys consisted of six Likert-scale questions, three regarding their reported use of documentation shortcuts, and three assessing attitudes about their own understanding of and predicted skill with the new E/M coding changes. Six additional multiple-choice questions assessed knowledge about documentation rules. A final question was for feedback and requested ideas for other E/M billing and coding education. The pre-intervention survey, distributed November 30, 2022, differed from the post-intervention survey of December 28, 2022, only in asking the self-reported number of sessions attended. (Supplement 2).

Resident skills were assessed using actual clinical documentation. Resident aggregate E/M levels were assessed across three months pre-intervention (October 1–December 31, 2022) and two months post-intervention (January 1–February 28, 2023). Due to variation in resident clinical schedules, we chose the above time periods to capture the greatest proportion of the ED encounters documented by residents. We used the Kirkpatrick model to evaluate our intervention's impact.[16] Surveys were used to assess resident subjective reactions, and objective knowledge by identification of billable elements in a provided sample MDM. We used actual clinical documentation to assess changes in behavior. Specifically, we assessed whether trainees had a statistically significant increase ($P < 0.05$) in the proportion of E/M level 5 charts (99285) and likewise a significant decrease in level 1, 2, 3, and 4 charts (99281, 99282, 99283, 99284).

We used descriptive statistics and comparison of means with the Mann-Whitney U test stratified by number of educational sessions attended to analyze significant differences in knowledge and attitudes before and after the intervention. For knowledge, these calculations were summarized with median and interquartile range (IQR) and compared across time periods using an exact Wilcoxon signed-rank test. A Bonferroni correction for the significance of the intervention changes the alpha to 0.01667. For each chart level (99281–99285), we created logistic regression models using generalized estimating equations for individual repeated measures to account for personal variability. The number of attended flipped-classroom sessions was treated as the independent variable. Zero trainings were considered to be the pre-period for analysis. All analyses considered alpha ≤ 0.05 to be statistically significant and were conducted using SPSS v 28.0[15] (SPSS Statistics, IBM Corp, Armonk, NY).

Forty-six of the 54 EM residents (85%) eligible for the study completed both pre- and post-intervention surveys. All 54 residents participated in at least one survey. Due to clinical schedules, some residents were not present at one or more of the three offered sessions. The first live session was attended

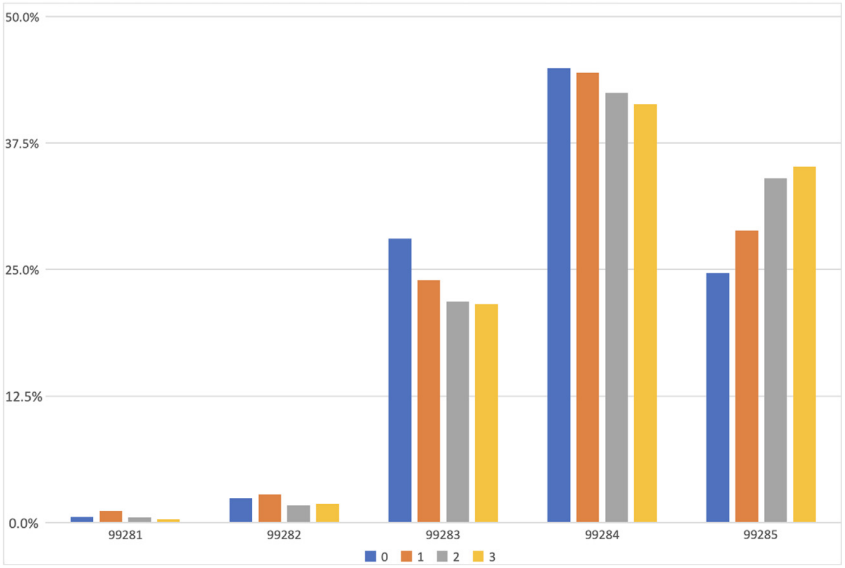

Figure. Proportion of each Current Procedural Terminology evaluation and management level by number of educational sessions attended.

by 33 (61%) residents, the second by 38 (70%), and the third by 40 (74%). Six (11%) residents attended one session, 15 (28%) attended two sessions, and 25 (46%) attended three sessions. Eight (15%) did not attend any sessions.

Residents demonstrated a significant improvement in knowledge regarding which elements are the key to the MDM within the 2023 E/M changes [6 (5–6.5) to 8 (7.5–8) $P < 0.001$], and by correctly identifying the number and complexity of problems, complexity of data, risk level, and the overall complexity of a sample encounter. There was no statistically significant improvement in identification of the important coding elements (4 [3–5] to 5 [3.5–5], $P = 0.38$). Residents also endorsed greater confidence in their ability to describe (2 [1–3] to 4 [3–4], $P < 0.005$), accurately document (3 [2–3] to 4 [3–4], $P < 0.005$), and bill (2 [2–3] to 3 [2–3] $P < 0.005$). There were no significant changes in their opinion of their ability to complete their charts in a timely manner ($P < 0.19$, CI 0.165–0.215) in the decision to use dictation software ($P = 1$), shortcuts ($P = 1$), or custom prepared text phrases ($P = 1$) following the intervention. Residents participating in any number of flipped-classroom sessions showed significant changes in their skills, including an increase in E/M Level 5 coded charts, and a significant decrease in Level 1, 2, and 3 coded charts ($P < 0.005$). The increase in Level 5 charts and decrease in Level 3 charts were significant after just one session (Figure). No significant change was observed in Level 4 charts.

To the best of our knowledge, this is the first study to date to describe the impact of an educational intervention on EM resident documentation knowledge, skills, and attitudes within the framework of the 2023 E/M changes. Naturally, our experience and results at our single EM residency program based at a large, urban, tertiary-care hospital may not be generalizable. This intervention data is single center and preliminary, and the intervention should undergo repetition and comparison before firm conclusions can be drawn.

We chose to collect data during a time range tied to the same illness season to keep the case acuity mix and attending/resident staffing comparable. We otherwise could have compared to the same months of the previous year for pre-intervention data, to best match the illness season, or alternatively, post-intervention data could have been drawn instead from the following year (2024) to help mitigate recency bias in the intervention group. That being said, the major differences in resident and attending staffing between times a year apart could also have confounded results.

We considered faculty supplemental documentation and its effect on documentation outcomes during our study design and took a pragmatic approach. For the duration of this study the attending population was stable, no significant changes to attending education were performed during this period, and attending staffing remained at baseline with no changes to ratios, shift durations, or standard distributions of encounters throughout the ED care areas. To further address this concern we attempted analysis of the attending distribution between these various groups. No attending had a greater than 1.4% change in their billing from pre- to post-intervention, and their small contributions to the overall billing for each intervention group was, therefore, unlikely to have biased the large differences seen between groups. However, the differences in distribution of attending shifts between the groups varied statistically significantly, and bias

cannot be assessed without patient-level billing records. This could be considered in future studies.

Our program may have implications regarding wellness as well. Residency training must prepare emergency physicians for all aspects of their eventual professional expectations. Residents receiving education expressed greater confidence in their ability to describe, accurately document, and bill for care provided. Business literature frequently notes how a lack of clear expectations increases work stress and harms employee wellness and productivity.[18] However, whether this association applies to emergency physicians deserves further study.

CONCLUSION

Overall, we observed significant improvements in resident knowledge, attitudes, skills, and behaviors regarding clinical documentation. We hope to apply these successes and lessons learned to the formation of enduring education materials at our own institution for documentation improvement for both residents and attendings.

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Telesimulation Use in Emergency Medicine Residency Programs: National Survey of Residency Simulation Leaders

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Introduction: Coronavirus 2019 (COVID-19) accelerated the need for virtual learning including telesimulation. Many emergency medicine (EM) programs halted in-person simulation and trialed telesimulation, but specifics on its utilization and plans for future use are unknown. Telesimulation has been defined as "a process by which telecommunication and simulation resources are utilized to provide education, training, and/or assessment to learners at an off-site location." Our objective in this study was to describe the patterns of telesimulation usage in EM residency programs during COVID-19-induced learning restrictions as well as its anticipated future utility.

Methods: We identified EM simulation leaders via the EMRA Match website, institutional websites, or personal contact with residency coordinators and directors, and invited them to participate by email. Participants completed a confidential, web-based survey consisting of multiple-choice items and one free-response question, developed by our study team with consideration of survey research best practices and Messick's validity framework. We collected data between January–February 2022. We calculated descriptive statistics for multiple-choice items and examined the free-response answers for common themes.

Results: We obtained contact information for simulation leaders at 139 EM residency programs. Survey response rate was 65% (91/139). During in-person restrictions, 62% (56/91) of programs used telesimulation. Assuming all restrictions lifted, 38% (34/90) of respondents planned to continue to use telesimulation, compared to 9% (8/91) using telesimulation before COVID-19. Most respondents planned to use telesimulation for medical knowledge (26/34, 76%) and communication/teamwork-focused cases (23/34, 68%). In response to the free-response question regarding experience with and plans for use, we identified three major themes: 1) telesimulation is a valuable alternative to in-person learning; 2) telesimulation is an option for learners unable to participate in person; and 3) telesimulation is challenging for procedural education.

Conclusion: Despite the relatively limited use of telesimulation in EM residencies prior to COVID-19, an increased number of programs have plans to continue incorporating telesimulation into their curricula. This plan for continued use opens opportunities for further innovation and scholarship within simulation education. [West J Emerg Med. 2024;25(6)907–912.]

INTRODUCTION

Restrictions imposed on in-person education during the coronavirus 2019 (COVID-19) pandemic accelerated the need for virtual learning, including telesimulation.[1,2] Telesimulation has been defined as "a process by which telecommunication and simulation resources are utilized to provide education, training, and/or assessment to learners at an off-site location."[3] Initial applications were in lower resource settings such as developing countries where learners did not have access to simulation centers or instructors.[4,5] Within telesimulation, different modalities have been described that vary in fidelity as well as location of the learners and instructors relative to each other and the simulation center.[6–8]

Several published articles since early 2020 have described different institutions' approaches to telesimulation since the pandemic.[1–2,9–13] Common themes include the need to modify learning objectives to virtual environments and to select the appropriate modality of telesimulation based on institutional needs and resources.[9–12] Different modalities of telesimulation have been described, including the following: 1) learners virtually observing and debriefing a live simulation[7]; 2) learners present with a manikin while instructors facilitate from a separate location[6]; 3) instructors present with a manikin while learners remotely participate[7]; and 4) completely remote option where learners and instructors both participate remotely from separate locations.[10,11]

Limited data comparing telesimulation vs traditional simulation suggests that learner satisfaction with telesimulation or hybrid virtual and in-person simulation is similar, although this was not found in all studies.[7,13,14] A scoping review from 2021 highlighted the mixed data on student perception of telesimulation, with some of the included studies indicating remote facilitation of simulation being perceived as equally or more effective than live facilitation, while others found remote facilitation to be inferior.[14] Facilitator perception of telesimulation has not been well studied. Limited learning outcome data has suggested similar improvements between in-person simulation and telesimulation.[8,14]

Our objective in this study was to describe the patterns of telesimulation usage in emergency medicine (EM) residency programs during COVID-19-induced, in-person learning restrictions as well as its anticipated utility moving forward. This information is crucial to understanding the value of telesimulation and its utility in medical education.

Population Health Research Capsule

What do we already know about this issue?
COVID-19 accelerated the need for virtual learning including telesimulation.

What was the research question?
To what extend was telesimulation used by EM residencies during COVID-19, and what is its anticipated utility moving forward?

What was the major finding of the study?
Only 9% (8/91) of programs used telesimulation before COVID-19. During COVID restrictions, 62% (56/91) of programs used it, while after limitations were lifted, 38% (34/90) planned to continue telesimulation.

How does this improve population health?
As an adjunct to traditional in-person simulation curriculum, telesimulation is a viable option to improve medical knowledge and communication-based competencies.

METHODS

Study Design, Setting, and Population

We conducted a cross-sectional survey study of faculty in charge of simulation for EM residency programs in the United States. We collected data from January–February 2022. After identifying EM residency programs and their websites from the EMRA Match database,[15] we searched each website for contact information for the director of simulation education. If there was no director designated, we emailed each residency's program coordinator and/or director asking for contact information for the faculty in charge of residency simulation. Each program was allowed only one designated participant. This study was given exempt status by the University of California, Los Angeles Institutional Review Board (IRB#21-001336) and the Johns Hopkins University Homewood IRB (HIRB00013694).

Survey Development and Dissemination

Given the lack of any previously created survey applicable to this construct, the primary author (MB) developed a web-based survey tool with consideration of survey research best practices and Messick's validity framework.[16–19] For content validity evidence, we first performed a literature review, and the author group of expert simulation educators and medical education researchers reviewed the survey for clarity and relevance to the construct. We defined telesimulation as including any simulation activity where "telecommunication and simulation resources are utilized to provide education, training, and/or assessment to learners at an off-site location."[3] We piloted the survey with a group of simulation educators who were not included in the target sample to gather response process validity evidence. After piloting, we revised the survey for clarity. The final survey included multiple-choice items and one free-text response item (Appendix 1).

We invited participants by email and sent two targeted, follow-up invitations to non-responders at bi-weekly intervals. We administered the survey via Qualtrics (Qualtrics, LLC, Provo, UT). No individual identifying information was collected. To maximize response rate and minimize guessing, we did not require participants to complete all survey items. Participants were not compensated for participating in the study.

Data Analysis

We calculated and reported descriptive statistics for items with discrete answers. We conducted calculations using Qualtrics and Microsoft Excel for Mac (Microsoft Corp, Redmond, WA). We examined the answers to the free-text responses to identify common themes that would broaden the reader's understanding of the data. Successive wave analysis was performed to assess the extent of possible nonresponse bias.[20] We examined whether use of telesimulation during the pandemic, planned future use of telesimulation after in-person restrictions, and respondent program format (postgraduate years [PGY] 1–3 vs 1–4) differed by wave. Bivariate chi-square tests for each variable of interest by wave were performed using Microsoft Excel for Mac, and *P*-values less than 0.05 were considered statistically significant. We used the consensus-based checklist for reporting of survey studies (CROSS) as reporting guidelines (Appendix 2).[23]

RESULTS

Of 139 simulation leaders we identified, 91 (65%) completed the survey with 87 (63%) completing all items. We report demographic data for survey respondents in Table 1, while respondents' experience and perceptions of telesimulation are shown in Table 2. Prior to the COVID-19 pandemic, 9% (8/91) of survey respondents were using telesimulation in their curricula. There was a wide variety of prior experiences with telesimulation, with the most common being that they had heard of telesimulation but never been involved (44%). Ninety-two percent (84/91) of respondents reported that their institution prohibited in-person learning activities at some point during the COVID-19 pandemic. During in-person learning restrictions, 62% (56/91) used telesimulation in some form.

When survey respondents were asked about what format(s) of telesimulation were used, 11% (10/90) stated that they only used a completely virtual oral-boards style format, while the rest of those who used telesimulation reported using a hybrid or virtual format involving a patient monitor and/or manikin. The largest percentage of survey respondents felt that medical knowledge and communication/teamwork-focused cases were best suited for telesimulation (72% and 47% respectively), while most felt that procedure training was not well suited for telesimulation (62%). Thirty-eight percent (34/90) of respondents stated they planned to use telesimulation in some form in their curriculum moving forward, mostly for medical knowledge and communication/teamwork-focused cases (76% and 68%, respectively).

Table 1. Survey respondent demographics.

	n (%)
Format of respondent's current residency program	
PGY 1–3	62/89 (70%)
PGY 1–4	27/89 (30%)
Size of respondent's current residency program (total number of residents in all years)	
≤20 residents	11/90 (12%)
21–40 residents	38/90 (43%)
41–60 residents	31/90 (34%)
≥60 residents	10/90 (11%)
Respondent's current residency program primary institution setting	
University-based	58/90 (64%)
Community-based	28/90 (31%)
County-based	13/90 (14%)
Prior simulation training of survey respondent	
Fellowship training in simulation	31/90 (34%)
Non-fellowship training in simulation	48/90 (53%)
No formal training in simulation	17/90 (19%)
Respondent years since residency graduation	
≤5	22/90 (24%)
6–10	33/90 (37%)
11–15	16/90 (18%)
16–20	8/90 (9%)
≥21	11/90 (12%)

PGY, postgraduate year.

We received 14 free-text responses, and identified three major themes, described below with exemplar quotes.

1. Telesimulation is a valuable alternative to in-person learning:
   "It has been the 'better than nothing' option but accepted by learners when other options are not feasible."
   "It has exceeded expectations in how helpful it has been."
2. Telesimulation is an option for learners unable to participate in person:
   "We found that it's a great option for residents with families or who have other extenuating circum-stances why they can't participate in person, ie, breastfeeding moms, new parents, elder care, etc. Many of our residents who are between nights or between mid-shifts will log on and participate."
3. Telesimulation is challenging for procedural education:
   "Difficult to learn muscle memory for high acuity, low occurrence skills."

Table 2. Key survey results.

	n (%)
EM residency program use of telesimulation	
Prior to COVID-19 pandemic	8/91 (9%)
During in-person learning restrictions	56/91 (62%)
Planned use after in-person restrictions lifted	34/90 (38%)
During any point in the COVID-19 pandemic, did your institution prohibit in-person learning activities?	
Yes	84/91 (92%)
No	7/91 (8%)
Experience with telesimulation prior to COVID-19	
Had never heard of telesimulation	17/91 (19%)
Heard of telesimulation but never involved	40/91 (44%)
Attended a presentation	20/91 (22%)
Participated as an instructor	19/91 (21%)
Participated as a learner	6/91 (7%)
Conducted a research project	5/91 (5%)
Read a paper about telesimulation	16/91 (18%)
Formats of telesimulation used during COVID-19 restrictions	
Completely virtual; utilizing real-time patient monitor and/or manikin	21/90 (23%)
Completely virtual; oral boards style cases	31/90 (35%)
Hybrid; instructor, learners and/or sim tech in sim center while others remote	31/90 (35%)
What simulation activities were best suited for telesimulation?	
Medical knowledge focused cases	65/90 (72%)
Communication/teamwork focused cases	42/90 (47%)
Procedure focused cases	5/90 (6%)
Dedicated procedure training	2/90 (2%)
Procedure training on homemade models	10/90 (11%)
What simulation activities were not well suited for telesimulation?	
Medical knowledge focused cases	0/87 (0%)
Communication/teamwork focused cases	18/87 (21%)
Procedure focused cases	52/87 (60%)
Dedicated procedure training	54/87 (62%)
Procedure training on homemade models	23/87 (26%)
Percent of future simulation curriculum involving telesimulation	
0% of the curriculum	56/90 (62%)
1–25% of the curriculum	30/90 (33%)
26–50% of the curriculum	3/90 (3%)
51–75% of the curriculum	1/90 (1%)
76–100% of the curriculum	0/90 (0%)
Types of future simulation activities for those who plan to continue using telesimulation	
Medical knowledge-focused cases	26/34 (76%)
Communication/teamwork-focused cases	23/34 (68%)
Procedure focused cases	7/34 (21%)
Dedicated procedural training	5/34 (15%)
Procedure training on homemade models	5/34 (15%)

EM, emergency medicine.

> "Procedural training was the most difficult to simulate via telesim."

For the wave analysis, the study included 91 respondents, including 42 in wave 1 (46%), 21 in wave 2 (23%), and 28 in wave 3 (31%). Results of the examined survey questions did not statistically differ by wave with all P-values > 0.05. (See Supplemental Table.)

DISCUSSION

Despite relatively low use of telesimulation within EM programs prior to the COVID-19 pandemic, we found that many EM residency programs (62%) quickly adapted to in-person learning restrictions by using telesimulation. While not all programs that trialed telesimulation plan to continue its use, 38% of respondent programs do plan to continue to use telesimulation, compared to 9% of programs using telesimulation prior to COVID-19. This represents a large increase in the overall usage of telesimulation within EM residencies. Our study also sheds light on how telesimulation can benefit EM programs. Being able to increase learner participation to include residents with family obligations or between night shifts could allow for increased return on investment for simulation resources and faculty time. Most respondents who plan to continue to use telesimulation reported that they will use it as a small percentage of their overall simulation curriculum, which highlights that telesimulation is not replacing in-person simulation but augmenting the traditional curriculum. This could be in a hybrid format that allows for increased participation, or as part of separate telesimulation days that could reduce the travel burdens on learners and instructors.

There was large variation in how programs conducted telesimulation during in-person restrictions. This is in line with prior literature and likely reflects individual program needs, preferences, and available resources.[1,2,8–11,13,22] Most described telesimulation as best suited for medical knowledge and communication/teamwork-focused cases, rather than for procedure teaching. This is interesting given that early descriptions of telesimulation in the literature mostly

involved procedural teaching.[5,6] One possible explanation for this discrepancy is that those early studies involved duplicate simulators at remote locations, an expense that is likely not practical, or necessary, for a residency program given the ability to host procedure training as part of the in-person curriculum. While it is apparent that there are increased plans for the use of telesimulation compared to the pre-pandemic era, not all residency programs who used telesimulation during times of in-person restrictions are planning to continue to do so. The reasons for this are unknown but may relate to telesimulation resource availability or limited outcome data on its utility.

Based on our results, we believe that telesimulation can continue to be a valuable addition to the traditional in-person simulation curriculum, particularly in allowing for increased participation of learners and instructors, reducing resource costs such as simulation center and staff time, and allowing for a viable option to practice medical knowledge and communication-based competencies. Now that telesimulation has been established as an instructional strategy that will continue to be part of many EM residency curricula, it opens opportunities for future innovation and scholarship within simulation-based medical education. Additional investigation could compare different modalities of telesimulation on objective learning outcomes.[23] It would also be interesting to explore the role of virtual and augmented reality within telesimulation.[24,25]

LIMITATIONS

Despite multiple attempts, we were not able to obtain contact information for a simulation leader from all EM programs. However, the breakdown of PGY 1–3 vs PGY 1–4 programs of survey respondents (70% PGY 1–3 vs 30% PGY 1–4), approximating the actual distribution of the EM residency programs (81% PGY 1–3 vs 19% PGY1–4), suggests that the sample closely resembles that of the population.[8] Given our response rate of 65%, it is possible non-response bias affected our results, with participants with less interest or familiarity with telesimulation being less likely to respond. However, the results of our successive wave analysis failed to detect non-response bias for the selected survey questions.

There may be other influences affecting a program's use of telesimulation that we were not able to capture, and in this survey study we examined only the opinions of faculty and not those of resident learners. Additionally, the literature-based definition of telesimulation we used may be overly broad and encompass more than what typical educators might consider telesimulation. Finally, we acknowledge that the survey was administered in 2022 with in-person learning restrictions just starting to be lifted, and how people are using telesimulation now may be changing. Future work could examine this evolving use of telesimulation within EM residency programs.

CONCLUSION

This study describes past and planned future use of telesimulation within EM residency programs. A large proportion of EM residencies trialed telesimulation during COVID-19-induced restrictions. Despite relatively low use of telesimulation prior to the pandemic, more EM programs plan to incorporate telesimulation moving forward as a limited portion of their overall simulation curriculum. Opportunities for further innovation and scholarship within this area of simulation education will be possible given this planned continued use.

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Palliative Care Boot Camp Offers Skill Building for Emergency Medicine Residents

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BACKGROUND

Emergency medicine (EM) residents routinely care for critically ill patients in both the emergency department (ED) and intensive care units.[1] Proficiency in primary palliative care skills is essential for all emergency clinicians.[2,3] However, a significant number of residents lack exposure to formal education and training in palliative care.[4,5] Moreover, education and training in palliative care encompasses several Accreditation Council for Graduate Medical Education (ACGME) competencies including system navigation for patient-centered care, understanding the physician's role in the healthcare system, patient- and family-centered communication, and interprofessional and team communication.[6]

Current curricula addressing primary palliative care skills in EM are notably limited.[7–12] Historically, our residency experienced inconsistencies in the teaching of primary palliative care skills. They were sporadically covered during regular conferences or left to develop organically over time. Furthermore, postgraduate year-2 (PGY-2) residents, who primarily manage seriously ill patients, found themselves engaging in challenging serious-illness conversations with patients and families with little to no training. Recognizing the imperative for more comprehensive education, we introduced a four-week, intensive primary palliative care curriculum specifically tailored for EM PGY-2 residents that was entitled "Palliative Care Bootcamp."

OBJECTIVES

The overall objective of the bootcamp was to introduce and strengthen primary palliative care skills among PGY-2 residents at an independent academic medical center. At the end of the curriculum, residents would be able to 1) define the scope of hospice and palliative medicine; 2) understand what primary palliative care skills are for non-specialty trained physicians; 3) recognize ED patients with palliative care needs; 4) implement a hospice evaluation; 5) understand how interdisciplinary teams are involved in the care of seriously ill patients; and 6) build communication skills for discussing goals of care (GOC).

CURRICULAR DESIGN

The curriculum and assessment were exempt from the institutional review board. Using Kern's six-step approach to curriculum development, we created an introductory primary palliative care curriculum. An EM faculty member with an interest in palliative care and residency leadership collaborated to develop the curriculum. The residency program endorsed the curriculum as it aligned with a curriculum redesign to include more PGY-specific education.

The curriculum was initially developed in 2017. The interdisciplinary palliative care team at the study institution served as content experts. The team performed a broad review of the residency curriculum and prioritized high-yield topics tailored to the local context. Sessions were scheduled during weekly conference and spanned four consecutive weeks. This schedule allowed for an intensive experience and allowed for rapid skill development. The curriculum is strategically delivered early in the PGY-2 year to leverage residents' existing experience in caring for seriously ill patients and facilitate meaningful reflection and inquiry.

The curriculum is structured in two phases (Table 1). The first phase spans three weeks and consists of three two-hour sessions. These sessions are dedicated to primary palliative care fundamentals such as an introduction to palliative care, prognosis and trajectory, and non-pain symptom management. Session facilitators included the EM faculty content expert as well as members of the institutional palliative care team, the director of chaplaincy who specialized in family support, the director of palliative care, and the palliative care fellow. Each session encompassed a didactic segment, interactive case-based discussions using scenarios prepared by facilitators or contributed by residents, and opportunities for resident questions.

In the final week, residents engaged in a four-hour session in the simulation center. This session was led by the EM content expert who is a trained facilitator with Vital Talk, a national non-profit that promotes evidence-based education in serious-illness communication.[13] This session involves using a standardized patient. Residents are assigned to a

Table 1. The breakdown of palliative care bootcamp sessions by hour detailing the topic, learning objectives, mapping to ACGME* competencies, and the format of the session.

Hour	Topic	Objectives	ACGME competencies	Format/facilitator
1	Intro to primary palliative care in emergency medicine	Define primary palliative care and identify common ED presentations of patients with unmet palliative care needs. Define advance care planning, goals of care, code status and treatment limitations and describe how these are codified in legal and medical documents Interpret a POLST (Physician Orders for Life Sustaining Treatment) form and describe its use in acute care settings	*System navigation for patient centered care* *Physician role in healthcare systems*	Lecture – EM faculty content expert
2	Prognosis and trajectory	Describe four common trajectories of life-limiting illness Define prognosis and describe 3 strategies to assess prognosis in ED patients with serious illness	*Diagnosis, treatment, and clinical reasoning*	Case-based learning – EM content expert
3	Chaplain chat	Describe the role of the chaplain in the interdisciplinary care of seriously ill patients in the ED	*System navigation for patient-centered care* *Interprofessional and team communication*	Case-based learning – chaplain
4	Non-pain symptom management	Choose appropriate first- and second-line treatment for seriously ill patients experiencing nausea and vomiting in the ED Choose appropriate first- and second-line treatment for seriously ill patients experiencing dyspnea in the ED Choose appropriate first- and second-line treatment for seriously ill patients experiencing constipation in the ED	*Pharmacotherapy* *Diagnosis, treatment, and clinical reasoning*	Case-based learning – hospital palliative care specialist
5	Ask a consultant	Describe the role of the HPM clinician in the care of seriously ill patients in the hospital Understand the role of HPM consultation in the emergency department	*Interprofessional and team communication*	Case-based learning – hospital palliative care specialist
6	Intro to hospice	Describe the scope of hospice services and the settings where it can take place Identify patients who may qualify for hospice and how to get them evaluated Provide goal concordant care to patients enrolled in hospice who present to the ED	*System navigation for patient-centered care* *Physician role in healthcare systems*	Lecture – community hospice medical director
7–10	Serious illness communication workshop (VitalTalk)	Practice skills associated with goals of care conversations with a simulated patient.	*Patient- and family-centered communication*	Simulation and standardized patient skills-based practice – EM content expert

**ACGME*, Accreditation Council for Graduate Medical Education; *ED*, emergency department; *EM*, emergency medicine; *HPM*, hospice and palliative medicine.

small group and they role-play delivering serious news with EM-based scenarios. This session builds skills around delivering serious news.

The curriculum underwent iterative adjustments informed by informal feedback from both facilitators and residents. Modifications were made based on facilitator availability and interest, resulting in the inclusion or modification of topics, while certain subjects, such as opioid pain management, were removed due to redundancy in other educational settings.

SURVEY DEVELOPMENT

Before implementing the curriculum, we created a brief, pre-bootcamp survey to assess residents' prior exposure and familiarity with palliative care. Subsequently, two post-surveys were used to gauge residents' perceptions regarding the achievement of session-specific goals. We developed the first survey to evaluate the first three weeks of the bootcamp. The initial development collected all potential survey items that were refined through expert consultation. The survey used a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The survey items had been pilot tested and refined in preceding years to ensure question clarity (Appendix 1).

A second survey, which was used for the simulation-based session, prompted residents to rate their self-assessed confidence surrounding the specific skills on conducting GOC conversations covered in the session (Appendix 2). The survey uses a five-point Likert scale ranging from 1 (not very confident) to 5 (very confident).

IMPACT/EFFECTIVENESS

The curriculum evaluation took place during the 2022 bootcamp. Each session had an average of 8–10 PGY-2 residents, of a total 17 potential participants. Attendance varied from week to week due to excused absences. Participation in both pre- and post-surveys was voluntary. Of the eligible residents, nine (52%) completed the pre-survey, revealing that all but one resident had prior exposure to a palliative care rotation during medical school, and 7 of 9 respondents (77%) reported previous communication skills training during their PGY-1 year.

Post-intervention surveys were collected after each session, with completion rates ranging from 25% (2/8 participants) to 70% (7/10 participants) per session. Notably, all respondents indicated agreement or strong agreement with the achievement of each session's objectives. For the simulation-based communication session, 88% (8/9) reported increased confidence overall, 88% (8/9) of residents reported increased confidence in responding to strong emotions, and 100% (9/9) reported enhanced confidence in eliciting patient goals and values.

TIPS FOR SUCCESS/CHALLENGES/LESSONS LEARNED

Several key themes emerged regarding the implementation of a bootcamp curriculum in primary palliative care for EM residents. One notable advantage of this curriculum is its longitudinal format, spanning four consecutive weeks with short intervals between sessions. This structure affords residents the opportunity to practice newly acquired skills while actively working in clinical settings, fostering continuous reflection and refinement of their abilities. Additionally, the curriculum is adaptable and enables its implementation in programs lacking EM palliative care-trained faculty. Programs can use local resources such as institutional palliative specialists, interdisciplinary palliative teams, or several publicly available online resources.[9,10,14]

However, despite its strengths, our curriculum faces several challenges. Notably, residents unable to attend sessions risk missing valuable educational opportunities, as the curriculum is not repeated during the academic year. Moreover, limited opportunities for ongoing skill acquisition and feedback outside scheduled sessions may hinder residents' ability to fully integrate palliative care principles into their practice. Furthermore, individual programs may be unwilling to invest 10 hours of curriculum to this specific topic and skillset. Lastly, while there was no cost for the simulation time and standardized patients at the study institution, there may be cost associated with this in other programs and this must be considered.

Furthermore, while participants expressed satisfaction with the curriculum, the outcomes data lack the rigor necessary to definitively establish its success. The impact of this curriculum on long-term knowledge or clinical behavior within the ED remains uncertain. It will be important to conduct more formal assessments of the curriculum objectives and to evaluate its application in the clinical setting.

CONCLUSION

As the role of primary palliative care in emergency medicine continues to evolve, there is a growing need to integrate these essential skills and concepts into all EM residencies. The bootcamp format has proven to be a valuable educational tool in our program, and its effectiveness warrants further exploration and dissemination within the broader EM community.

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Improving Patient Understanding of Emergency Department Discharge Instructions

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Introduction: Previous studies have shown that patients in the emergency department (ED) are frequently given incomplete discharge instructions that are written at least four grade levels above the recommended sixth-grade reading level, leading to poor understanding. Our aims in this study were to implement standardized discharge instructions containing six key components written at a more appropriate reading level for common emergency department (ED) diagnoses to improve patient understanding.

Methods: We conducted this study in a 20-bed ED at an urban Veteran's Administration hospital. Data was collected via in-person patient and clinician interviews. Patient interviews were conducted after patients received their discharge instructions. We compared patient responses to clinician responses and marked them as incorrect, partially correct, or correct with a score of 0, 0.5, or 1, respectively. The maximum possible score for each interview was six. Six key components of discharge instructions were asked about: diagnosis; new medications; at-home care; duration of illness; reasons to return; and follow-up. There were 25 patients in the pre-intervention group and 20 in the intervention group with the standardized set of instructions. We performed a Mann-Whitney U test on the total interview scores in the control and intervention groups and conducted a sub-analysis on the individual scores for each of the six key components.

Results: The patients in the intervention demonstrated a statistically significant increase in patient-clinician correlation when compared to the patients in the pre-intervention group overall ($P < 0.05$), and two of the six key components of the discharge instructions individually showed statistically significant increase in patient-clinician correlation when standardized discharge instructions were used.

Conclusion: Patients who received the standardized discharge instructions had improved understanding of their discharge instructions. Future opportunities extending off this pilot study include expanding the number of diagnoses for which standardized instructions are used and investigating patient-centered outcomes related to these instructions. [West J Emerg Med. 2024;25(6)917–920.]

INTRODUCTION

Several studies have analyzed the effectiveness of discharge instructions given to emergency department (ED) patients at the time of discharge and have identified areas for improvement.[1] These studies recommend that key components of discharge instructions include diagnosis, expected duration of illness, at-home care, return precautions, and follow-up plan. Nonetheless, many ED patients do not receive discharge instructions that include all these components.[2,3] In addition to being incomplete, discharge instructions are often difficult to read.[4,5] In fact, discharge information given to trauma patients at one institution was written at least four grade levels higher on average than the National Institutes of Health-recommended

sixth grade reading level. They noted that after improving readability by breaking up complex sentences, using simple words, and using bullet points and subheadings, there was a significant decrease in post-discharge return phone calls and readmissions.[5] Additionally, having a good understanding of one's discharge instructions can help promote optimal health and recovery following an ED visit. Patients may also have fewer unnecessary return visits to the ED if they better understand their discharge instructions.[6]

Currently, discharge instructions at this urban Veteran's Administration (VA) hospital include a section at the beginning of the instructions where clinicians can free text any specific instructions they have for the patient. This section may also be kept blank. There is also standardized information about the discharge diagnosis, which is included in all instructions. In this pilot study we aimed to determine whether implementing discharge instructions that are standardized at an appropriate reading level and include key components would improve patient understanding of discharge instructions (measured by patient-clinician correlation).

Population Health Research Capsule

What do we already know about this issue?
Patient understanding of ED discharge instructions is important for patient care, outcomes, and experience.

What was the research question?
Does implementing standardized discharge instruction templates improve patient understanding at time of discharge?

What was the major finding of the study?
The intervention group demonstrated a statistically significant increase in understanding of their instructions ($P < 0.05$).

How does this improve population health?
Good understanding of ED discharge instructions is vital to patient health and empowers patients by allowing them to better understand their disease and its course.

METHODS

We conducted this pilot study at a 20-bed ED urban VA hospital. This study did not collect any personal patient data and thus was deemed by the VA internal review board office to be institutional review board- exempt. Study participants were approached by nursing staff, clinicians, or study staff and asked whether they would be willing to participate in a short interview to help a quality improvement project focused on discharge instructions. If the patient agreed, they were interviewed by study staff regarding the key components of discharge instructions. They were asked to state their diagnosis, what (if any) new medications were prescribed, what they needed to do at home to take care of their illness, expected duration of illness, reasons to return to the ED, and who to follow up with. Study staff recorded their answers. Patients were permitted to look at their discharge instructions at any time during the interview to help answer the questions and were reminded of this at the start of the interview. Study staff then asked the clinician (physician or advanced practice practioner [APP]) the same questions.

For the initial control group, clinicians were free to include whatever they wanted in the free-text portion of the discharge instructions. This group of 25 patients had the following discharge diagnoses: edema; motor vehicle collision; concussion; strain; acute psychosis; constipation; fracture; shingles; hyperglycemia; cystic acne; cervical radiculopathy; oral mucosal lesions; conjunctivitis; sinusitis; pneumonia; ear infection; cellulitis; fatigue; diarrhea; chest pain; back pain; balanoposthitis; chronic obstructive pulmonary disease (COPD); and dehydration. The clinicians treating this group included 10 physicians and two APPs. Data was again collected by study staff (Russell) in the form of in-person interviews and addressed the six key components.

A set of standardized discharge instructions were developed for 12 common ED diagnoses and edited to contain six key components. These templates were created with subheadings and bullet points to make the instructions easier to follow and understand (Appendix A). The discharge diagnoses addressed in this group included many of the most common emergency department diagnoses: abdominal pain; back pain; cellulitis; chest pain; congestive heart failure; COPD; concussion; fracture; headache; no fracture (sprain/strain); rib fracture; and vertigo. These discharge instruction templates were reviewed for accuracy and completeness by three board-certified emergency physicians, including one study staff, one director of ED operations, and one educational director.

A convenience sample of emergency clinicians, including both board-certified physicians and physician assistants, voluntarily participated in the post-standardized intervention phase. Volunteer clinicians had the standardized discharge instructions uploaded into their dictation software Dragon (Nuance Communications, Inc, Burlington, MA) and used these standardized instructions when study staff was on site to conduct interviews. The study staff then collected data via in-person interviews for these clinicians and for the 20 patients for whom the standardized discharge instructions were used.

In both groups, patient responses were compared to their own clinician's responses and marked and coded as incorrect (0), partially correct (0.5), or correct (1) with a maximum total score of six. Results were scored by each member of the study team independently as well as by a third, board-certified emergency physicians who was the director of ED operations. We performed a Mann-Whitney U test on the total interview scores in the control and intervention groups and conducted a sub-analysis on the individual scores for each of the six key components.

RESULTS

Demographics: The treatment clinicians for the patients in the baseline group included 10 physicians and two APPs. The treatment clinicians in the post-standardized intervention group included three physicians and two APPs. Note that some clinicians were involved in both groups.

Patients in the pre-standardization group already showed high levels of understanding in three areas (above .75): their diagnosis; new medications; and who to follow up with. The patients in the post-standardized group overall demonstrated a statistically significant increase in patient-clinician concordance when compared to the patients in the baseline group ($P < 0.05$) (Figure), and two of the three low understanding areas— duration of illness and reasons to return—had statistically significant increases in patient-clinician concordance in the baseline vs post-standardized group.

DISCUSSION

The data from this pilot study suggests that implementing discharge instructions standardized to increase readability and include key components improved patient understanding compared to discharge instructions entered in via free text by the clinician. Like other studies, our study demonstrated that reasons to return were among the most poorly understood.[7] As seen in the Figure, there is clear improvement in this area with the implementation of standardized instructions. This is essential to patient care in the ED. Transitions of care have been identified as critically important times for transfer of information.[8] This is especially true when patients are transitioning from hospital-based care in the ED to home. Indeed, patient understanding of discharge instructions has been shown to improve health outcomes including minimizing return visits, increasing follow-up, and enabling improved at-home compliance with their clinician's plan of care.[6]

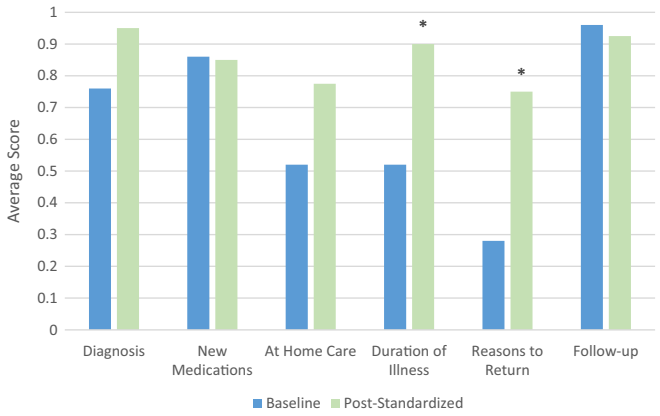

Figure. Average score by question (*signifies statistical significance).

Further, institutions such as the Centers for Medicare and Medicaid Services have identified patient understanding of discharge instructions as a key domain of patient experience, and patients are asked how well they were able to understand the discharge instructions provided during their ED visit on the ED Consumer Assessment of Healthcare Providers and Systems Survey. One recent study implemented a mnemonic "DC HOME" (discharge diagnosis, care rendered, health and lifestyle modifications, obstacles after discharge, prescribed medications, and expectations) and formalized education regarding its implementation among resident physicians, which demonstrated success in both inclusion of these components and patient satisfaction.[9] This intervention included several of the components we included in our standardized written instructions.

Having a good understanding of one's discharge instructions is important for many reasons, including that patients can have optimal health and recovery following their ED visit. Better understanding of discharge instructions can also decrease unnecessary return visits to the ED by empowering patients with the information they need to make appropriate follow-up appointments and to better understand the expected course of their illness, which may decrease the unnecessary cost of an additional ED visit for the patient.

LIMITATIONS

One limitation of this study is that inter-rater reliability was not assessed within the data collection and statistical analysis. We did not collect this data and, therefore, it is unclear how closely the doctors' ratings correlated to one another. Future analysis and interventions would benefit from two doctors rating the understanding and then performing kappa statistics to measure the level of agreement between the two doctors. An additional limitation of this study is its small sample sizes. We used small sample sizes as this was a pilot study with the goal of assessing significant impact as well as feasibility of implementation. As this pilot demonstrates statistical significance and clear beneficial impact to patient understanding, we now have a foundation for future expansion and additional research within this area.

Based on this pilot study we recognize several future opportunities. While this study was focused on standardizing 12 common discharge diagnoses, a future work could expand the number of diagnoses as well as the number of clinicians.

There is an opportunity to examine patient-centered outcomes including following patients after discharge to assess knowledge retention, return ED visits, and adherence with recommended follow-up. This pilot study demonstrates a first step in better understanding these patient centered outcomes potentially impacted by discharge instructions. Further, nursing staff were the primary individuals distributing the written discharge instructions to the patients and explaining them one final time prior to discharge. There is currently widely variable practice on how nursing staff provide and discuss these instructions with the patients. This study did not address this variability as our goal was to evaluate how changing the single variable of the written discharge instructions would affect patient understanding. Future work may include standardizing how clinicians or nursing staff provide discharge instructions as this has also been shown to impact patient understanding and satisfaction.[9]

CONCLUSION

Overall, this crucial pilot study suggests that standardized discharge instructions significantly improve patients' understanding of their instructions overall and, specifically, the expected duration of illness and reasons to return. This intervention is easy to implement, cost effective, empowers patients to better understand their health condition, impacts core ED quality measures, and should be further studied.

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Why Do Patients Opt for the Emergency Department over Other Care Choices? A Multi-Hospital Analysis

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Introduction: There are several options for receiving acute care besides emergency departments (ED), such as primary care physician (PCP) offices, urgent care centers (UCC), and telehealth services. It is unknown whether these alternative modes of care have decreased the number of ED visits for patients or whether they are considered before visiting the ED. A comprehensive study considering all potential methods of care is needed to address the evolving landscape of healthcare. Our goal was to identify any factors or barriers that may have influenced a patient's choice to visit the ED as opposed to a UCC, PCP, another local ED, or use telehealth services.

Methods: We surveyed ED patients between three hospital sites in the greater Buffalo, NY, area. The survey consisted of questions regarding the patients' reasons and rationale for choosing the ED over the alternative care options. The study also involved a health record review of the patients' diagnoses, tests/procedures, consults, and final disposition after completion of the survey.

Results: Of the 590 patients consented and surveyed, 152 (25.7%) considered seeking care at a UCC, 18 (3.1%) considered telehealth services, and 146 (24.7%) attempted to contact their PCP. On the recommendation of their PCP, patients presented to the ED 110 (20.7%) times and on the recommendation of the clinician at the UCC 54 (9.2%) times. Patients' perceived seriousness of their condition was the most common reason for their selected mode of transport to the ED and reason for choosing the ED as opposed to alternative care sites (PCP, UCC, telehealth). Based on criteria for an avoidable ED visit, 83 (14.1%) ED patients met these criteria.

Conclusion: Individuals prioritize the perceived severity of their condition when deciding where to seek emergency care. While some considered alternatives (PCP, UCC, telehealth services), uncertainties about their condition and recommendations from other clinicians led many to opt for ED care. Our findings suggest a potential gap in understanding the severity of symptoms and determining the most suitable place to seek medical care for these particular conditions. [West J Emerg Med. 2024;25(6)921–928.]

Keywords: *emergency department; urgent care center; primary care physician; telehealth; hospital utilization.*

INTRODUCTION

Emergency departments (ED) have become a haven for patients seeking urgent medical attention. As required by federal law, EDs cannot refuse evaluation and emergency treatment, regardless of the patient's ability to pay.[1] A 1996 study revealed that 11.3% of ambulance transports were considered unnecessary, highlighting a positive correlation between these visits to the ED and limited transportation options.[2] Given the increased availability of alternative transportation choices today compared with 1996, including public transportation and ride-sharing services, this correlation may have shifted. The current medical landscape also provides various alternatives for managing emergent medical conditions, including seeing primary care physicians (PCP), visiting urgent care centers (UCC), and using telehealth services.

The rise of alternative medical care options raises questions about their impact on reducing ED visits for conditions treatable through PCPs, UCCs, or telehealth services. Recent studies have examined why patients opt for the ED over other medical treatment facilities, citing factors such as limited access to or confidence in primary care, perceived urgency, convenience, recommendations from other physicians, friends, or family, and the belief that their condition necessitated resources provided by hospital-based emergency care.[3–11]

Despite the finding that 13.7–27.1% of all ED visits could be evaluated and treated at UCCs or retail clinics with lower cost, patients still frequently choose EDs for nonemergent care.[7,12] Another common occurrence among patients visiting the ED with lower acuity conditions is unnecessary referral from a PCP or UCC.[13,14] One study found that there were significantly more avoidable referrals from PCPs (13.9%) than UCCs (7.9%).[13] Zitek et al found that 35.9% of the patients enrolled in their study who transferred from a UCC to the ED were considered an unnecessary transfer.[14]

Limited research has examined patient decision-making when choosing between the ED and UCC. A 2018 study highlighted patients' uncertainty about what constituted urgent care, focusing on psychological factors rather than societal or physical determinants.[15] Mukamel et al (2019) addressed these factors, emphasizing out-of-pocket costs and wait times for several medical conditions and care choices.[8] Their findings revealed that lower out-of-pocket costs were prioritized over wait time for conditions lower in severity or acuity, whereas wait time gained importance for conditions perceived to be more urgent.[8]

The current study provides a comprehensive assessment of ED patients' choices for care and explores the factors and obstacles impacting patients' choices of a particular ED over a PCP, UCC, telehealth service, or another nearby ED. Additionally, we wanted to assess how avoidable some of these ED visits could be by examining patients' perceptions of PCPs', UCCs', and telehealth services' abilities to care for the medical conditions that caused them to seek care in the ED and to understand the selection patterns within this group. Understanding the location, size, clientele, and specialized care of the EDs may provide insight as to why individuals opt for one medical care option over another. A thorough examination of patients' choices could offer valuable insights into enhancing the availability and accessibility of various medical care options for individuals with urgent conditions.

Population Health Research Capsule

What do we already know about this issue?
Traditionally, patients opt for the emergency department (ED) over other medical options due to many factors including access limitations, perceived urgency, convenience, and recommendations from others.

What was the research question?
Given their increased availability, do ED patients consider using alternative care options prior to reporting to the ED?

What was the major finding of the study?
Among ED patients, 14.1% met the avoidable visit criteria, providing an opportunity to improve resource allocation.

How does this improve population health?
As a safety net for medicine and society, EDs can become overburdened. Alternative care options for non-emergent cases may help alleviate the load on EDs, to focus on the sickest patients.

METHODS

Study Design

This study consisted of a multi-hospital survey and electronic health chart review. Research associates (RA) administered the survey to patients seeking care at three separate hospital EDs. Surveys were administered during normal business hours when most other care options would be open and available. Participants provided written consent at their bedside prior to completing the survey. The survey included general demographic questions and several questions regarding their decision to seek care in the specific ED in which they were approached, as opposed to using a PCP, UCC, telehealth service, or another local ED. We

Table 1. Hospital site information and statistics.[17–20]

Hospitals	Hospital type	Beds	Location	Specialization	ED patients per year
Site 1	County	573	Urban	Full service, regional Level I trauma center	70,000
Site 2	Not for profit	484	Urban	Full service, regional stroke and STEMI center	64,000
Site 3	Not for profit	265	Suburban	Full service	50,000

ED, emergency department; *STEMI*, ST-Elevation Myocardial Infarction.

conducted a subsequent health chart review for diagnoses, tests/procedures, consults, and final disposition for each participating patient. The survey was developed from a previous study conducted locally,[2] adapted to fit current standards and medical care options, and it was reviewed by a group of local emergency physicians.[13,16] This study was approved by the institutional review board at the University at Buffalo.

Setting

The survey was conducted at three local hospital sites located in a single county. Two are in the center of a metropolitan area and one in a city suburb (Table 1). Sites 2 and 3 are part of the same hospital system. The EDs at all three sites are staffed by the same physician group. The population of the local county is about 950,000 as of 2021 and includes the city with a population of about 277,000.

Data Collection

Each RA was trained by the study coordinator at Sites 1 and 2 on the proper procedures for reviewing the consent form, administering the survey, and collecting the final data outcomes. All enrollments at Site 3 were done solely by the study coordinator. Enrollment for this study began on January 3, 2023, and concluded on May 1, 2023. Data collection took place at all three sites between 10 AM – 10 PM, Sunday-Saturday. Subjects were included if they were at least 18 years old, read and spoke English, and had the capacity to provide consent to participate. The RAs at each hospital then consulted with the patient's clinicians to determine whether the patient was able to give consent to participate in the survey. The RAs did not approach patients if they were altered, too sick to participate, mentally incapable, non-English speaking, sleeping, potentially infectious, receiving care, >89 years old, or reported by staff as being too agitated or upset to participate. Additionally, prisoners were not considered for this study as the location of their care is arranged without their input. If patients were unable to be approached for these reasons, they were recorded as ineligible.

After written consent was received, the survey was administered verbally, and every answer was recorded on an iPad using REDCap 10.3.3 (Research Electronic Data Capture Vanderbilt University, Nashville, TN) data management platform software hosted at University at Buffalo. All questions from the survey were asked to the patients as open-ended, but the RAs who asked the question would categorize the answer based on the survey options. The RAs were trained on how to categorize each response by the study coordinator. If the response did not fit any of the provided categories, it would be labeled as "other," and the RA would describe the answer on REDCap via a blank text box.

After each participating patient was discharged, admitted, or transferred from the ED, RAs recorded their discharge diagnosis, any tests and procedures done, any specialists consulted, and the final disposition. We used this information to determine whether the patient's visit to the ED could be categorized as avoidable. We defined an ED visit as avoidable if the patient did not have a high-acuity triage category of level 1 (resuscitation) or level 2 (emergent), was not admitted to the hospital or transferred, had no advanced imaging, had no specialist consultation while in the ED, and did not have a discharge diagnosis of chest pain or syncope. We defined advanced imaging as any imaging other than a radiograph (eg, computed tomography, magnetic resonance imaging, or ultrasound). These criteria were based on previous research coupled with a consensus from local emergency physicians to fit regional standards.[2,13,16]

Analysis

We analyzed the data obtained from the surveys using SPSS Statistical Software v 27 (IBM Corporation, Armonk, NY) after it was exported from REDCap. Descriptive statistics were used to analyze the responses to the survey and present the data.

RESULTS

Across the three hospitals, 52,246 patients reported to the ED during the study period. Of the 1,665 people considered for participation, 958 (57%) were approached and 590 (35.4%) consented to participate in the survey, resulting in a 1.1% study sample of the total patient population during the collection period (Table 2). Most participants were female (60.6%) and White (75.8%) (Table 3).

The most common methods of transportation reported were having a family member or friend drive them (43.9%), followed by ambulance transport (28.3%) and driving themselves to the hospital (19.7%). Of those patients who had a family member or friend drive them, most of them

Table 2. Study sample representation of emergency department population. Emergency Severity Index.

	Study patients		Total ED patients during study period	
Hospitals	Patients surveyed	Average triage ESI score	ED patients seen	Average triage ESI score
Site 1	198	2.52	18,041	2.75
Site 2	197	2.75	18,122	2.85
Site 3	195	2.88	16,083	2.88
Total:	590	2.71	52,246	2.82

ED, emergency department; *ESI*, emergency severity index.

described the reason as being too sick to drive themselves (67.2%). Of those patients who came in an ambulance, around half of them explained that they felt they needed immediate medical attention (48.5%). Additionally, most of those who arrived by ambulance stated they either called the ambulance themselves (32.9%), or a family member or friend called one for them (37.1%).

Of the 590 patients, 530 (89.8%) reported having a PCP. Only 146 (27.5%) of those 530 attempted to reach out to their PCP, with 127 (24.0%) making contact. Among those 127 patients who successfully contacted their PCP, 110 (86.6%) stated that their physician advised visiting the ED (Figure 1). Of those 110 patients, 75 (68.2%) had a triage category of 3 and 30 (27.3%) had a triage category of 2 (Table 4). Among the 152 (25.7%) patients who considered visiting a UCC, 135 (88.8%) had used a UCC in the past, 148 (97.4%) were aware of a UCC in their area, and 140 (92.1%) said they would consider using a UCC in the future. When asked why they chose the ED over a UCC, 54 (35.5%) patients reported they went to a UCC first, but the UCC clinician recommended they go to the ED. The second most common answer was the patient believed their condition was too serious for a UCC, 33 (22.4%) (Figure 2).

Only 18 patients (3.1%) considered using telehealth services. Of those 18, 12 (66.7%) sought care through a telehealth service visit in the past, 16 (88.9%) would consider using telehealth services in the future, and 10 (55.6%) stated they believed they needed the resources of a hospital, which is why they chose the ED over a telehealth service visit.

The main reasons why patients chose their respective EDs over other local EDs included prior use of healthcare services at that hospital (23.9%), living near the ED (21.2%), and the belief that the hospital offered the specialized services they needed (18.1%). There were 190 (32.2%) patients with a triage category of 1 or 2. A total of 254 (43.1%) patients were admitted to the hospital, 325 (55.1%) had advanced imaging, and 150 (25.4%) had a specialist consultation. At discharge, 125 (21.2%) patients had a diagnosis of chest pain or syncope.

Table 3. Demographics of consented participants.

	Total (N = 590)
Gender	
Male	228 (38.5%)
Female	359 (60.6%)
Other	3 (0.5%)
Prefer not to answer	0 (0.0%)
Age	
Mean Years	51.15
SD	17.82
Race	
Black	113 (19.1%)
Asian/Pacific Islander	10 (1.7%)
White	449 (75.8%)
Native American	11 (1.9%)
Other	19 (3.2%)
Prefer not to answer	2 (0.3)
Hispanic/LatinX	
Yes	46 (7.8%)
No	544 (91.9%)
Highest level of education	
No high school	2 (0.3%)
Some high school	38 (6.4%)
High school graduate	153 (25.8%)
Some college	121 (20.4%)
Associate's degree	78 (13.2%)
Bachelor's degree	113 (19.1%)
Postgraduate degree	78 (13.2%)
Trade/technical training	7 (1.2%)
Other	0 (0.0%)
Type of health insurance	
Private	374 (63.4%)
Medicare	112 (19.0%)
Medicaid	88 (14.9%)
Uninsured	13 (2.2%)
Military	3 (0.5%)
Other	0 (0.0%)

Of the 590 patients surveyed, only 83 (14.1%) patients met our criteria for being an avoidable visit.

DISCUSSION

Patients' perceived seriousness of their condition was the most common reason for seeking care at the ED instead of alternative sources of care (Figures 1 and 2). Previous studies suggest that many people choose to take an ambulance because someone else called the ambulance for them or

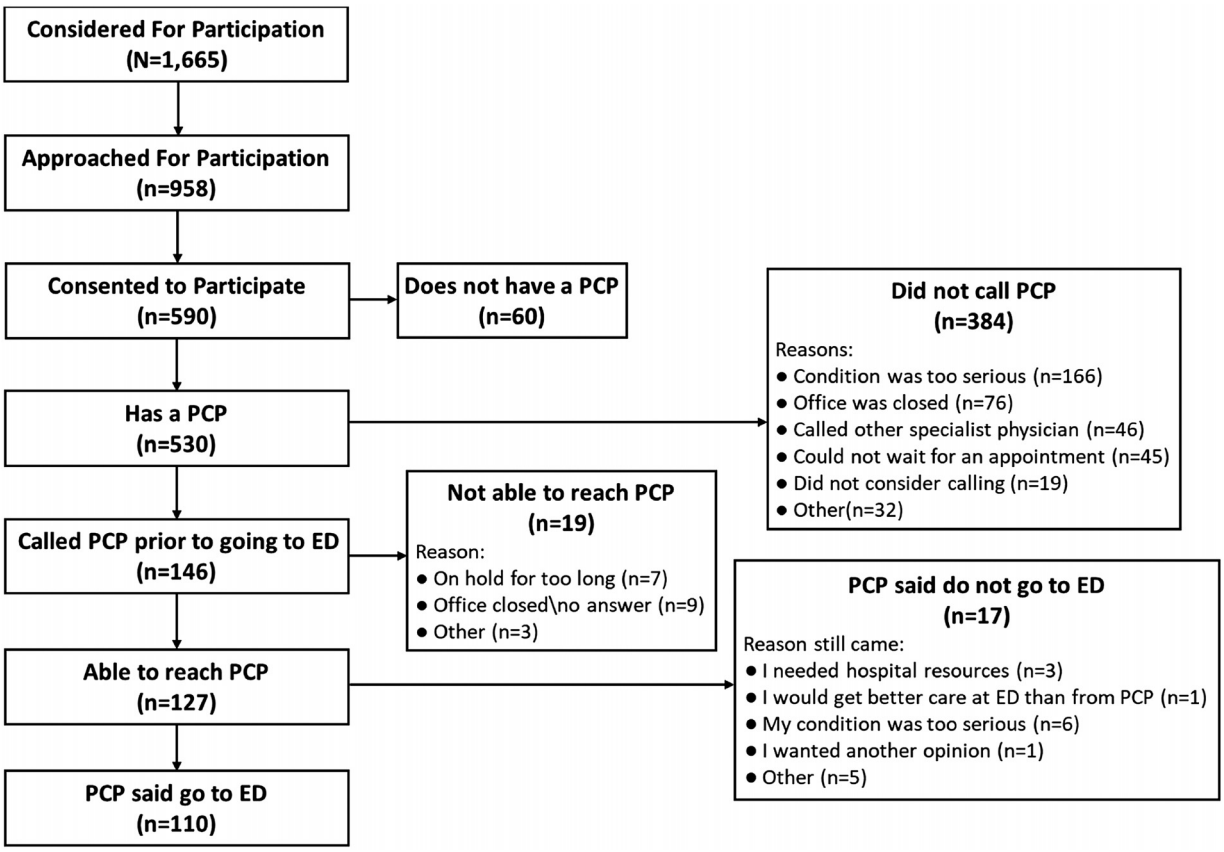

Figure 1. Description of involvement of primary care physician (PCP) in decision to go to the ED.

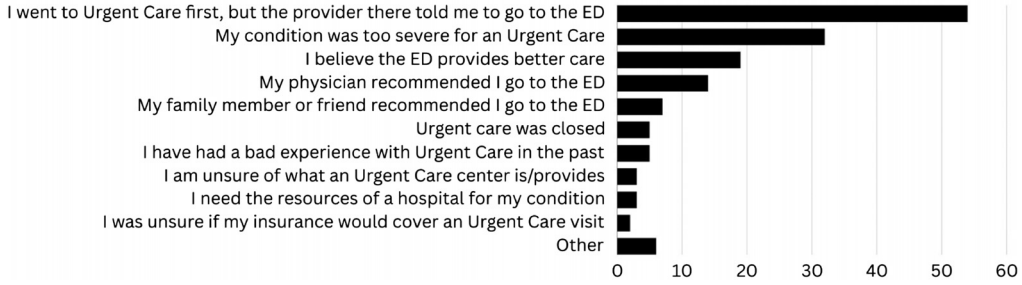

Figure 2. Reasons why patients chose the emergency department (ED) instead of urgent care center (UCC).

because of the perceived urgency or uncertainty about their medical conditions.[21,22] This aligned with our findings because, of the 167 patients who presented to the ED by ambulance, 81 (48.5%) stated that they needed immediate medical assistance and 29 (17.4%) stated that they were too sick or in too much pain to drive themselves. Furthermore, of the patients who had a family member or friend drive them to the ED, the reason of being too sick to drive themselves was far more common than the other possible reasons (67.2%).

Of the 590 patients surveyed, 384 (65.1%) did not attempt to contact a PCP prior to going to the ED despite 530 (89.8%) reporting that they had a PCP. Previous research cites patients favoring the ED due to perceived urgency, limited access to PCPs, and the convenience of readily available tests in the ED.[6,11,23,24] Another study found the primary reason patients chose the ED instead of a PCP was the perception of speed and convenience. However, this finding may be contradictory because of prolonged ED wait times that may occur with less acute conditions.[25] Similar to Gorodetzer et al (2020), we found more than double the number of referrals from PCPs compared to UCCs (110 vs 54, respectively).[13] Most patients who did not call their PCP's office stated that they believed their condition was too urgent, which is comparable to previous studies.[5,11,24,26]

Table 4. Triage category compared to recommendation from primary care physician (N = 127).

	Triage Category				
	1: Resuscitation	2: Emergent	3: Urgent	4: Less urgent	5: Nonurgent
Doctor recommended going to ED (n = 110)	2 (1.8%)	30 (27.3%)	75 (68.2%)	3 (2.7%)	0 (0%)
Doctor did NOT recommend going to ED (n = 17)	0 (0%)	5 (29.4%)	11 (64.7%)	1 (5.9%)	0 (0%)

PCP, primary care physician; *ED*, emergency department.

Additionally, for those patients who went to the ED against the advice of their PCP, 56.3% stated that they believed their condition was too serious or that they thought they needed the resources of a hospital for their condition (Figure 1), which aligns with previous research.[11] Notably, of the patients who went to the ED despite not being advised to do so by their PCP, 29.4% had a triage acuity of 2 and 64.7% had a triage acuity of 3 (Table 4), indicating that some patients' self-referral may have been more advantageous than if they had not chosen to visit the ED. Although this may identify an area for improvement for patients' PCPs, it is difficult to accurately interpret situations because this study did not record whether patients called or physically visited their PCPs' offices or to whom patients may have spoken to there.

Of the patients who considered visiting a UCC, most of them reported using a UCC in the past, knew of a UCC in their area, and said they would consider using a UCC in the future. This information contrasts the findings of Pope et al, suggesting that people in the United States might have more of a general awareness of what a UCC is and the services they may provide.[15] In this study, patients who stated that they did not consider UCCs were not asked why. Adding this question to the survey may provide a better indication of the psychological, societal, and physical determinants as to why patients choose the ED over UCCs such as costs, wait times, and lack of understanding of UCC services, as previous literature suggests.[8,15]

To our knowledge, this is one of the first studies to investigate patient choices between ED and telehealth services. Although it has been shown that telehealth service use decreased ED volumes during the early days of the COVID-19 pandemic in 2020, the current study was conducted January–May 2023 and did not receive many responses (18, 3.1%) pertaining to the consideration of telehealth services in this population.[9] Ten participants (55.6%) of the 18 who considered telehealth stated they chose the ED over telehealth services because of the perceived need for hospital resources, similar to the reasoning behind choosing the ED over PCP offices or UCCs. Furthermore, when this survey was conducted, not all health insurances policies covered telehealth services, potentially limiting their impact.

Understanding the significant decision-making behavior and future considerations for these patients is challenging, given that only 14.1% of the patients met our criteria for avoidable visits. Additionally, several studies have attempted to label a "non-urgent" ED visit in the past, each with different criteria, sample size, study design, and results.[8,12–14] This complicates distinguishing between those who truly required ED care and those who might not have needed it, creating a convoluted and ambiguous process.

LIMITATIONS

For privacy, surveys were conducted after patients were assigned and moved to an ED room. Patients who were treated in non-private areas such as fast track, hallway bed, or waiting room-adjacent areas were not included; these may represent a group with a greater ratio of avoidable visits. Additionally, RAs were unable interview patients who presented to the ED and left before receiving treatment.

The requirement for RAs to review a consent form and obtain a signature from the patient may have resulted in reluctance or hesitation for participation and subsequent declination to participate from 109 patients for multiple reasons. First, in their review of the consent form, RAs were required to explain that the study team would be obtaining basic information from the patient's health record after the patient completed the survey, which may have been perceived as a potential breach of confidentiality. Next, reviewing the consent document took approximately four minutes, which could have been enough time for the prospective subjects to lose interest, potentially feel too ill to participate, or for a clinician to intervene during the enrollment process. Lastly, the regulatory requirement of obtaining written consent may have decreased the potential number of patients that could have been enrolled in this study and may have introduced bias into our findings.

Discussing and answering questions about their ED visits may be an emotional or sensitive topic for patients. Although the RAs were trained to ask the questions in a non-judgmental and welcoming tone, some patients may have been disinclined to provide honest or complete responses. Additionally, going to the ED for some may be considered a traumatic experience, regardless of triage acuity, which may have reduced willingness to participate. Finally, patients who were too sick, intoxicated, or incapacitated were not approached to participate due to their condition. These patients were presumed to be an

unavoidable ED visit; thus, omitting their data may impacted the results.

Future studies should focus on including rural hospitals compared to suburban and urban hospitals. Inclusion of a rural setting may contribute more data surrounding patients' use of telehealth services. Additionally, including those patients seen in fast track or other lower acuity areas would provide more information on avoidable ED visits. Previous studies also found that there is a high number of avoidable pediatric patient visits to the ED.[14] Incorporating pediatric patients and the decision-making of their accompanying adult(s) in future work could also shed light on how people decide where to go for their emergency care.

CONCLUSION

Per our findings, individuals primarily rely on their perception of the severity of their condition when making decisions about seeking emergency care. While several patients contemplated alternative options such as scheduling a visit to a PCP's office, visiting a UCC, or accessing healthcare through telemedicine services, the uncertainty surrounding their medical condition, recommendations from other healthcare professionals, and the perceived quality of care significantly influenced their choice in directing them to the ED. Non-emergent patients report to the ED for many reasons including a discrepancy in both understanding the severity of symptoms and determining the most suitable place to seek medical care.

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Emergency Department Patient Satisfaction Scores Are Lower for Patients Who Arrive During the Night Shift

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Background: Increasingly, patient satisfaction scores are being used to assess emergency physicians. We sought to determine whether the patient satisfaction scores collected by our hospital system are lower for patients who are treated in the emergency department (ED) on night shifts as compared to those treated on day shifts.

Methods: We performed a cross-sectional analysis of patient satisfaction scores from three EDs in Florida. We obtained satisfaction data from NRC Health (the company that provides our surveys) using a random sample of 1,000 completed surveys from patients treated in 2022; we also performed manual chart review to obtain clinical data. The satisfaction surveys asked patients how likely they would be to recommend the facility (from 0–10). Patients who provided a score of 9 or 10 were considered "promoters." For our primary analysis, we compared the percentage of promoters for the day shift encounters (7 AM to 7 PM) to the night shift encounters (7 PM to 7 AM). We also performed a multivariable logistic regression analysis using several demographic and clinical variables to further assess the association between night shift arrival and satisfaction scores.

Results: Of the 1,000 surveys analyzed, 66.3% of patients arrived during the day shift, and 33.7% arrived during the night shift. Of those who arrived during the day shift, 525 (79.2%) were promoters compared to 228 (67.7%) of those who arrived during the night shift, a difference of 11.5% (95% confidence interval [CI] 5.7–17.4%), $P < 0.001$. On multivariable analysis, night shift arrival was associated with a lower chance of a patient being a promoter, with adjusted odds ratio 0.60 (95% CI 0.43–0.84), $P = 0.003$.

Conclusion: Patients who presented to the ED during the night shift were less likely to be promoters than patients who arrived during the day shift. Assessments of patient satisfaction data should account for time of visit and other facility-related and operational characteristics. [West J Emerg Med. 2024;25(6)929–937.]

INTRODUCTION

With emergency departments (ED) open 24/7, most emergency physicians work some night shifts. Unfortunately, prior data has shown that night shift work is associated with increased risk of a variety of medical conditions[1–5] and motor vehicle collisions after those shifts.[6] Additionally, emergency physicians working at night may have to deal with reduced support staff, tired patients, and fewer available consultants. Moreover, multiple prior studies have demonstrated that while on night shift, cognitive performance declines.[7,8]

Despite the unique challenges of night shifts, emergency physicians are generally held to the same standards on night shifts as they are on day shifts, and one way they are now assessed is by patient satisfaction scores. Indeed, patient satisfaction has become an increasingly important part of healthcare in large part because of the incentives initiated by the Affordable Care Act in 2010[9]; now, both institution and physician payment are sometimes based on patient satisfaction scores.[10]

Prior studies have shown that certain factors including shorter ED length of stay (LOS),[11–13] older patient age,[14] and good communication[15] are associated with better ED patient satisfaction scores. Two prior studies have investigated the relationship between treatment during night shifts and patient satisfaction scores.[14,16] One found no statistically significant association,[14] while another found that physicians who worked fewer night shifts had higher patient satisfaction scores.[16] Given the conflicting evidence to date and the increasing emphasis on patient satisfaction, we felt that additional study was warranted to assess the relationship between night shift work in the ED and patient satisfaction.

Our primary objective in this study was to determine whether patients who are cared for during night shifts provide lower patient satisfaction scores than those cared for during day shifts, using the real-world satisfaction data. Secondarily, we sought to determine whether other demographic and clinical characteristics are associated with ED patient satisfaction scores.

Population Health Research Capsule

What do we already know about this issue?
Physicians are judged based on patient satisfaction scores. Prior data found that certain patient and facility characteristics are associated with satisfaction scores.

What was the research question?
Do patients who present to the ED at night provide lower satisfaction scores than patients who present during the daytime?

What was the major finding of the study?
Of day shift patients, 79.2% were "promoters" vs 67.7% of night shift patients (difference 11.5% [95% CI 5.7–17.4%]), P < 0.001.

How does this improve population health?
This data helps us better interpret patient satisfaction data, which may help improve our ability to provide patient-centered care.

METHODS

Study Design and Setting

We performed a cross-sectional analysis of ED patient satisfaction scores from patients who presented to a single hospital system in the State of Florida in the southeastern United States from January 1–December 31, 2022. Specifically, we performed a secondary analysis of a previously collected dataset of satisfaction scores, and we performed a chart review to supplement that data. We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. The study was approved by the Mount Sinai Medical Center Institutional Review Board. This study received no external funding.

Our hospital system has a tertiary care, community teaching hospital located in Miami Beach, Florida, as well as a freestanding ED located in Hialeah, Florida, (freestanding ED #1) and a freestanding ED located in Aventura, Florida, (freestanding ED #2). The main hospital's ED had 56,005 visits during 2022, while freestanding ED #1 had 37,932 visits and freestanding ED #2 had 19,635 visits. Emergency medicine residents work shifts only at the main hospital's ED. Advanced practice practitioners (APP) work shifts at all three facilities. Shift times are shown in Table 1. In 2022, three emergency physicians only worked only night shifts, and one physician worked only day shifts. Some attending physicians and APPs only worked at one facility; others worked at two or all three.

Selection of Participants

In 2022, NRC Health (Lincoln, NE) administered our patient satisfaction surveys and tracked satisfaction data. Surveys were sent by both text message and email to all patients who left the ED. All patients who completed the NRC Health ED patient satisfaction survey in 2022 were eligible for inclusion in this study. Admitted patients were not sent surveys and were excluded from analysis.

Measurements

NRC Health keeps a database with the responses from satisfaction surveys and demographic information about the

Table 1. Emergency department staff shift times in 2022.

	Main ED	Freestanding ED #1	Freestanding ED #2
Nursing shifts	7 AM to 7 PM 10 AM to 10 PM 2 PM to 2 AM	7 AM to 7 PM 10 AM to 10 PM 2 PM to 2 AM	7 AM to 7 PM 10 AM to 10 PM 2 PM to 2 AM
Attending physician shifts	7 AM to 3 PM 10 AM to 10 PM 11 AM to 9 PM 2 PM to midnight 9 PM to 7 AM	7 AM to 7 PM 11 AM to 11 PM 7 PM to 7 AM	7 AM to 7 PM 7 PM to 7 AM
Resident shifts	All shifts except 7 AM to 3 PM on Wednesdays*	None	None
Advanced practice practitioner shifts	10 AM to 10 PM	9 AM to 9 PM 2 PM to 2 AM	10 AM to 10 PM

*Residents are not in the ED on Wednesday mornings from 7 AM to 1 PM due to academic conference.
ED, emergency department.

patients who complete the surveys. In our hospital system, currently, individual physician-level patient satisfaction scores are tracked and assessed using these data, but compensation is not dependent upon them. We generated a report from NRC Health's data for all patients who completed a satisfaction survey during 2022 and then used a random number generator to create a sample of 1,000 patient encounters for analysis. For each of these patient encounters, two medical students transferred patient responses and available demographic information into a spreadsheet in Microsoft Excel v16.79.1 (Microsoft Corp, Redmond, WA). In particular, NRC Health provided us with the following data for each encounter: the date of the visit; the facility; the name of the physician or APP; method of patient response (email or text message); and the patient's age, sex, race, medical record number, address, marital status, and preferred language. The two medical students who abstracted these data points had no role in the abstraction of the other data discussed below.

Next, we created a separate spreadsheet with additional clinical information for each of the 1.000 patient encounters using our electronic health record system (EHR) (Epic Systems Corporation, Madison, WI). Six abstractors (three emergency medicine residents, two emergency attendings, and one nurse practitioner) performed manual chart review to determine the patient's ethnicity, mode of arrival to the ED, times of arrival and departure, Emergency Severity Index (ESI) score,[17] disposition, clinician who discharged the patient (and their supervising attending, if applicable), and whether or not each of the following was performed during the patient encounter: resident participation; sign-out; blood test; advanced imaging; in-person consultant evaluation, consultation by phone (only); opioid pain medicine administration; and prescription provided.

In general, manual chart review followed the methods suggested by Kaji et al.[18] The abstractors who performed manual chart review were blinded from the satisfaction data. None of the abstractors or investigators have been a nocturnist. The abstractors filled in 15 columns in the spreadsheet with the data points above. They were trained on proper data abstraction by the principal investigator (TZ), and they followed a data dictionary that explicitly defined the variables and explained where to find them in the EHR. The data dictionary is included as an appendix, which provides detailed definitions of all variables. The definitions of a few important variables are also defined here as follows:

We considered patients to have arrived during the day shift if they arrived in the ED between 7 AM–7 PM and to the night shift if they arrived between 7 PM–7 AM. We chose these definitions because many physician and nursing shifts follow these time schedules in our system (Table 1). We also divided patients into the time of year they came to the ED by standard quarters.

The type of clinician (physician or APP) who evaluated the patient primarily was determined based on the name of the clinician on the survey as per NRC Health data. For example, a patient was considered to have been seen primarily by an APP if the APP was the person listed on the satisfaction survey. As mentioned above, we also manually recorded the name of the clinician (and their supervising attending) who discharged the patient for each patient encounter. For patients who were not signed out, the discharging clinician (or supervising attending) was fully consistent with the listed name on the surveys. However, for patients who were signed out, sometimes the initial clinician who treated the patient was listed on the survey and sometimes a subsequent one was. Since administrators assess the satisfaction data based on the name of the clinician on the surveys, we used the name of the clinician on the survey as the primary treating clinician.

Patients who left the ED before being evaluated by a physician or APP could still be included in the study if they

completed a satisfaction survey but were considered to have not been seen by a physician or APP. All six abstractors obtained the data for a group of the same 50 patients to allow for an assessment of the inter-rater reliability. We calculated the free-marginal kappa for the two variables that we considered to be the most difficult to abstract: sign-out, and in-person evaluation by consultant.

After completing data collection, the principal investigator (TZ) merged the spreadsheets with the satisfaction data and the clinical data, and the data was analyzed as described below.

Outcomes

In 2022, our administration considered the most important question on the satisfaction surveys to be: "How likely is it that you would recommend [facility name] to a friend or colleague?" (from 0–10). A patient who provided a score of 9 or 10 was considered to be a "promoter"; a score of 7 or 8 was considered "passive"; and a score of 0–6 was considered to be a "detractor." The percentage of promoters minus the percentage of detractors is deemed the "net promoter score," which is used to measure overall satisfaction in healthcare as well as in other businesses.[19,20] Our primary outcome was the percentage of completed patient satisfaction surveys that qualified as promoters. Secondarily, we determined the net promoter score and the adjusted odds ratios for being a promoter for several demographic and clinical variables.

Analysis

Based on a preliminary analysis of NRC Health data, we anticipated that there would be approximately twice as many completed surveys from patients who arrived during the day shift vs the night. Additionally, we knew that approximately 75% of our completed surveys in 2022 qualified as promoters. Based on gestalt, we hypothesized that the percentage of promoters from the day shift would be eight points higher than the night shift. To test our hypothesis with an alpha of 0.05 and power 0.8, we required responses from 957 patients. We rounded this up to 1,000 and chose that as our sample size.

For our primary analysis, we compared the percentage of promoters for patient encounters in which the patient arrived during the day shift compared to night shift. We made the unadjusted comparison our primary analysis since that is how patient satisfaction scores are being used to assess emergency physicians in our hospital system. We also compared the demographic and clinical characteristics of the patient encounters for the two groups. We determined normality with the Shapiro-Wilk test. For normal distributions, we compared the means of groups using *t*-tests. For non-normal distributions, we compared medians using the median test. We used the Fisher exact test to compare categorical variables.

Secondarily, given that a patient who arrives during the end of a day shift might be mostly treated by the night staff (or vice versa), we also analyzed patients based on the time of ED departure. In other words, we considered night shift patients to be those who departed between 7 PM – 7 AM. Lastly, to further isolate the night-time hours when people are generally sleeping, we divided patients by arrival time into three eight-hour epochs: 6 AM – 2 PM (day), 2 PM – 10 PM (swing), and 10 PM – 6 AM (night).

Lastly, we performed a multivariable logistic regression analysis with "promoter" (yes or no) as the dependent variable. Based on prior data,[11–14,16,21–23] we included the following variables in our model: ED LOS (continuous); ED site (categorical); elderly (age > 65) (binary); pediatric (binary); race (White or not); ethnicity (Hispanic or non-Hispanic), health insurance type (no insurance, commercial, or government/other); non-English speaking (binary); Emergency Severity Index (ESI) (2 or 3 vs 4 or 5); and advanced imaging performed (binary). Based on investigator hypothesis, we also chose to include the following as covariates: quarter of the year (1, 2, 3, or 4); married (binary); seen by a resident (binary); seen primarily by an APP (binary); arrival by ambulance (binary); and blood test performed (binary). We also hypothesized that consultant evaluations would be associated with better satisfaction

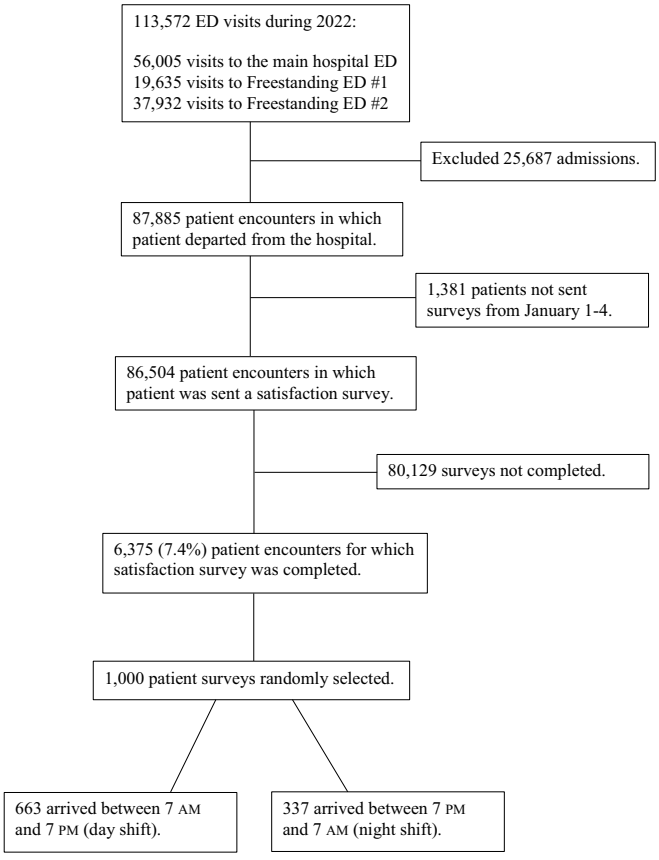

Figure. Flow of patient encounters.

Table 2. Characteristics of patient visits for patients who arrived during the day shift (7 AM to 7 PM) as compared to those who arrived during the night shift (7 PM to 7 AM).

	Day-shift arrival (n = 663)	Night-shift arrival (n = 337)	Absolute difference (95% CI)	*P*-value
Patient demographics				
Mean age (SD)	49.3 (22.2)	43.0 (23.4)	6.3 (3.2 to 9.3)	<0.001*
Pediatric (< 18 years), n (%)	60 (9.0)	46 (13.7)	4.7 (0.3 to 8.9)	0.03*
Elderly (> 65 years), n (%)	203 (30.6)	78 (23.2)	7.4 (1.8 to 13.2)	0.01*
Male, n (%)	273 (41.2)	147 (43.6)	2.4 (–4.0 to 8.9)	0.46
Race White, n (%)	530 (79.9)	248 (73.6)	6.3 (0.7 to 12.0)	0.02
Race Black, n (%)	53 (8.0)	31 (9.2)	1.2 (–2.5 to 4.9)	0.52
Hispanic, n (%)	365 (55.1)	205 (60.8)	5.8 (–0.7 to 12.2)	0.08
Commercial health insurance, n (%)	391 (59.0)	203 (60.2)	1.2 (–5.2 to 7.7)	0.70
No health insurance, n (%)	53 (8.0)	48 (14.2)	6.3 (2.0 to 10.5)	0.002*
Married, n (%)	267 (40.8)	99 (29.6)	11.1 (5.0 to 17.3)	<0.001*
Non-English speaking, n (%)	228 (34.4)	114 (33.8)	0.6 (–5.7 to 6.8)	0.86
From out of state, n (%)	41 (6.2)	23 (6.8)	0.6 (–2.6 to 3.9)	0.70
Time of year of visit				
Quarter 1, n (%)	155 (23.4)	82 (24.3)	1.0 (–4.7 to 6.6)	0.74
Quarter 2, n (%)	186 (28.1)	87 (25.8)	2.2 (–3.6 to 8.0)	0.75
Quarter 3, n (%)	157 (23.7)	83 (4.6)	1.0 (–4.7 to 6.6)	0.74
Quarter 4, n (%)	165 (24.9)	85 (25.2)	0.3 (–5.4 to 6.0)	0.91
Clinician and facility characteristics				
Main hospital	388 (58.5)	204 (60.5)	2.0 (–4.4 to 8.4)	0.54
Freestanding ED #1	160 (24.1)	67 (19.9)	4.3 (–1.1 to 9.6)	0.13
Freestanding ED #2	115 (17.4)	66 (19.6)	2.2 (–2.9 to 7.4)	0.38
Resident participated, n (%)	217 (32.7)	179 (53.1)	20.4 (14.0 to 26.8)	<0.001*
Advanced practice practitioner, n (%)	171 (25.8)	36 (10.7)	15.1 (10.4 to 19.8)	<0.001*
Sign-out, n (%)	24 (3.6)	30 (8.9)	5.3 (1.9 to 8.6)	<0.001*
Clinical characteristics				
ESI[a] 2, n (%)	20 (3.0)	13 (3.9)	0.9 (–1.6 to 3.3)	0.48
ESI 3, n (%)	401 (60.5)	229 (68.0)	7.5 (1.3 to 13.7)	0.02*
ESI 4, n (%)	239 (36.1)	93 (27.6)	8.5 (2.4 to 14.5)	0.007*
ESI 5, n (%)	3 (0.5)	2 (0.6)	0.1 (–0.8 to 1.1)	0.77
Arrived by ambulance, n (%)	24 (3.6)	22 (6.5)	2.9 (0.0 to 5.9)	0.04*
Blood test performed, n (%)	287 (43.3)	126 (37.4)	5.9 (–0.5 to 12.3)	0.07
Advanced imaging performed, n (%)	228 (34.4)	90 (26.7)	7.7 (1.7 to 13.6)	0.01*
In-person consultant evaluation, n (%)	20 (3.0)	8 (2.4)	0.7 (–1.4 to 2.7)	0.56
Phone (only) consultation, n (%)	23 (3.5)	2 (0.6)	2.9 (1.3 to 4.5)	0.006*
Opioid pain medicine given, n (%)	72 (10.9)	36 (10.7)	0.2 (–3.9 to 4.2)	0.93
Given prescription, n (%)	374 (56.4)	170 (50.4)	6.0 (–0.6 to 12.5)	0.07
Median length of stay (IQR), min	194 (123–259)	184 (123–265)	10 (–7 to 28)	0.28
AMA, eloped, or LBT[b], n (%)	18 (2.7)	17 (5.0)	2.3 (–0.3 to 5.0)	0.06

[a]Emergency Severity Index. There were no patients with an ESI of 1.
[b]All other patients were discharged except for two who were transferred to other hospitals.
*Indicates a statistically significant difference between groups.
AMA, against medical advice; *CI*, confidence interval; *ED*, emergency department; *ESI*, Emergency Severity Index; *IQR*, interquartile range; *LBT*, left before treatment.

scores, but these occurred too rarely in our dataset to be included in the regression analysis. We used the Hosmer-Lemeshow statistic to assess goodness of fit of the regression model.

Data was aggregated in Excel and analyzed in R Studio v2023.03.0 (RStudio PBC, Boston, MA). Using two-sided hypothesis tests, we considered $P < 0.05$ to be statistically significant.

Missing Data

In a few cases, race and ethnicity were not recorded. This was handled as follows: Patients who were documented as having White or Caucasian race were considered to be "White." Patients who were documented as Black or African American were considered to be "Black." Patients documented as Asian, American Indian, multiracial, other, or for whom race was not documented were considered neither White nor Black. Similarly, if a patient was documented as "Hispanic," their ethnicity was considered to be "Hispanic." If they were documented to be non-Hispanic or if their ethnicity was not documented, they were considered "non-Hispanic."

RESULTS

Overall

As shown in the Figure, 6,375 satisfaction surveys were completed in 2022, and we randomly selected 1,000 for analysis. Of these, 824 patients responded by text message and 176 responded by email. Our data included surveys evaluating 44 different attending physicians and 18 APPs. There were no missing data points, except for five patients for whom no race and ethnicity were recorded. Inter-rater reliability for the two assessed variables was almost perfect with free-marginal kappa 0.98 (95% confidence interval [CI] 0.94–1.0) for sign-out and 0.98 (95% CI 0.9–1.0) for in-person evaluation by a consultant. Overall, 75.3% of patient encounters qualified as promoters, and net promoter score was 57.8.

Night vs Day Shifts

In total, 663 (66.3%) patients arrived during the day shift, and 337 (33.7%) arrived during the night shift. Table 2 shows a comparison of characteristics of these two groups. Notably, the groups were not balanced on several characteristics including age, race, marital status, insurance, type of clinicians involved, ESI, and advanced imaging performed. Regarding the primary outcome, 525 (79.2%) of those who arrived during the day shift were promoters compared to 228 (67.7%) of those who arrived during the night shift, an absolute difference between groups of 11.5% (95% CI 5.7–17.4%), $P < 0.001$. The net promoter score for the day shift was 64.9 and 44.0 for the night shift. Data stratified by facility are shown in Table 3.

When redefining day shift by departure time, there were 492 day-shift patients and 508 night-shift patients. Of those, 396 (80.5%) and 357 (70.3%) were promoters for the day and night shift, respectively, a difference of 10.2% (95% CI 4.9–15.6%), $P < 0.001$.

When analyzing the data by eight-hour epochs, 307 (80.2%) of 383 patients who arrived between 6 AM–2 PM were promoters. Meanwhile, 339 (75.5%) of 449 patients who arrived between 2 PM–10 PM were promoters, and 107 (63.7%) of 168 who arrived between 10 PM–6 AM were promoters. Combining the eight-hour day and swing shifts together, 77.6% of surveys were promoters, which is 13.9% (95% CI 6.2–21.8%) higher than the eight-hour night shift group, $P < 0.001$.

Nineteen completed surveys came from patients seen by one of our three nocturnists. Of those, 12 (63.2%) were promoters. Additionally, the one physician who only worked day shifts had 24 completed surveys, of which 21 (87.5%) were promoters. Excluding the combined 43 encounters from that physician and the three nocturnists made it such that 78.8% of patients who arrived between 7 AM–7 PM were promoters and 68.2% of the patients who arrived between 7 PM–7 AM were promoters, a difference of 10.6% (95% CI 4.6–16.6%), $P = < 0.001$.

Multivariable Regression Analysis

On multivariable analysis, arrival during the night shift had a statistically significant association with a lower chance that the patient would be a promoter, with adjusted odds ratio 0.60 (95% CI 0.43–0.84), $P = 0.003$. Other

Table 3. The percentage of completed satisfaction surveys considered promoters overall and at each of the three emergency departments, comparing patients who arrived on day shift vs night shift.

	Day-shift arrival promoters, n (%)	Night-shift arrival promoters, n (%)	Absolute % difference (95% CI)	*P*-value
Overall (N = 1,000)	525 (79.2)	228 (67.7)	11.5 (5.7 to 17.4)	<0.001*
Main hospital (n = 592)	304 (78.4)	137 (67.2)	11.2 (3.6 to 18.8)*	0.003*
Freestanding ED #1 (n = 227)	160 (85.0)	47 (70.2)	14.8 (2.6 to 27.1)*	0.01*
Freestanding ED #2 (n = 181)	85 (73.9)	44 (66.7)	7.2 (–6.7 to 21.2)	0.30

*Indicates a statistically significant difference.
CI, confidence interval; *ED*, emergency department.

Table 4. The adjusted odds ratios of various demographic and clinical variables and their association with being a "promoter" (a patient who gives high ratings to a physician on patient satisfaction surveys).

Characteristic	Adjusted odds ratio for being a promoter (95% CI)
Demographics	
Elderly (age > 65) (n = 281)	2.62 (1.72–4.08)*
Pediatric (age < 18) (n = 106)	0.80 (0.48–1.34)
White race (n = 778)	0.91 (0.62–1.31)
Hispanic ethnicity (n = 570)	0.86 (0.59–1.26)
Health Insurance	
Commercial (n = 594)	0.78 (0.53–1.14)
Government or other	Reference
No insurance (n = 101)	0.83 (0.47–1.46)
Married (n = 366)	0.98 (0.70–1.40)
Non-English speaking (n = 341)	**1.82 (1.18–2.82)***
Time of year of visit	
Quarter 1 (n = 237)	0.93 (0.60–1.43)
Quarter 2 (n = 273)	0.84 (0.55–1.28)
Quarter 3 (n = 240)	1.29 (0.82–2.03)
Quarter 4 (n = 250)	Reference
Facility	
Main ED (n = 592)	Reference
Freestanding ED #1 (n = 227)	0.91 (0.38–1.08)
Freestanding ED #2 (n = 181)	0.65 (0.51–1.60)
Clinician characteristics	
Seen by a resident (n = 397)	0.81 (0.51–1.27)
APP primarily (n = 207)	0.78 (0.51–1.19)
Sign-out (n = 54)	1.08 (0.54–2.28)
Clinical characteristics	
Emergency severity index	
ESI level 2 or 3 (n = 663)	Reference
ESI level 4 or 5 (n = 337)	0.97 (0.67–1.41)
Arrived by ambulance (n = 46)	0.54 (0.28–1.09)
Blood test performed (n = 413)	1.11 (0.76–1.64)
Advanced Imaging performed (n = 318)	1.38 (0.92–2.09)
Opioid pain medicine given (n = 108)	1.01 (0.60–1.73)
Prescription given (n = 543)	1.15 (0.84–1.59)
ED length of stay (for 1-h increase)	0.94 (0.84–1.04)
Arrival during night shift (n = 337)	0.60 (0.43–0.84)*

*Indicates a statistically significant association.
APP, advanced practice practitioner; *CI*, confidence interval; *ED*, emergency department; *ESI*, Emergency Severity Index.

than night-shift arrival, no other variables were associated with a reduced chance of being a promoter. On the other hand, elderly patients (age > 65) and non-English speaking patients had positive associations with being a promoter (Table 4).

DISCUSSION

In this cross-sectional study, we found that ED patients who arrive or depart during night shift are less likely to be promoters as compared to day-shift patients. Notably, the patient population that completed the satisfaction surveys

and arrived during a night shift was substantially different than those patients who arrived during day shift. Considering this and other intuitive challenges of night shifts, unadjusted comparisons of physicians who work different ratios of day and night shifts on any number of metrics are likely to be compromised. However, in our study even after adjusting for several differences between day and night shifts, we still found an association between night-shift arrival and lower patient satisfaction scores.

Prior data on this subject has been mixed. One prior study evaluated the relationship between night shifts and ED patient satisfaction scores using data from 2009–2013 from a single ED and did not show a significant association.[14] On the other hand, a prior large study using data from 42 facilities from 2012–2015 found that physicians who worked fewer night shifts had higher patient satisfaction scores.[16] Both of these studies attempted to assess a large number of physician, facility, and operational factors that might affect patient satisfaction scores. A relative strength of our study was that it was a more targeted and granular assessment specifically of night- vs day-shift patient satisfaction scores.

Our study was not designed to specifically assess the associations of other variables with patient satisfaction scores, but we will briefly review the secondary findings. In this regard, our results were largely consistent with previous work, including our findings that elderly patients and non-English speaking patients are more likely to provide high satisfaction scores.[14,22] Prior data has been mixed with regard to the association of LOS and patient satisfaction.[11–13,16,24,25] We failed to find an association between ED LOS and patient satisfaction (Table 4), which is consistent with previous work that has reported that perceived LOS is more important than actual LOS.[24,25]

Overall, although empathy and communication are important contributors to patient satisfaction[15,22,24] that an emergency clinician can mostly control, there are many factors that they cannot. Our data and previous demonstrate that night shift work, the patient population,[14] and the facility[16,23] all influence patient satisfaction scores. Considering also that the response rate for ED satisfaction surveys is so low (<10% in our system and similar in many others[26]) and that only discharged patients are sent surveys, we recommend against the use of patient satisfaction scores to determine payment for emergency clinicians.

LIMITATIONS

This study had several limitations. First, our data comes from a single hospital system that has fairly high patient satisfaction scores; so, our results may not be applicable to other EDs. Additionally, given the retrospective and observational nature of the study, there could have been some unmeasured confounders that could explain the differences in patient satisfaction between the day and night shifts. Namely, while physicians usually work both day and night shifts, nursing staff and support staff more typically work only days or only nights. Therefore, differences in staffing might explain the differences in satisfaction scores. Moreover, prior studies have demonstrated that communication is an important factor in ED patient satisfaction scores,[22,27] but given the design of this study, it was not possible to assess the quality of communication.

Next, our data did not have the granularity to adjust for patient volume for each shift, which could have impacted patient satisfaction. However, given that the median ED LOS was similar in the day- and night-shift groups, we doubt that differences in patient volume would explain the lower satisfaction scores by night-shift patients. Lastly, the low response rate to patient satisfaction surveys is a limitation in that survey responses are likely substantially influenced by selection bias, but we do not consider this a limitation specific to our study because our goal was to compare the real-world patient satisfaction scores from day- vs night-shift patients (with current survey techniques). Our results thus provide a comparison of the data that is actually being used to assess clinicians' performance on patient satisfaction.

CONCLUSION

In this cross-sectional study, night-shift arrival to the ED was associated with a statistically significant lower chance that the patient would be a promoter on satisfaction surveys. Given this finding and previous data suggesting that other issues beyond the physician's control heavily influence satisfaction scores, facility factors, patient characteristics, and operational factors (including the time of the ED visit) should be considered when assessing patient satisfaction scores.

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Comparison of Emergency Department Disposition Times in Adult Level I and Level II Trauma Centers

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Introduction: The efficient utilization of resources is a crucial aspect of healthcare, particularly in both Level I and Level II American College of Surgeons (ACS)-verified trauma centers. The effect of resource allocation on emergency department length of stay (ED-LOS) of trauma patients has remained under-investigated. As ED crowding has become more prevalent, especially at quaternary care centers, an evaluation of the potential disparities in ED-LOS between Level I and Level II trauma centers is warranted. We hypothesized a longer ED-LOS at Level I centers compared to Level II centers.

Methods: We queried the 2017–2021 Trauma Quality Improvement Process (TQIP) database for trauma patients ≥18 years of age presenting to either a Level-I or -II center. The TQIP defines ED-LOS as the time from arrival until the time an ED disposition (admission or discharge) order is written. We excluded transferred patients and those with missing data regarding ACS trauma center verification level. We performed bivariate analyses, as well as subgroup analyses based on location of disposition.

Results: Of 2,225,067 trauma patients, 59.3% (1,318,497) received treatment at Level I centers. No significant differences were found in Injury Severity Scores between patients admitted to the operating room or non-intensive care unit (ICU) locations, or discharged home from Level-I and -II centers (all $P < 0.05$). The ED-LOS for trauma patients was longer at Level-I centers for all patient categories: overall (198 vs 145 minutes [min], $P < 0.001$), discharged home (286 vs 160 min, $P < 0.001$), non-ICU admissions (234 vs 164 min, $P < 0.001$), and those requiring surgery (126 vs 101 min, $P < 0.001$).

Conclusion: Even when treating patients with similar injury severity, trauma patients at Level I trauma centers had longer ED-LOS compared to Level II centers, irrespective of the patients' final disposition (surgery, non-ICU admission, or discharge). To optimize resource utilization and alleviate ED saturation, further research must delve into the underlying causes of these discrepancies to identify best practices and solutions. [West J Emerg Med. 2024;25(6)938–945.]

INTRODUCTION

Trauma continues to pose a significant public health challenge that places substantial demands on healthcare systems. Since 2010, trauma has consistently been the leading cause of death for young adults.[1] The Coalition for National Trauma Research reports that trauma accounts for approximately 41 million emergency department (ED) visits each year as well as two million hospital admissions annually.[2] In this context, the length of stay (LOS) in the ED acts as a key metric, reflecting the efficiency and effectiveness

of patient care. Prolonged ED-LOS is associated with adverse clinical outcomes, including increased risk of hospital-acquired infections, delays in the administration of critical medications, and increased mortality, which highlights the importance of rapid and well-coordinated emergency care.[3–10] Existing literature highlights disparities in ED-LOS across various medical centers; however, there is a significant lack of data focusing on trauma centers.[11]

Trauma centers are designated by the American College of Surgeons (ACS) based on patient volume, staffing, resources, injury prevention, and education.[12] This tiered structure has enabled a shift from traditional, hospital-centric models to a more integrated, regionalized system of trauma care.[13] Despite existing studies highlighting the complexities of trauma cases and the impact of prolonged ED-LOS, there remains a substantial gap in research concerning how resource allocation affects ED-LOS for trauma patients, particularly between various levels of trauma centers.[14–18] These levels may differ in terms of resources and capabilities in the ED, with Level I trauma centers (L1TC) typically handling more complex cases and having more comprehensive resources compared to Level II trauma centers (L2TC).

The importance of investigating ED-LOS differences between L1TCs and L2TCs has become more pronounced in the wake of the COVID-19 pandemic. The pandemic affected trauma mechanisms and outcomes including exacerbated ED crowding, a longstanding issue in healthcare, and posed unique challenges to trauma care, particularly in higher level trauma centers, which often serve as quaternary care facilities.[19–24] Crowding leads to delays in care and a bidirectional impact on both trauma and non-trauma patients. The influx of trauma patients to the ED reallocates staff and resources from other patients undergoing simultaneous evaluation and treatment, increasing their ED-LOS.[25,26]

In this study we aimed to analyze a large United States trauma database to compare ED-LOS between adult trauma patients at L1TCs and L2TCs. We hypothesized an increased ED-LOS at L1TCs compared to L2TCs. This research may help improve patient experience and quality of healthcare as ED crowding continues to impact hospitals nationwide.

Population Health Research Capsule

What do we already know about this issue?
Prolonged ED length of stay (LOS) is linked to adverse clinical outcomes and highlights the importance of rapid and well-coordinated emergency care.

What was the research question?
How does ED-LOS for trauma patients differ between Level I and Level II trauma centers?

What was the major finding of the study?
The ED-LOS for trauma patients at Level I centers was longer overall (198 vs 145 minutes, $P < 0.001$) compared to Level II centers.

How does this improve population health?
This research enhances our understanding of patient experience and quality of healthcare by addressing ED crowding, a longstanding issue nationwide.

METHODS

This study was deemed exempt from institutional board review, and a waiver of consent was granted for use of a de-identified national database. We performed a retrospective analysis of the Trauma Quality Improvement Program (TQIP) database from 2017–2021. Patients ≥18 years of age presenting to either an ACS-verified L1TC or L2TC were included. We excluded all patients transferred from another facility as well as those with missing data regarding ACS trauma center-verification level. Our primary focus was to accurately assess ED-LOS for trauma patients. Including transfer patients would have introduced confounding factors that could have significantly skewed our analysis. Trauma transfer patients may have already undergone extensive evaluations and imaging at the initial hospital, which can artificially shorten their ED-LOS at the receiving hospital. Additionally, some of these patients may have been pre-accepted by the trauma team, resulting in a more expedited admission process compared to non-transfer patients. Therefore, including transfer patients would not provide an accurate representation of ED-LOS for trauma patients. We compared two groups: adult trauma patients treated at L1TCs vs L2TCs. This included a comparison of all patients regardless of level of care.

We collected patient demographic variables including age and prehospital comorbidities such as diabetes mellitus, hypertension, anticoagulant therapy, mental or personality disorder, smoking status, houselessness, and substance use. The injury profile included the Injury Severity Score (ISS), and the Abbreviated Injury Scale (AIS) of the head, abdomen, and thorax. We also collected vitals on arrival including hypotension (systolic blood pressure ≤ 90 millimeters of mercury), tachycardia (heart rate > 120 beats per minute), and tachypnea (respiratory rate > 22 breaths per minute). The primary outcome measured was ED-LOS. Additionally, we collected patient disposition from the ED, including admission to the general hospital floor, intensive care unit (ICU), operating room (OR), or discharge to home.

We also analyzed inpatient complications, such as acute kidney injury, cardiac arrest, unplanned intubation, ventilator-acquired pneumonia, and deep vein thrombosis. We contrasted patient characteristics, injury profiles, complications, and dispositions between adult patients treated at L1TCs and L2TCs.

We performed bivariate analyses using a Mann-Whitney U test to compare continuous variables and chi-square to compare categorical variables. We report categorical data as percentages and continuous data as medians with interquartile range (IQR) or as means with standard deviation. A multivariable logistic regression analysis was also performed to determine the associated risk of mortality and complications. Each model included known risk factors for mortality and inhospital complications for trauma patients including age, vitals on admission, mechanism, ISS, and the presence of traumatic brain injury.[27–30] These covariates were determined by co-author consensus and review of the literature. All *P*-values were two-sided with a statistical significance level of <0.05. We performed all analyses with SPSS Statistics for Windows v29 (IBM Corp, Armonk, NY). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist was used to ensure adherence with established guidelines for reporting observational studies.[31]

RESULTS

Demographics, Characteristics, and Injuries of Patients at Level-I vs II-Trauma Centers

Of 2,225,067 patients, 59.3% (1,318,497) received treatment at a L1TC and 40.7% (906,570) at a L2TC. Patients at L1TCs were generally younger (median 50 vs 58 years, $P < 0.001$) than at L2TCs. The L1TC and L2TC patients had a similar median ISS of 9. However, patients at L2TCs had higher rates of the following prehospital comorbidities: anticoagulant therapy (12.1% vs 8.8%, $P < 0.001$); diabetes mellitus (15.2% vs 13.5%, $P < 0.001$), and hypertension (37.2% vs 31.9%, $P < 0.001$). Patients at L1TCs were more often houseless (1.6% vs 1.2%, $P < 0.001$); more often underwent blood transfusions compared to L2TCs (5.9% vs 3.6%, $P < 0.001$), and had higher rates of substance use disorder (9.0% vs 6.3%, $P < 0.001$) (Table 1). Patients

Table 1. Demographics, comorbidities, and vital signs of adult trauma patients treated at level I vs level II trauma centers.

Characteristic	Level I (n = 1,318,497)	Level II (n = 906,570)	*P*-value
Age, year, median (IQR)	50 (32, 68)	58 (39, 77)	<0.001
Comorbidities, n (%)			
Alcohol use disorder	92,090 (7.1%)	54,266 (6.1%)	<0.001
Houselessness*	4,834 (1.6%)	2,383 (1.2%)	<0.001
Congestive heart failure	48,149 (3.7%)	40,712 (4.5%)	<0.001
Current smoker	306,022 (23.5%)	168,447 (18.8%)	<0.001
Chronic renal failure	20,982 (1.6%)	15,992 (1.8%)	<0.001
Cerebrovascular accident	32,748 (2.5%)	25,637 (2.9%)	<0.001
Diabetes mellitus	175,825 (13.5%)	135,779 (15.2%)	<0.001
Hypertension	416,425 (31.9%)	334,025 (37.2%)	<0.001
Chronic obstructive pulmonary disease	76,547 (5.9%)	65,353 (7.3%)	<0.001
Cirrhosis	15,868 (1.2%)	9,301 (1.0%)	<0.001
Dementia	53,592 (4.1%)	53,164 (5.9%)	<0.001
Anticoagulant therapy	114,428 (8.8%)	108,082 (12.1%)	<0.001
Angina pectoris	1,872 (0.1%)	2,137 (0.2%)	<0.001
Myocardial infarction	7,609 (0.6%)	5,833 (0.7%)	<0.001
Peripheral arterial disease	10,938 (0.8%)	9,362 (1.0%)	<0.001
Substance use disorder	117,680 (9.0%)	56,160 (6.3%)	<0.001
Vitals on admission, n (%)			
Hypotension (SBP < 90)	59,051 (4.6%)	29,024 (3.3%)	<0.001
Tachycardia (HR > 120)	99,388 (7.7%)	55,816 (6.3%)	<0.001
Tachypnea (RR > 22)	223,774 (17.6%)	136,745 (15.5%)	<0.001
Blood transfusion, n (%)	78,273 (5.9%)	32,230 (3.6%)	<0.001

*Only includes 2021 data.
IQR; interquartile range; *HR*, heart rate; *RR*, respiratory rate; *SBP*, systolic blood pressure.

treated at L1TCs also had increased rates of high-grade injuries (AIS > 3) to the head (14.4% vs 14.2%, $P < 0.002$), abdomen (4.8% vs. 3.5%, $P < 0.001$), and thorax (15.8% vs. 13.1%, $P < 0.001$) (Table 2).

ED-LOS of L1TC and L2TC

Patients at L1TCs were admitted at higher rates to the ICU (19.3% vs 17.6%, $P < 0.001$) and directly to the OR (13.7% vs 10.6%, $P < 0.001$), while patients at L2TCs were admitted at higher rates to the general hospital floor/ward (57.1% vs 55.4%, $P < 0.001$) and discharged home (9.8% vs 7.9%, $P < 0.001$). The L1TC patients had increased median ED-LOS for all dispositions when compared to L2TC patients: overall (198 vs 145 minutes [min], $P < 0.001$); discharged home (286 vs 160 min $P < 0.001$); non-ICU admissions (234 vs 164 min, $P < 0.001$), ICU admissions (123 vs 108 min, $P < 0.001$), and direct transport to the OR (126 vs 101 min, $P < 0.001$) (Table 3).

Other Measured Outcomes of Level I- and II-Trauma Centers

When compared with L2TCs, the occurrence of an inhospital complication was higher at L1TCs (5.8% vs 4.4%, $P < 0.001$). This included increased rates of unplanned intubation (1.1% vs 0.8%, $P < 0.001$), ventilator- acquired pneumonia (0.5% vs 0.3%, $P < 0.001$), and deep vein thrombosis (0.7% vs 0.5%, $P < 0.001$) at L1TCs. Increased rates of unplanned ICU admissions (1.6% vs 1.3%, $P < 0.001$) and unplanned returns to the OR (0.7% vs 0.5%, $P < 0.001$) also occurred more commonly at L1TCs (Table 4). After adjusting for confounders, L1TC patients continued to exhibit a higher associated risk of complications (odds ratio [OR] 1.22, confidence interval [CI] 1.20–1.24, $P < 0.001$). Compared with L2TC patients, L1TC patients exhibited a higher rate of mortality (4.8% vs 3.8%, $P < 0.001$) (Table 4). However, this trend did not persist when controlling for known risk factors of mortality (OR 0.99, CI 0.97–1.01, $P = 0.09$).

DISCUSSION

This comprehensive five-year retrospective national analysis revealed that despite comparable injury burdens, patients treated at L1TCs experienced a longer associated ED-LOS across all disposition categories, along with a higher rate and associated risk of complications, compared to those at L2TCs. Interestingly, the associated risk of mortality remained similar between the two levels of trauma center designations.

Emergency department crowding remains a prominent issue, representing a pervasive challenge associated with delayed treatment, reduced patient satisfaction, and increased mortality.[32,33] This situation occurs when the demand for emergency care surpasses the available resources in the ED, hospital, or both.[34] Despite variations in definitions and measurements of crowding among hospitals, its repercussions will almost always result in a longer ED-LOS.[35] White et al's study, focusing on discharged patients, corroborates this correlation by revealing a 10% increase in ED-LOS for patients seen during periods of ED crowding.[36] Crowding often leads to a bottleneck effect in patient flow,

Table 2. Injuries for adult trauma patients treated at level I vs level II trauma center.

Characteristic, n (%)	Level I (n = 1,318,497)	Level II (n = 906,570)	*P*-value
ISS, median (IQR)	9 (4.5, 13.5)	9 (6,12)	<0.001
Blunt mechanism, n (%)	1,107,121 (84.0%)	810,732 (89.4%)	<0.001
AIS grade > 3, n (%)			
Head	189,248 (14.4%)	128,778 (14.2%)	<0.002
Abdomen	63,011 (4.8%)	31,659 (3.5%)	<0.001
Thorax	208,098 (15.8%)	118,421 (13.1%)	<0.001
Injury, n (%)			
Brain	221,032 (16.8%)	134,573 (14.8%)	<0.001
Liver	43,616 (3.3%)	18,070 (2.0%)	<0.001
Small intestine	17,861 (1.4 %)	6,904 (0.8 %)	<0.001
Colon	16,162 (1.2%)	5,979 (0.7%)	<0.001
Rectum	2,072 (0.2%)	675 (0.1%)	<0.001
Kidney	20,043 (1.5%)	9,370 (1.0%)	<0.001
Spleen	36,477 (2.8%)	17,827 (2.0%)	<0.001
Pancreas	4,756 (0.4%)	1,687 (0.2%)	<0.001
Stomach	5,138 (0.4%)	1,723 (0.2%)	<0.001

AIS, Abbreviated Injury Scale; *IQR*, interquartile range; *ISS*, Injury Severity Scale.

Table 3. Disposition of adult trauma patients treated at a level I vs level II trauma center.

Characteristic	Level I (n = 1,318,497)	Level II (n = 906,570)	*P*-value
Disposition from ED, n (%)			
Admit to floor	731,039 (55.4%)	517,613 (57.1%)	<0.001
Admit to ICU	254,892 (19.3%)	159,987 (17.6%)	<0.001
Direct to OR	180,479 (13.7%)	95,952 (10.6%)	<0.001
Discharged home	103,779 (7.9%)	88,399 (9.8%)	<0.001
ED LOS, minutes, median (IQR)			
All patients	198 (233)	145 (138)	<0.001
Admit to floor	234 (230)	164 (140)	<0.001
Admit to ICU	123 (163)	108 (108)	<0.001
Direct to OR	126 (196)	101 (117)	<0.001
Discharged home	286 (283)	160 (139)	<0.001

ED, emergency department; *ICU*, intensive care unit; *IQR*, interquartile range; *LOS*, length of stay; *OR*, operating room.

where patients awaiting admission occupy ED beds, thus limiting the availability for new patients. This scenario is further exacerbated during peak times or public health crises, like the COVID-19 pandemic, where an influx of patients can overwhelm ED resources. Prolonged wait times can lead to patient discomfort and dissatisfaction.[37] Pines et al observed that extended ED-LOS was linked to a diminished probability of patients recommending the hospital to others, coupled with a lower perception of effective teamwork among hospital staff.[38]

The dynamics of resource utilization at trauma centers requires further investigation to uncover the underlying reasons for the observed prolonged ED-LOS at L1TCs. For instance, these centers are widely acknowledged for managing high patient volumes and catering to more complex cases that might hinder the flow of patients through the ED.[39] This is supported by our study demonstrating that L1TCs more often treat patients with severe injuries to the head, abdomen, and thorax, compared to L2TCs. This may necessitate more comprehensive diagnostic evaluations, specialized interventions, and/or coordination among various surgical specialties, all of which contribute to longer LOS in the ED. Additionally, L1TCs often host residency programs and frequently involve residents and house staff in patient care, a feature less commonly found at L2TCs.[40] The involvement of trainees may contribute to a longer ED-LOS, as residents and house staff may need to consult with attending physicians and supervisors to discuss treatment plans, which may lead to increased deliberation and decision-making time.[41–43] Understanding the impact of educational programs on ED-LOS is necessary for optimizing resource allocation and enhancing efficiency of trauma care delivery within different levels of resource centers.

Patients at L1TCs were also more frequently impacted by social determinants of health including houselessness and substance use disorder. Our study revealed that L1TCs more often cared for houseless patients and those suffering from substance use disorder. Unhoused patients tend to experience longer ED-LOS since disposition planning and arrangements prove to be more complicated for patients lacking stable housing while their medical needs are being addressed.[44–46] Moreover, houseless patients face markedly higher odds of hospital admission compared to their housed counterparts, a disparity likely influenced by clinicians' concerns over the risks and safety of discharging individuals back to the streets.[47,48] The pronounced presence of social determinants of health among patients at L1TCs highlights the complex interplay between healthcare delivery and societal issues, emphasizing the need for further investigation into healthcare disparities.

Increased ED-LOS may result in worsened clinical outcomes. We did not find a higher risk of mortality for patients treated at L1TCs; however, we did find a higher associated risk of inhospital complications. This pattern suggests suboptimal utilization or availability of important resources, potentially leading to the decompensation of patients. In support of this hypothesis, we found that patients at L1TCs had higher rates of unplanned intubation, ICU admission, and return to the OR. While the TQIP database is not granular enough to determine whether these complications were the result of increased ED-LOS, it does highlight the need for enhanced management strategies to ensure that patients receive timely and effective care, particularly in high-acuity settings where the margin for error is minimal.

Efficiently addressing the challenge of ED-LOS involves a multifaceted approach, integrating both strategic capacity management and innovative patient care practices. Key strategies include optimizing inpatient bed use, expanding ED capacity through additional beds or staffing, and early

Table 4. Outcomes for adult trauma patients treated at level I vs level II trauma centers.

Characteristic, n (%)	Level I (n = 1,318,497)	Level II (n = 906,570)	*P*-value
Any complication	76,217 (5.8%)	39,600 (4.4%)	<0.001
Cardiac arrest	12,623 (1.0%)	6,782 (0.7%)	<0.001
Catheter-associated UTI	2,329 (0.2 %)	1,073 (0.1%)	<0.001
Deep SSI	1,863 (0.1%)	646 (0.1%)	<0.001
Organ space SSI	1,432 (0.1%)	392 (<0.1%)	<0.001
Superficial SSI	1,360 (0.1%)	635 (0.1%)	<0.001
Deep vein thrombosis	8,802 (0.7%)	4,647 (0.5%)	<0.001
Pulmonary embolism	4,890 (0.4%)	2,016 (0.2%)	<0.001
Unplanned intubation	13,927 (1.1%)	7,400 (0.8%)	<0.001
Acute kidney injury	7,296 (0.6%)	3,971 (0.4%)	<0.001
Pressure ulcer	6,036 (0.5%)	2,948 (0.3%)	<0.001
Acute respiratory distress syndrome	3,884 (0.3%)	1,822 (0.2%)	<0.001
Unplanned return to OR	8,784 (0.7%)	4,126 (0.5%)	<0.001
Sepsis	4,107 (0.3%)	1,968 (0.2%)	<0.001
Stroke	3,581 (0.3%)	1,931 (0.2%)	<0.001
Unplanned ICU admission	21,417 (1.6%)	11,540 (1.3%)	<0.001
Ventilator-associated PNA	7,027 (0.5%)	2,654 (0.3%)	<0.001
Mortality rate, n (%)	63,347 (4.8%)	34,067 (3.8%)	<0.001

ICU, intensive care unit; *OR*, operating room; *PNA*, pneumonia; *SSI*, surgical site infection; *UTI*, urinary tract infection.

physician assessments to expedite decision-making, thereby reducing ED crowding and prolonged ED-LOS.[49] Proven interventions such as the fast-track process, which notably reduced ED-LOS for low-acuity patients by 25%, and revised triage approaches in L1TCs have demonstrated success in expediting care and reducing ED-LOS.[50] Another example of effective triage-system redesign involves establishing specialized units specifically for less severe cases, along with the inclusion of advanced practice practitioners. This approach has successfully led to a reduction in ED-LOS by more than 30 minutes.[51]

LIMITATIONS

This study is limited by potential reporting and selection biases, coding errors, and missing data inherent in database studies. We did not consider a wide array of external factors that could influence ED-LOS, such as fluctuations in ED volume per center, disproportionate increases in centers approved, and variations in hospital and ED occupancy. Additionally, our study contains constraints in identifying specific treatment locations within the hospital, whether that be a dedicated trauma area or the general ED. A further limitation is our inability to control for competing LOS factors. Specifically, we were unable to account for factors including resident staffing, consult management, and the differing practice patterns for emergent and non-emergent care between the ED and other hospital settings.

Geographical differences between trauma centers were not considered, which might impact ED-LOS due to variations in regional healthcare policies, patient demographics, and resource availability. The TQIP database does not provide granular details on specific interventions and decision-making processes in the ED, which could affect LOS. Furthermore, we did not include patient socioeconomic factors in the analysis, which could have impacted ED-LOS and patient outcomes. Finally, as with all database studies, we cannot conclude any definitive causality statement regarding trauma center level and ED-LOS. Despite these limitations, our findings contribute significantly to the discourse on ED-LOS, laying a foundation for future research aimed at optimizing resource allocation and improving trauma care delivery in L1TCs and L2TCs.

CONCLUSION

This comprehensive analysis highlights a significant observed disparity in ED length of stay between Level I and Level II trauma centers. Level I trauma centers consistently reported longer associated ED-LOS across various patient dispositions, as well as a higher risk of complications, despite treating similarly injured patients. Factors leading to these findings could range from operational protocols and resource management to patient case complexity and institutional policies. Due to limitations of the Trauma Quality

Improvement Program database, we were unable to attribute the observed differences in ED-LOS to any single factor, as the associations observed in our study are based on data from a large national database, which enhances the generalizability of our findings across diverse settings. This broad scope reduces the influence of regional policies and allows our results to be applicable on a wider scale. However, addressing these underlying causes is essential not only for enhancing the efficiency of patient flow through the hospital but also for improving the overall quality of care provided to trauma patients. To effectively tackle this issue, further prospective research is needed to delve into the specifics of why these discrepancies exist. This includes examining hospital operational strategies, patient flow processes, staffing models, and the use of technology in patient management.

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Weighing In

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"What is your patient's biggest problem?"

This simple question was posed two decades ago by an attending physician to a medical student rotating in a family medicine clinic. The patient had the common trio of diabetes, hypertension, and hyperlipidemia, and the student went through this list of conditions. The student's attending, however, remained unconvinced. "Obesity," the attending finally said. "Obesity is this patient's biggest problem." The patient was overweight, yes, but in that comfortable way that we overlook in our family members, in our friends, and in ourselves. That was the first time in that medical student's training that any clinician had put weight on par with, and indeed above, other established chronic medical conditions. It was also the last time.

This vignette highlights our lack of routine acknowledgment of obesity as a disease.

Obesity is a disease,[1,2] just as diabetes, hypertension, and hyperlipidemia are diseases. Obesity is also a public health crisis, both locally and globally.[3] In the United States, up to one in three adults and one in six children are affected, and the incidence and prevalence has been increasing steadily over the past 20 years.[3] The increase in morbidity and mortality due to obesity cannot be understated: obese adults have lower life expectancy, lower quality of life, and substantial increases in healthcare costs.[3] Additionally, obesity increases the risk of being diagnosed with other lifelong diseases such as diabetes, hypertension, coronary artery disease, myocardial infarction, and stroke.[4] In addition, the combination of obesity and other comorbid conditions, eg, smoking, can increase the risk of death by up to 11 times that of a non-obese, non-smoker.[5] It is through these lenses that public health officials have recognized obesity as an alarming disease process that threatens the lives of both young and old and is increasingly prevalent in US healthcare.

As emergency physicians, we do not, for the most part, have long-term relationships with our patients. We expect primary care physicians and those who provide ongoing care to make it their business to counsel on weight loss. Unfortunately, the data says otherwise. According to the US Centers for Disease Control and Prevention (CDC), even in physician visits made specifically for obesity, weight-related health education was only offered half of the time.[6]

Emergency departments (ED) are the safety nets of the US healthcare system, caring for acute, unscheduled patients regardless of ability to pay. While many ED visits are subsequently deemed to be non-emergent, they still require a timely evaluation and involve some, albeit not as comprehensive, preventative care interventions. We tell our patients to quit smoking, practice safe sex, take seizure precautions, wear their seat belts and bicycle helmets, and get their COVID-19 shots. Charts are littered with "dot phrases" such as the following: "Patient is counseled for tobacco cessation"; "Will admit for TIA rule-out and initiate statin therapy"; "Patient is treated empirically for urethritis and is counseled on safe sexual practices"; or "Patient is given information on low-salt diet for congestive heart failure." However, advice on proper diet and exercise is uncommon; in our clinical experience, we tend to address obesity only when it is morbid and when it disrupts our intended care plan; for example, when the patient is too overweight for a stretcher, a scanner, or a procedure. Should we be talking about weight in the ED? If the answer is yes, then what is the best way to have such discussions?

The question of the medical community's approach to obesity is important for two reasons. The first is what the COVID-19 pandemic taught us about obesity. The COVID-19 pandemic brought many of the failures in US healthcare into sharp focus, and the obesity epidemic was one of them. Our collective personal experience of clinical medicine during the pandemic made it clear: COVID-19 and obesity make catastrophic bedfellows. Of the 2.5 million COVID-19 deaths reported by February 2021, 2.2 million occurred in countries where more than half the population had a body mass index over 25.[7] Additionally, the CDC reported that obesity tripled the rate of hospitalization for COVID-19.[8] The second reason this topic is timely is because of the increasing move to normalize obesity,[9] a move that makes it less likely for physicians and patients alike to recognize obesity for what it is: a disease. This type of normalization threatens to make our opening vignette the continued standard.

Of course, the issue of obesity is complex. Obesity's causes are multifactorial, and any treatment must, as such, be multi-leveled.[10] In preventative health, the social ecology model (SEM) —a framework for health promotion that uses a multitiered approach to address the interplay between multiple factors that influence a given problem—would be employed to tackle obesity at the population level. The SEM postulates that conditions such as obesity are shaped at several levels: the individual, interpersonal, organizational, community, and public policy levels.[11] The SEM pivots away from an isolated attentiveness on individual behavior to a more encompassing understanding of tiers of influence. The SEM promotes interventions on the social determinants of health, the forces and systems that shape the well-being of a population. This means not only supporting individual efforts toward healthy diet and regular physical activity but also changing the context in which behaviors arise and are sustained. Thus, public health officials can include trans fat elimination in processed foods, community infrastructure that promotes greater physical activity, improving access to healthy foods, etc, as potential interventions.

Given all this, one might decide that obesity is too complex to deal with in the ED. No patient to our knowledge has ever signed into an ED with a chief complaint of "I am overweight"; that is to say, a patient's weight is never the reason they choose to come to the ED. So, why try to discuss what many consider a sensitive matter and risk jeopardizing one's rapport with a patient? We believe the ED, while certainly not the end-all-be-all, is still an important tier of influence; so, such discussions do have a place there.

How then can we talk to our patients about obesity in the ED? There are guidelines and practical approaches published in the medical literature that provide a framework in the primary care setting for engaging with patients about their weight.[12,13] The Canadian Obesity Network developed the "5As" of obesity counseling; ask, assess, advise, agree and assist.[14] Given the brevity of the ED encounter, we suggest the ED approach should be an abbreviated version of the 5As, perhaps better termed the 3As. It would involve first **asking** permission to discuss the patient's health risk, one risk being that they are well above ideal body weight. Sensitivity and non-judgmental language are paramount. If the patient is open to a conversation, one could go on to **advise** them on how their obesity can hurt them. Finally, it would be important to **assist** the patient by providing resources for outpatient follow-up and management. This is not unlike what we already do when we provide brief counseling to patients for other health concerns. The difference is that other health concerns are recognized by both patients and clinicians as addressable issues, while there is a pervasive lack of recognition of obesity as a disease.

But obesity is a disease. It behooves us now, more than ever, to address it as such.

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Perceptions and Use of Automated Hospital Outcome Data by EMS Providers: A Pilot Study

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Background: Our primary objective evaluated the perception of emergency medical service (EMS) providers' review of automated hospital outcome data. Secondarily, we assessed participation in outcome review as a means of microlearning to obtain continuing education (CE).

Methods: From October–December 2023, three high-volume EMS systems participated in a three-part intervention with results evaluated using a mixed-methods approach. First, EMS providers (emergency medical technicians and paramedics) were invited, via their electronic health record (EHR), to complete a presurvey evaluating their perceptions of reviewing outcomes. Then, EMS providers were notified about the opportunity to earn CE via a microlearning intervention, offering Commission on Accreditation for Pre-Hospital Continuing Education (CAPCE)-approved CE hours for completion of outcome reviews and associated learning modules. Finally, EMS providers were invited to complete a post-survey mirroring the pre-survey. Qualitative analyses identified themes among open-ended responses. Quantitative analyses examined perceptions between pre- and post- surveys.

Results: Of 843 providers contacted, 217 responded to the pre-survey (25.7%). The most endorsed rationale for reviewing outcomes included improving clinical knowledge (95%), improving patient care (94%), and knowing whether care made a difference (93%). Nearly all (91%) reported being more likely to review outcomes if CE were awarded. Among the 67 who completed the open-ended items, the three dominant themes included enhance personal confidence and competence (43%); acquire personal knowledge (39%); and operations (21%). Of 211 providers who participated in the intervention, 56 (27%) were awarded CE. A total of 152 providers responded to the post-survey, and the percentage who agreed that reviewing outcomes improves job satisfaction rose from 89% to 95% between pre- and post-surveys ($P = 0.05$).

Conclusion: EMS providers supported the personal and professional development and patient care improvement of reviewing patients' outcomes with associated CE. Further study is warranted to evaluate the generalizability of these findings and the best user experience. [West J Emerg Med. 2024;25(6)949–957.]

BACKGROUND

Emergency medical services (EMS) providers provide the majority of prehospital medical care in the United States and serve as a crucial component of the nation's healthcare delivery system. For EMS providers to maintain their license, every state has unique continuing education (CE) requirements, typically in the fashion of required hours, for licensure renewal. The National Registry of Emergency Medical Technicians also maintains an hour and topic requirement for recertification. This hour model has been used to ensure the continual competency of EMS providers,[1] as it has been historically accepted that competency can be maintained through CE hour requirements despite a lack of empirical evidence.[2]

In continuing medical education (CME), a broader concept of continued professional development (CPD), is emerging. Continued professional development includes education focused on problem identification and solution development, allowing the healthcare professional to tailor the learning process to their individual needs.[3] The process of CPD recognizes a one-size-fits-all approach, which is not specific enough for each learner. The Institute of Medicine recommends a CPD system that includes patient-centered care, interprofessional teamwork, quality improvement application, and clinical outcome data utilization for individual, team, and institutional assessment.[2,4] Feedback has also been demonstrated to improve system performance and patient outcomes.[5] Very public voices, including the EMS Agenda 2050, have included calls for EMS systems and providers to receive feedback, including patient outcomes, in real time, as a means for continuous quality improvement, thus moving toward a CPD approach to competency.[6] The National Association of EMS Physicians has also called for continual monitoring of airway performance data and its use in the continued credentialing process and quality management activities with large-scale bidirectional information shared between EMS and receiving facilities in their position paper on airway management and training.[7]

Despite this desired transition to CPD, providing patient-specific outcomes to EMS providers has long been a challenge. Bidirectional data sharing between EMS and hospitals has raised concerns about patient privacy and technological challenges[8,9] Fortunately, this trend is improving, based on the provision of outcome elements as a part of the National Emergency Medical Services Information System dataset and the clarification that such data-sharing is consistent with the Health Insurance Portability and Accountability Act guidelines.[10–12] When surveyed, EMS providers reported a desire for patient-specific outcomes. They even reported using informal networks or going around the system to obtain patient outcome information, assisting them to develop clinical skills.[7] This lack of insight, specifically centered around patient outcomes and EMS provider diagnosis accuracy, has been reported to impact provider mental health.[13]

Population Health Research Capsule

What do we already know about this issue?
EMS providers receive limited formal clinical feedback or microlearning continuing education (CE) following the treatment and transfer of their patients.

What was the research question?
What are the perceptions of EMS providers' review of automated hospital outcome data and associated CE credit?

What was the major finding of the study?
Following outcome review and CE opportunities, surveys demonstrated job satisfaction rose from 89% to 95% ($P = 0.05$).

How does this improve population health?
EMS review of patient outcomes improves job satisfaction and clinical knowledge, thus providing a means for continued competency of a highly trained EMS workforce.

The EMS provider is interested in including patient outcome data as a means of professional development similar to their colleagues in medicine.[14,15] Physicians' continued medical education has included electronic health records (EHR) to assess the quality of care and has been used to suggest areas for improvement through the use of CME.[16] Similarly, medical databases have found ways to help physicians receive CME with routine clinical questions and problem-solving in their daily practice.[17] Graduate medical education also envisions a system in which patient health records and outcome data can be incorporated into the curriculum. This framework includes mentors or instructors using the outcome data to assess, supervise, and teach, creating a mature, professional community where everyone receives and provides feedback.[18] The Accreditation Council for Graduate Medical Education similarly requires programs to connect resident-physician education to patient outcomes.[19]

Using patient outcome data as feedback continues to be called for and, on a small scale, has been demonstrated to be an effective part of CPD programs for EMS providers. In fact, the EHR serves as a valuable resource for CPD in providing patient-specific outcomes.[20] When evaluating CE

in pediatric emergencies, brief and frequent CE programs are recommended as a means to provide repetition with immediate feedback and error correction.[21] While feedback following a call is outside the proposed theoretical framework for clinical judgment in EMS, it has been noted as important in the development of EMS providers and allows for improvement in performance.[22] Post-resuscitation provider feedback for patients who have suffered cardiac arrest and heart attacks has led to improvements in time and treatment.[23,24] Sammuel and colleagues conducted a scoping review of the effects of CPD on healthcare professionals' performance and patient outcomes and were also able to demonstrate changes in providers' behavior and patient outcomes.[25]

Despite calls from leading national EMS organizations and other healthcare professions to incorporate patient outcomes into CE, little is known about EMS providers' perceptions of automated patient outcome data nor its use as microlearning to obtain continuing education. Our primary objective in this study was to evaluate EMS providers' perceptions of the utility of automated hospital outcome data for professional development. Secondarily, we evaluated their participation in outcome review as a means of microlearning to obtain CE.

METHODS

Study Design and Population

In this mixed-methods study we ued quantitative and qualitative methods to understand EMS provider perceptions regarding the use of an automated system enabling them to obtain Commission on Accreditation for Pre-Hospital Continuing Education (CAPCE)-approved CE by reviewing patient outcomes and completing associated learning modules. The CAPCE is an accrediting body charged with the review and accreditation of EMS CE.[26] The study was conducted from October–December 2023 in three high-volume urban EMS systems. The EMS providers were certified at the emergency medical technician through the paramedic level and were continuously provided 100% of their required CE hours through their employer.

At the beginning of the study, EMS providers in each system received a prompt inviting them to anonymously participate in this pilot study when they logged into their EHR (ESO, Austin TX). Each participating agency uses a system that allows EMS providers to automatically receive outcome data from the hospital, specific to patients they encountered in the prehospital setting. All CE activities were completed in a single online learning platform.

For those who agreed to participate in the first phase of the pilot study, participants were asked to voluntarily complete a pre-survey. They were also informed that they would be eligible to receive CE hours, approved by CAPCE, upon completion of outcome reviews, associated videos, and outcome review assessments. A prompt to review outcomes as part of this study was received by participants when they logged into the EHR and navigated to the outcome review section. The CE phase was open for at least two weeks. This was followed by another invitation in the EHR to complete the post-survey that mirrored the pre-survey. Participants were required to specifically opt into each survey and the CE phase of the study.

CAPCE-Approved Continuing Education

During the CE phase, participants were provided a link from the outcome review page that directed them to login to the learning platform. Two prerequisite videos provided background information and described the types of outcome information available: International Classification of Diseases diagnosis codes and Centers for Medicare and Medicaid Services disposition (eg, discharge to home, discharge to skill nursing, transfer, death, etc). Upon completion of these prerequisites, participants were able to review their patient-specific outcomes and answer a series of questions regarding each review.

Data Analysis

We used quantitative analyses to examine perceptions between pre- and post-surveys using chi-square tests or Fisher exact tests, as appropriate. Likert-scale response options (agree vs disagree) and demographics (Level: paramedic vs other; Role: patient care provider vs other; years of experience: 0–4 years, 5–10 years, 11–20 years, ≥21 years; previous frequency of outcomes review: very frequently/frequently vs occasionally/ rarely/never) were collapsed, as needed and where appropriate, due to cell size. Participation in the CAPCE CE phase of the study was also quantified. Data is reported as percentages and frequencies. *P*-values of statistical tests are also included. We performed quantitative analysis using STATA MP version 18.0 (StataCorp LLC; College Station, TX).

Qualitative analyses identified themes among open-ended responses. We used conventional content analysis as described by Hsieh and Shannon (2005). An inductive approach was used to extract meaning and themes from responses. All codes were generated from the content directly without a priori themes. Once codes were identified, we used a deductive approach to determine the frequency and distribution of themes as well as any relationships that existed between themes and respondent characteristics. Qualitative analysis was assisted using the QDA Miner Lite 3.0 (Provalis Research; Montreal, Quebec) software package.

This study was deemed exempt by the University of California Los Angeles Institutional Review Board.

RESULTS

During the study period, 843 EMS providers from the participating agencies logged into the EHR and were

therefore eligible to participate. A total of 217 (25.7%) EMS providers anonymously responded to the pre-survey while on duty, and 152 (18.0%) anonymously responded to the post-survey while on duty. Demographics were similar among those that responded to the pre- and post-survey (Table 1).

Overall, responses were similar when comparing those who responded to the pre-survey and those who responded to the post-survey (Table 2). Notably, 89% in the pre-survey vs 95% in the post-survey indicated agreement that outcomes review enhanced job satisfaction ($P = 0.05$). When evaluating only those with a paramedic certification, we saw a statistically significant increase ($P = 0.03$) in the percentage of those indicating they review outcomes to improve clinical knowledge when comparing pre-survey respondents to post-survey respondents (94% vs 99%, respectively). We also noted that pre- and post-survey differences with respect to improvements in job satisfaction remained significant when only evaluating paramedics. No statistically significant difference was noted among pre-and post-survey respondents of those with other certification levels (Table S1). When examining years of EMS experience or role in the EMS system, responses between pre- and post-survey respondents were similar regardless of how many years the individual had worked in EMS (Table S2).

There were two significant differences when comparing those who responded to the pre-survey and those who responded to the post-survey when stratified by historical frequency of outcomes review. Among those who indicated that they review patient outcomes frequently or very frequently, we saw a significantly higher percentage of post-survey respondents indicating that they reviewed patient outcomes to obtain closure (90% vs 98%, $P = 0.01$, respectively) and that reviewing patient outcomes improves job satisfaction (92% vs 99%, $P = 0.02$, respectively) (Table S3).

CAPCE-Approved Continuing Education

A total of 211 individuals from the three participating EMS systems opted in to the CAPCE CE phase of this pilot study. Among those, 63% (133/211) successfully logged into

Table 1. Participant characteristics.

% (n)	Pre-survey (N = 217)	Post-survey (N = 152)
Certification level		
Emergency medical technician (EMT)	14.8% (32)	11.2% (17)
Advanced emergency medical technician (AEMT)	2.3% (5)	3.3% (5)
Paramedic	77.9% (169)	82.9% (126)
Other	1.8% (4)	0.0% (0)
None	3.2% (7)	2.6% (4)
Role within the organization		
Patient care professional	61.2% (131)	71.3% (107)
First-line supervisor	20.6% (44)	18.0% (27)
Administrator/manager	4.7% (10)	1.3% (2)
Preceptor	3.7% (8)	3.3% (5)
Educator	0.9% (2)	0.7% (1)
Other	8.9% (19)	5.3% (8)
Years of experience (4 categories)		
0–4 years	18.1% (39)	18.4% (28)
5–10 years	28.2% (61)	28.9% (44)
11–20 years	31.5% (68)	28.9% (44)
≥21 years	22.2% (48)	23.7% (36)
Frequency of patient outcomes review		
Very frequently (more than once per week)	38.8% (83)	36.2% (55)
Frequently (about once per week)	32.2% (69)	33.6% (51)
Occasionally (about once or twice per month)	19.2% (41)	25.7% (39)
Rarely (about once or twice per year)	3.3% (7)	2.0% (3)
Very rarely (less than once per year)	2.8% (6)	2.6% (4)
Never (I have never viewed an outcome)	3.7% (8)	0.0% (0)

Table 2. Pre-survey and post-survey overall responses.

% (n)	Pre-survey		Post-survey		*P*-value
	Disagree	Agree	Disagree	Agree	
I review outcomes to improve the care I provide to patients.	6.0% (12)	94.0% (188)	4.1% (6)	95.9% (141)	0.43
I review outcomes to improve my clinical knowledge.	5.5% (11)	94.5% (188)	2.1% (3)	97.9% (140)	0.17
I review outcomes to know whether my care made a difference.	7.0% (14)	93.0% (186)	4.1% (6)	95.9% (140)	0.26
I review outcomes to know whether I provided the right care.	6.9% (14)	93.1% (188)	2.8% (4)	97.2% (141)	0.09
I review outcomes to obtain closure on patient encounters.	14.0% (28)	86.0% (172)	8.9% (13)	91.1% (133)	0.15
Reviewing hospital outcome data through the patient outcomes feature helps improve my job satisfaction.	11.3% (24)	88.7% (188)	5.3% (8)	94.7% (142)	0.05
Reviewing hospital outcome data through the patient outcomes feature helps improve my clinical knowledge.	6.8% (14)	93.2% (192)	6.9% (10)	93.1% (135)	0.97
If I were provided 15 minutes of approved continuing education credit for each patient outcome I reviewed, I would be more likely to review my patient outcomes in the patient outcomes feature.	8.1% (17)	91.9% (193)	9.3% (14)	90.7% (136)	0.68

the ESO learning platform. Of those who successfully logged in, 74% (98/133) completed their required profile. The prerequisites were completed by 70% (64/98) of those with a completed profile, and 88% (56/64) of those completed at least one CE activity. Among those who completed any CE, 88% (35/64) completed more than one CE activity and less than 10% (4/64) completed all available CE activities (Figure 1). A total of 287 outcomes were reviewed, and responses following the outcome review activity are listed in Table 3.

Qualitative Analysis

There were 72 pre-survey participants who answered the free-text question that asked, "Please describe any other reasons you review outcomes." Free-text responses were uploaded into QDA Data Miner for analysis. All coding was performed by a single researcher (SB) and reviewed by AF and MK. Most initial codes related to reasons respondents reviewed the outcomes or benefits gained by doing so. The most common code identified was *improve understanding of patients I've seen,* which was identified 14 times (13% of all codes). The second most identified code was a*ffirming (that my diagnosis and treatment were correct),* identified eight times (7% of all codes). We excluded from further analysis 10 respondents whose only text content was coded as "do not review outcomes" or "wish list" (a code for entries that described features they wanted to see in the future).

We grouped the codes into themes organized by common attributes. These initial codes were organized by beneficiary of patient outcome review CE: the respondent; the patient encounter; and the EMS operation (Figure S1). Notably, *unknown,* a group created for codes that didn't seem to fit any of the identified themes, comprised 17% of all codes. As a result, we performed a second thematic analysis in an attempt to integrate "unknown" codes and identify higher level meanings behind the codes. The resulting themes represented broader personal, operational, and system-related benefits to reviewing patient outcomes. These revised themes and their associated codes were reviewed by AF and MK with minor revisions recommended and integrated.

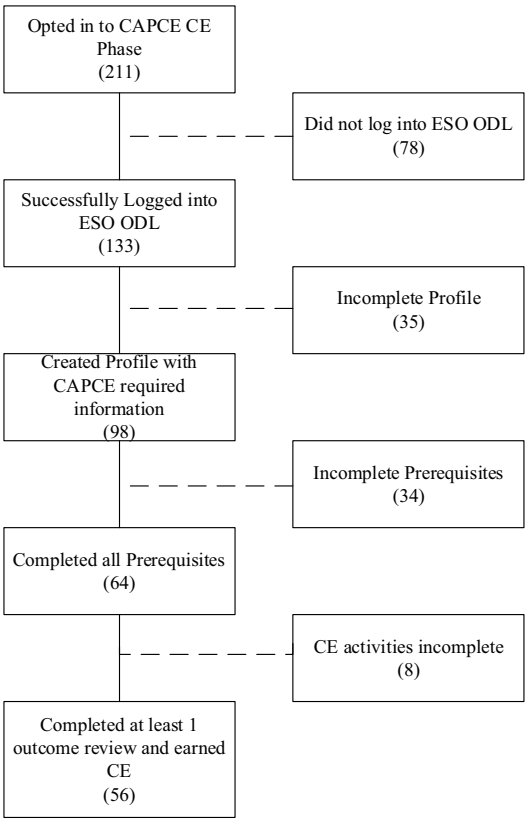

Figure 1. CAPCE CE optional participation.
CAPCE, Commission on Accreditation for Pre-Hospital Continuing Education; *CE*, continuing education.

Table 3. Continuing education activity review questions and responses.

All continuing education reviews	
Goals of your outcome review (select all that apply):	
Obtain continuing education credit for licensure renewal.	22% (224)
Increase my knowledge regarding the clinical condition of the patient.	25% (247)
Determine whether my assessment and treatments were appropriate.	26% (258)
Determine whether my field impression aligns with the hospital diagnosis.	27% (267)
Based on this review:	
I would provide the same treatment.	84% (242)
I need more information.	6% (17)
I would modify my treatment.	10% (28)
Indicate how strongly you agree or disagree with the following: My use of outcomes reinforces or increases my clinical knowledge.	
4 – strongly agree	52% (149)
3 – agree	46% (132)
2 – disagree	0% (1)
1 – strongly disagree	2% (5)
Indicate how strongly you agree or disagree with the following: My use of outcomes improves the quality of care I provide to my patients.	
4 – strongly agree	50% (142)
3 – agree	49% (139)
2 – disagree	1% (3)
1 – strongly disagree	1% (2)
Indicate how strongly you agree or disagree with the following: If I were provided additional online continuing education opportunities related to this patient outcome, I would complete the training.	
4 – strongly agree	44% (127)
3 – agree	55% (156)
2 – disagree	0% (1)
1 – strongly disagree	1% (2)

The final themes and code groupings can be found in Figure S2. We believe these codes and themes accurately reflect survey responses, and we used them for analysis of the post-survey, free-text question using the same method. Table 4 provides an overview of the themes, dominant codes, and key quotes for pre- and post-survey groups. In addition, we compared thematic frequency reports between the entire survey group and various demographic groups by respondent level, experience, and frequency of outcome review. These results can be found in Table S1–S4.

There were shifts in the perceived value of patient outcome review between the pre- and post-survey periods and across individuals with different backgrounds and experience (Figure 2). Those respondents who indicated they did not provide direct patient care placed the most value on operations and systemwide quality. For the remainder of respondents, pre-survey results found that the predominant value identified was related to *acquiring personal knowledge,* with *enhancing personal confidence and competence,* and *improving personal clinical practice* following—nearly 10% lower. During the post-survey, *acquiring personal knowledge* fell to the fourth position, with *enhancing personal confidence and competence* the predominant theme, followed by *improving personal clinical practice* and *operations.* In the post-survey population, *acquiring personal knowledge* remained valued by EMTs and individuals with 0–4 years of experience but was not valued at all in those with ≥21 years of experience.

DISCUSSION

Enhance Personal Confidence/Competence and Improve Patient Care

When surveyed anonymously, EMS providers favored viewing their patient outcomes. Qualitative analysis of pre-survey results revealed that the majority of certified personnel felt the primary benefit would be increases in personal knowledge; this attitude was particularly prevalent for EMTs and individuals who had limited experience. In post-survey results, providers found that reviewing patient outcomes was more relevant to gaining confidence and competence rather than knowledge acquisition. McGuire and colleagues evaluated feedback requests received from EMS providers and found the most common request was for the final diagnosis and outcome/disposition.[28] This enhancement is commonly reflected in EMS providers who assess and care for their patients but are limited to only the beginning of the patient's experience, not the final outcome. Providing them with the outcome of their patient allows them to either increase confidence in their assessment and diagnosis or participate in an opportunity for continued learning. This finding represents the workforce's desire for an outcome-centric continued competence model over traditional forms of CE.

Providers also perceived improved patient care by viewing their hospital outcome data, which previous work has demonstrated is beneficial to the learning process and can improve patient outcomes. The qualitative review of post-survey results revealed an increase in the emphasis on enhancing personal confidence and competence and improving personal clinical practice, suggesting that providers see the potential for this education to improve their clinical practice rather than just providing knowledge. Post-resuscitation feedback has also been demonstrated to improve the quality of Advanced Life Support, specifically in

Table 4. Overview of themes, codes, and key quotes from the pre- and post-survey.

Theme	Description	Dominant codes pre-survey	Dominant codes post-survey
Acquire personal knowledge	Codes that reflect learning about clinical presentations, medical knowledge, and hospital related to patients seen.	• Improve my understanding of patients I've seen • Further clinical knowledge	• Improve my understanding of patients I've seen
	Key quote: *To follow up on patient encounters and understand the care the patient later received*		
Enhance personal confidence and competence	Codes that affirm that EMS diagnosis and care were appropriate, reflect on the impact of EMS care on patient outcome, and contribute to self QA/QI.	• Affirming • Self QA/QI	• Affirming
	Key quote: *I review charts to review my findings and QA/QI myself for future patients*		
Improve personal clinical practice	Codes that reflect improvement in personal clinical practice including informing future diagnosis and treatment of recurring patients.	• Future betterment • Inform future differential diagnosis	• Inform future visits to same patient • Future betterment to improve care
	Key quote: *Helps prioritize follow-ups and what resources should be brought to bear for our clients*		
Operations	Codes reflecting impact on operational tasks including documentation, follow-ups services and training.	• It's my job • Research billing inquiry	• Training/reinforcement for trainees • Inform follow-up post discharge
	Key quote: *I review outcome data with . . . employees . . . it helps us learn together, building the educational safety among our group*		
Support system-wide QI	Codes reflecting collaboration, culture of learning and education, and organization wide QA/QI.	• Organization-wide compares crew medical decision making, protocol utilization to patient diagnosis and outcome • System QA/QI	• System QA/QI • Create a culture of learning and education
	Key quote: *It helps create a culture in which learning and education are the focus, not errors or missteps*		

EMS, emergency medical services; *QA*, quality assurance; *QI*, quality improvement.

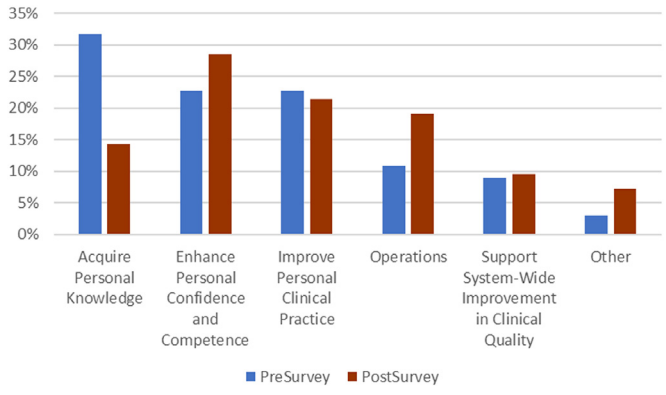

Figure 2. Comparison of themes pre- to post-survey.

survival until hospital discharge and favorable neurological outcomes and is why real-life, post-resuscitation feedback is recommended.[23] Time to treatment in heart attack victims has also been shown to decrease following the implementation of data feedback to EMS providers, even in a system that was already achieving internationally established goals.[24] Sammuel and colleagues conducted a scoping review of the effects of CPD on health professionals' performance and patient outcomes and demonstrated changes in providers' behavior and patient outcomes.[25] Survey results published by Pollard and Black found that after receiving patient outcome data, most EMS providers reflected on the call and did further reading.[29]

EMS Provider Job Satisfaction

Study participants felt that learning their patient-specific hospital outcomes improved job satisfaction. Similar results have demonstrated that when asked, EMS providers anticipate patient outcome feedback benefiting their well-being and work engagement.[14] Providing patient outcomes helps bring EMS providers further into the healthcare continuum, and doing so reduces the causes of burnout for them.[30] This is an important finding as agencies face a workforce shortage and the US sees fewer and fewer EMTs and paramedics.[31]

Microlearning

The CAPCE-approved CE was presented to EMS providers in the form of microlearning. Microlearning consists of small doses of content in the form of lesson modules or short-term activities. This method allows learners to control all aspects of their learning, including the time in which they review, the pace, and the method by which they complete the activity. Providers reported being more likely to complete the review if they were provided with a means to use it to complete certification renewal; thus, if an agency provides patient outcomes to providers, it is best to include it as a means for certification renewal.

This patient outcome-specific education describes a new method of CE for EMS providers and aligns with the goals of CPD. Additionally, patient outcome-led education has been demonstrated to improve provider competency and improve patient outcomes. More study is needed on a wider scale to determine whether this type of education delivery ensures more competency than an hour-based model. This type of learning may also be appealing from an operational perspective, providing flexibility with respect to scheduling educational offerings and reducing the time that EMS providers are required to spend in a classroom.

LIMITATIONS

The sample size is specific to these three agencies (convenience sample) and those who chose to complete the survey; as such it may not be generalizable to the entire EMS workforce. The window for completing the survey was open for two weeks; thus, there may have been some providers who did not work in that period and could not complete the survey. Additionally, the request to complete the survey occurred during operational hours; so, participation may have been limited due to other, more urgent tasks. By its nature, qualitative analysis is heavily dependent on the background and skills of the researcher and may be influenced by personal biases.

A low proportion of providers who began the CE process actually gained CE credits, indicating the steps or process may be too difficult or cumbersome. It is also possible that participants did not need the CE credits, as each of the participating agencies provides 100% of the required hours. Additional research is needed to determine how to best integrate this learning method with existing work patterns and CE programs.

CONCLUSION

Emergency medical services providers supported the personal and professional development and patient care improvement value of reviewing patient outcomes, including microlearning activities. Participation in the required activities to obtain continuing education was low. However, subjects who did participate demonstrated a shift in perceived value from mere acquisition of knowledge to development of improved personal and systemwide clinical practice. Further study is warranted to evaluate the generalizability of these findings and the best user experience to facilitate the completion of CE.

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Validation of the Turkish Version of the Professional Fulfillment Index

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Introduction: Clinician burnout represents a significant occupational hazard among physicians, with a notably high prevalence among emergency physicians. The Stanford Professional Fulfillment Index (PFI) was developed to comprehensively assess various aspects of doctors' work experiences, including professional fulfillment. In this study we aimed to validate the Turkish version of the PFI (T-PFI), a 16-item instrument designed to measure physicians' professional fulfillment and burnout.

Methods: In this cross-sectional study, we validated the T-PFI in two phases. The initial phase involved translating and culturally adapting the original PFI into Turkish. We evaluated the content validity of the translated version using item and scale content validity indices (I-CVI and S-CVI, respectively). The validated T-PFI was then distributed among a broad cohort of emergency physicians via an online survey to further assess its reliability and validity. The assessment tools included Cronbach α, confirmatory factor analysis, and content validity indices.

Results: Of 1,434 physicians who were sent the survey, 425 fully completed it (29.6%). There was an almost equal distribution of 215 females and 210 males. Only 9.6% of the participants reported high levels of professional fulfillment, whereas a significant majority (79.1%) were susceptible to burnout. The Cronbach α values for the professional fulfillment and overall burnout scales were 0.87 and 0.90, respectively. The content validity was confirmed by I-CVI values exceeding 0.80 and an S-CVI/average relevance of 0.92. The confirmatory factor analysis demonstrated an acceptable model fit after adjustments.

Conclusion: The T-PFI is a reliable and valid tool for assessing professional fulfillment and burnout among emergency physicians in Turkey. Effective interventions to mitigate burnout are essential to improve physician well-being in Turkish healthcare settings. [West J Emerg Med. 2024;25(6)958–965.]

INTRODUCTION

Burnout is a syndrome resulting from chronic workplace stress and overload.[1] It is characterized by three dimensions: emotional exhaustion; depersonalization; and reduced personal accomplishment.[2] Studies have shown that physicians experience higher rates of burnout and lower satisfaction with work-life integration compared to the general population.[3] Emergency physicians, in particular, are highly susceptible to burnout, with rates surpassing those seen in other medical specialties.[3] Research on the work experiences of emergency physicians has largely focused on individual and workplace factors contributing to burnout.[4,5] Burnout not only affects clinicians' health but also negatively impacts patient

care outcomes and the overall functioning of healthcare systems.[6,7]

To effectively measure burnout among healthcare professionals, it is crucial to assess not only the negative aspects, such as emotional exhaustion and depersonalization, but also the positive aspects such as professional satisfaction, well-being, and occupational fulfillment.[8–11] Unlike traditional burnout scales, the Stanford Professional Fulfillment Index (PFI) was developed to provide a comprehensive assessment of physicians' work experiences.[10] The PFI is a concise tool specifically designed for physicians, offering valuable insights into their well-being, quality of life, and productivity. It helps healthcare organizations evaluate both burnout and professional satisfaction levels, enabling the development of programs to enhance job satisfaction and overall well-being. However, for the PFI to be effective across different cultural contexts, it must be translated and adapted to ensure its validity and relevance. The PFI has been successfully adapted in countries such as Brazil and Japan, but further validation is needed to confirm its psychometric strength and cultural applicability.[12,13]

In this study we aimed to develop and validate the Turkish PFI (T-PFI) to assess the professional fulfillment and burnout levels of emergency physicians in Turkey. The T-PFI is based on the Stanford PFI and has been translated and adapted to fit the specific cultural and healthcare context of Turkey. We then evaluated the psychometric properties of the T-PFI to ensure its reliability and validity. Our goal was to provide a robust tool for accurately assessing and monitoring the professional well-being of emergency physicians in Turkey.

Population Health Research Capsule

What do we already know about this issue?
Emergency physicians experience high rates of burnout, negatively impacting their well-being and patient care.

What was the research question?
Is the Turkish version of the Professional Fulfillment Index (T-PFI) valid and reliable?

What was the major finding of the study?
The T-PFI showed strong internal consistency (Cronbach α: 0.87 for PF, 0.90 for burnout).

How does this improve population health?
The T-PFI offers a reliable measure of professional fulfillment and burnout, enabling healthcare organizations to monitor physician well-being.

METHODS

Participants

The research team collaborated with the heads of high-volume emergency departments (ED) in prominent healthcare institutions across Turkey to recruit participants. Recognizing the potential for a low response rate due to the demanding schedules of emergency physicians, we employed several strategies recommended by the literature to improve response rates and mitigate non-response bias.[14] These strategies included sending multiple reminders and using various communication platforms to distribute the survey link.

We invited emergency physicians affiliated with these organizations through emails, social media groups, and internal communication platforms, such as online messaging systems. To ensure clarity for potential participants, we provided a detailed explanation of the study's purpose and objectives. Eligible participants included physicians actively working in EDs. While our primary aim was to identify burnout among these healthcare professionals, we expanded the study to include residents, attending physicians, consultant physicians, and faculty members. With this broader scope we aimed to capture a diverse range of perspectives, ensuring comprehensive representation of healthcare professionals within emergency medicine (EM).

We sent the survey to 1,434 medical doctors. Participants provided electronic informed consent before completing the survey, confirming their voluntary participation and understanding of the study's objectives and procedures. To protect their privacy and encourage candid responses, we designed the survey to be anonymous. We included only fully completed questionnaires in the statistical analysis, resulting in a response rate of 29.6%.

Procedure

We conducted this cross-sectional study in two phases to validate the T-PFI. In the first phase, we translated and culturally adapted the original PFI into Turkish, adhering to World Health Organization guidelines for linguistic accuracy and cultural relevance.[15] Two bilingual emergency physicians performed the forward translation of the PFI from English to Turkish. A panel of experts, including three faculty members (one professor and two associate professors) and two emergency physicians with a special interest in physician well-being, reviewed and revised the translation to improve its cultural relevance.

To assess the content validity of the translated PFI, we calculated item and scale content validity indices (I-CVI and S-CVI). Ten independent experts rated item relevance on a four-point scale, with 1 or 2 indicating no relevance and 3 or 4 indicating relevance. We set acceptable thresholds at I-CVI

>0.78 and S-CVI >0.90, based on guidelines for expert panels of 6–10 members.[16]

In the pre-test phase, we obtained feedback from five male and five female emergency physicians working in crowded EDs. Based on this feedback, we refined the instrument, resulting in the final version of the T-PFI (Appendix A). We then distributed the validated Turkish version to a broader cohort of respondents in EDs for further validation. The Institutional Review Board of the University of Health Sciences Fatih Sultan Mehmet Education and Research Hospital approved all procedures.

Measures

The PFI, developed by Trockel et al, assesses professional fulfillment and burnout among physicians.[10] The original PFI comprises 16 items categorized into two scales: the Professional Fulfillment (PF) scale (six items) and the Overall Burnout scale (10 items), measuring three dimensions: professional fulfillment; professional exhaustion, and interpersonal disengagement. Each item is evaluated using a five-point Likert scale (0 to 4). Higher scores on the PF scale (7.5 or greater) indicate higher professional fulfillment, while scores exceeding 3.325 on the burnout scale suggest potential burnout. The PFI, validated in 2018, evaluates emotional exhaustion, interpersonal disengagement, and professional achievement, expanding beyond traditional burnout dimensions to include intrinsic work components such as happiness, meaning, self-esteem, and satisfaction.[10]

Data Analysis

We computed descriptive statistics for demographic characteristics and T-PFI scores. Mean scores for each item and dimension were calculated according to Trockel's instructions.[10] We evaluated the reliability of the T-PFI through internal consistency, which estimates the extent to which the constituent items of the scale are interrelated. The Cronbach α coefficient was used to assess internal consistency, with values above 0.70 indicating acceptability.[17,18] We evaluated construct validity through confirmatory factor analysis (CFA) of responses to all 16 items, aiming to assess model fit. Factor loadings were calculated using maximum likelihood estimation. To evaluate the model's goodness of fit, we considered several indices, including the chi-square statistic (χ^2), root mean square error of approximation (RMSEA), comparative fit index (CFI), and the Tucker-Lewis index (TLI). The thresholds for these indices were as follows: TLI >0.90 (acceptable), >0.95 (excellent); CFI >0.90 (acceptable), >0.95 (excellent); RMSEA <0.08 (acceptable), <0.05 (excellent); and chi-square statistic divided by the degree of freedom (<3 acceptable).[19,20] Error items were only correlated if they belonged to the same construct.

For validation studies, it is recommended to have a minimum of 50 respondents for each criterion and construct validation studies that involve calculating correlation coefficients. However, larger sample sizes exceeding 100 are preferred to enhance the robustness of the findings.[21]

RESULTS

We sent the survey to 1,434 medical doctors, and 425 fully completed it, resulting in a response rate of 29.6%. Among the respondents, 215 (50.6%) were female and 210 (49.4%) were male. Of the participants, 193 (45.4%) identified as emergency physicians, 156 (36.7%) as EM residents, and 76 (17.9%) as medical doctors without a specialty. Additionally,

Table 1. Characteristics of the study group.

Sociodemographic variables	n (%)
Sex	
Male	215 (50.6)
Female	210 (49.4)
Profession	
Emergency physician	193 (45.4)
EM resident	156 (36.7)
Medical doctor	76 (17.9)
Title	
Faculty members	38 (9.0)
Academic staff	156 (36.6)
Non-academic staff	231 (54.4)
Work experience (years)	
<2	83 (19.5)
2–5	109 (25.6)
6–10	111 (26.1)
11–15	61 (14.4)
>15	61 (14.4)
Institution	
Private hospital	13 (3.1)
State hospital	122 (28.7)
City hospital	45 (10.6)
University hospital	85 (20.0)
Educational and research hospital	160 (37.5)
Weekly hours of work	
<40	23 (5.4)
40–72	330 (77.6)
>72	72 (16.9)

This table presents the distribution of sociodemographic variables among emergency physicians who participated in the study. The data includes information on sex, professional role, academic title, years of work experience, type of institution where they are employed, and their weekly working hours. Each category and subcategory is provided with the number of individuals and the corresponding percentage of the total participant pool.
ED, emergency department; *EM*, emergency medicine.

38 participants held an academic title. The majority (94.5%) of respondents reported working more than 40 hours per week. Table 1 summarizes the descriptive sociodemographic statistics of the study population.

We used Trockel's cut points to analyze the responses, which indicated that only 9.6% of respondents were considered professionally fulfilled. Conversely, a significant 79.1% of respondents reported experiencing burnout. The content validity assessment, which employed both I-CVI index values and the S-CVI/average relevance (Ave), yielded excellent content validity. All items demonstrated an I-CVI value exceeding 0.80, with the S-CVI/ Ave reaching 0.92. The mean scores (standard deviation) for the items ranged from 3.34 (2.94) to 6.47 (2.62), as shown in Table 2. The Cronbach α score for the professional fulfillment scale and the overall burnout scale were 0.87 and 0.90, respectively. The Cronbach α values for each dimension are presented in Table 3.

The CFA run on the initial model with three factors and 16 items (Model 1) demonstrated low CFI and TLI and did not meet criteria for goodness of fit. Factor loadings of all items were greater than 0.40; therefore, no item was removed from the initial model. All factor loadings for each item are presented in Table 4. Index modifications suggested by CFA were applied subsequently to improve the model fit. After index modifications, Model 2 was significantly improved with acceptable CFI, TLI and RMSEA (Table 5, Figure).

DISCUSSION

The T-PFI has demonstrated itself to be a robust and reliable measurement tool among emergency physicians in Turkey. Our study evaluated the T-PFI's reliability and validity, revealing high internal consistency, strong factor loadings, and CFA results that align with international standards.[11] This is significant given that previous cross-cultural adaptation studies of the PFI were conducted in Brazil and Japan, but not in Turkey.[12,13] Our diverse participant group, consisting of physicians with various demographic characteristics and professional roles, enhances the generalizability of our findings. This diversity provides valuable insights into the experiences of emergency physicians, similar to studies conducted in other contexts. For instance, Asaoka et al included healthcare professionals from disaster medical assistance teams in Japan, while Silva-Junior et al focused on workplace physicians in Brazil.[12,13]

In our study, we achieved a response rate of 29.6%. Various factors, such as the high workload of emergency physicians, may have contributed to this response rate. According to Phillips et al, response rates in surveys of health

Table 2. Mean scores and standard deviations of the survey tool items.

Survey tool items	Mean (SD)
Professional fulfillment	4.27 (2.29)
1. I feel happy at work	3.53 (2.65)
2. I feel worthwhile at work	3.34 (2.94)
3. My work is satisfying to me	3.97 (2.84)
4. I feel in control when dealing with difficult problems at work	4.11 (2.90)
5. My work is meaningful to me	5.74 (3.10)
6. I'm contributing professionally in the ways I value most	4.94 (3.10)
Overall burnout	5.26 (2.18)
Burnout: professional exhaustion	5.98 (2.28)
1. A sense of dread when I think about the work I have to do	4.92 (2.90)
2. Physically exhausted at work	6.47 (2.62)
3. Lacking in enthusiasm at work	6.42 (2.92)
4. Emotionally exhausted at work	6.12 (3.06)
Burnout: interpersonal disengagement	4.78 (2.48)
1. Less empathetic with my patients	4.74 (2.89)
2. Less empathetic with my colleagues	3.92 (2.92)
3. Less sensitive to others' feelings/emotions	5.04 (2.98)
4. Less interested in talking with my patients	5.43 (3.05)
5. Less connected with my patients	5.38 (3.04)
6. Less connected with my colleagues	4.20 (3.10)

This table presents the mean scores and SDs for items related to professional fulfillment and burnout as assessed by the Turkish Professional Fulfillment Index.

Table 3. Internal consistency of the dimension of the Turkish Professional Fulfillment Index.

Scale	Cronbach α		
	This study	Original	Japanese study
Professional fulfillment	0.87	0.91	0.91
Overall burnout	0.90	0.92	NA
Professional exhaustion	0.84	0.86	0.80
Interpersonal disengagement	0.91	0.92	0.90

The table displays the internal consistency of the dimensions of the Turkish Professional Fulfillment Index in this study, measured by the Cronbach α, in comparison to the original scale and results from the Japanese study. The results of the Brazilian study are not included in this table since only global Cronbach α of the PFI (0.95) was cited by Silva-Junior et al.[13] NA: not applicable (The Japanese study did not provide the Cronbach's α of overall burnout).

Table 4. Factor loadings for each item of the Turkish Professional Fulfillment Index.

Factors	Items	Standardized factor loadings	
		Model 1	Model 2
Professional fulfillment	1. I feel happy at work	0.89	0.90
	2. I feel worthwhile at work	0.82	0.83
	3. My work is satisfying to me	0.78	0.78
	4. I feel in control when dealing with difficult problems at work	0.63	0.63
	5. My work is meaningful to me	0.61	0.58
	6. I am contributing professionally in the ways I value most	0.62	0.59
Burnout: professional exhaustion	1. A sense of dread when I think about work, I have to do	0.48	0.45
	2. Physically exhausted at work	0.71	0.70
	3. Lacking in enthusiasm at work	0.92	0.93
	4. Emotionally exhausted at work	0.89	0.89
Burnout: interpersonal disengagement	1. Less empathetic with my patients	0.82	0.83
	2. Less empathetic with my colleagues	0.64	0.65
	3. Less sensitive to others' feelings/emotions	0.86	0.86
	4. Less interested in talking with my patients	0.88	0.88
	5. Less connected with my patients	0.90	0.91
	6. Less connected with my colleagues	0.59	0.56

This table presents the standardized factor loadings for each item of the Turkish Professional Fulfillment Index, as measured in two different models (Model 1 and Model 2). Model 1: before modification index; and Model 2: after modification index.

professions trainees vary widely, ranging from 26.6–100%, with multi-institutional surveys typically having lower response rates compared to single-institution surveys.[22] Our study, being multi-institutional, also faced this challenge. To improve the response rate, we employed multiple methods, including emails, social media groups, and internal communication platforms, such as online messaging systems, and we sent reminders to participants. By employing these strategies, we aimed to maximize participation and reduce non-response bias, ensuring that our findings accurately reflect the perspectives of a broad range of healthcare professionals within EM.

Based on our survey results, we found that emergency physicians in Turkey experience high levels of burnout. Only 9.6% of participants reported professional fulfillment, while 79.1% were likely experiencing burnout based on Trockel's cut-off points. This finding is consistent with previous research that has linked the field of EM to high rates of burnout, attributed to the challenging nature of the specialty.[3–5,23–29] For instance, a meta-analysis on burnout prevalence and risk factors among emergency healthcare workers found that Turkey has the highest prevalence of high emotional exhaustion.[25]

A cross-sectional survey study conducted among faculty members of the Academic Emergency Medicine Association, which also used the PFI scale, yielded intriguing results.[30] In that study, 38.7% of participants reported feeling satisfied with their occupation, while 39.1% reported experiencing

Table 5. Confirmatory factor analysis: models' goodness of fit of the Turkish Professional Fulfillment Index and other versions.

	# of items	χ^2/df	*P*	CFI	TLI	RMSEA	AIC
Model 1	16	5.963	<0.001	0.890	0.869	0.108	672.301
Model 2	16	2.894	<0.001	0.960	0.950	0.067	358.761
Brazilian version	16	3.498	<0.001	0.950		0.08	
Japanese version	16		<0.001	0.897	0.909	0.085	

This table summarizes the results of the confirmatory factor analysis (CFA) conducted to assess the goodness of fit for various models of the Turkish Professional Fulfillment Index and its comparisons with other international versions. χ^2/df: chi-square/degree of freedom.
AIC, Akaike information criterion; *CFI*, comparative fit index; Model 1, before modification index; Model 2, after modification index; *RMSEA*, root mean square error of approximation; *TLI*, Tucker-Lewis Index.

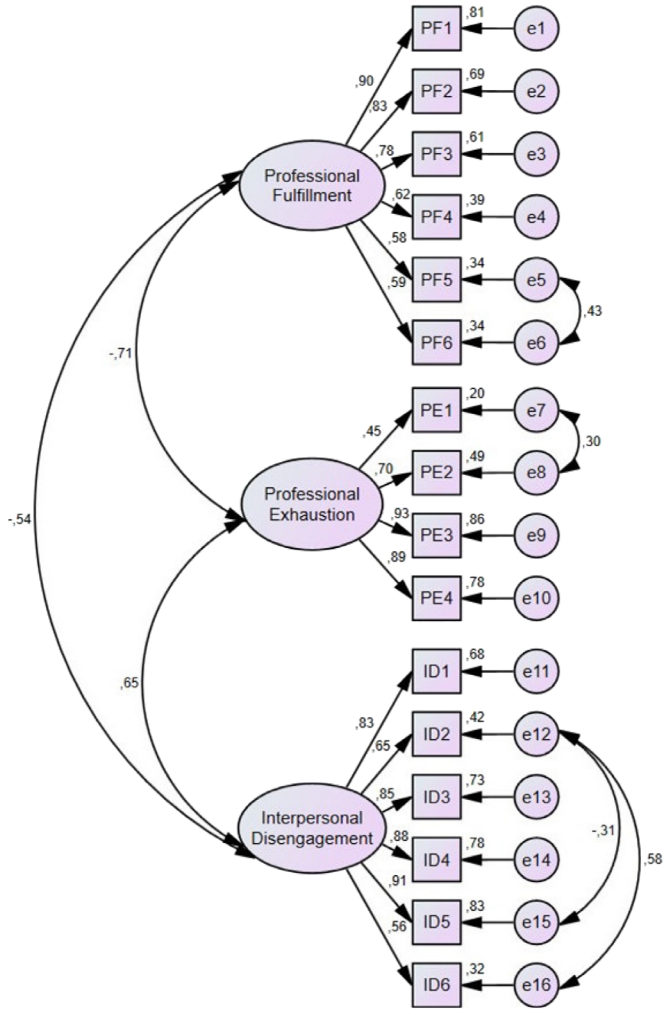

Figure. Confirmatory factor analysis of the Turkish Professional Fulfillment Index, Model 2 (after modification index).
This figure presents the confirmatory factor analysis for the Turkish Professional Fulfillment Index. The model depicts the interrelationships between three latent constructs. The observed variables associated with the constructs of professional fulfillment (PF), professional exhaustion (PE), and interpersonal disengagement (ID) are presented.

burnout. These results indicate a lower prevalence of burnout compared to our study. The discrepancy may be attributed to the fact that the sample included solely ED faculty members, whereas our study group consisted of a heterogeneous representation of emergency physicians, including residents and attending physicians. Consequently, our findings are more generalizable due to the diversity of participants, providing valuable insights into the experiences of clinicians in EDs.

The internal consistency of the T-PFI was robust, with the Cronbach α for professional fulfillment at 0.87 and for overall burnout at 0.90. These values are comparable to those reported in the original US validation study and the Japanese study.[10,12] In the Brazilian validation study, only a global Cronbach α of 0.95 was reported, indicating high reliability across different cultural contexts.[13]

The initial CFA for the T-PFI indicated low CFI and TLI, which did not meet the criteria for goodness of fit. After applying index modifications, the fit indices significantly improved, with Model 2 achieving a CFI of 0.960 and an RMSEA of 0.067. These results align with those of the Japanese study, which also demonstrated acceptable fit indices after modifications.[12] The Brazilian study similarly reported a CFI of 0.950 and RMSEA of 0.08, underscoring the model's robustness across different populations.[13] In the Japanese validation study, the CFA model fit was modest, and exploratory factor analysis confirmed a three-factor structure similar to the original scale. Our study's factor loadings ranged from 0.45–0.93, confirming the T-PFI's structural validity.

Although we did not assess convergent validity with external measures, the findings from the Japanese study of the PFI demonstrated significant positive correlations between professional fulfillment and quality of life, as well as between burnout subscales and depressive symptoms.[12] This aligns with literature suggesting that higher levels of professional fulfillment are associated with better quality of life, while higher levels of burnout are linked to increased depressive symptoms.[10]

The use of the PFI in different healthcare settings, including pharmacists and physicians, has demonstrated its versatility and reliability.[31,32] For instance, a study on US pharmacists found that professional fulfillment was associated with demographics and work settings, with community pharmacists reporting the lowest fulfillment and highest burnout.[32] This pattern is similar to our findings, where emergency physicians exposed to high stress and long working hours reported significant burnout and low professional fulfillment.

The results of this study have significant implications for both clinical practice and healthcare policy. The high prevalence of burnout among emergency physicians in Turkey highlights the urgent need for systematic interventions. Healthcare administrators should integrate the T-PFI into regular evaluations to monitor physician well-being proactively. This could lead to early identification of burnout symptoms, allowing for timely interventions. For instance, Bodenheimer and Sinsky emphasize the importance of the quadruple aim, which includes improving clinicians' work life as a crucial component of enhancing patient care.[9] Additionally, Shanafelt et al found that addressing physician burnout can significantly improve patient care quality and reduce healthcare costs.[3,7]

The findings of this study can inform policy decisions at both organizational and governmental levels. Policies designed to reduce work hours, provide mental health resources, and create a supportive work environment are justified by the data indicating high burnout levels. Future research should investigate the longitudinal impact of burnout and professional fulfillment on career longevity and patient care quality among emergency physicians. Collaborative efforts across countries could further refine the T-PFI, making it a global standard for assessing physician well-being.

LIMITATIONS

A notable limitation of this study is its focus on emergency physicians, which may limit the generalizability of the findings to other medical specialties or departments. Future research should include a broader range of healthcare professionals across various specialties to enhance the comprehensiveness of the findings. Additionally, we did not compare the demographic characteristics of respondents and non-respondents. Future studies might benefit from such comparisons to better address non-response bias. Longitudinal studies are also recommended to understand the temporal dynamics of professional fulfillment and burnout. Investigating organizational factors could provide deeper insights into creating healthier work environments for physicians.

CONCLUSION

In this study we successfully translated, adapted, and validated the Turkish Professional Fulfillment Index, establishing its reliability as a tool for assessing professional fulfillment and burnout among medical doctors in Turkish EDs. The findings highlight a significant prevalence of burnout, emphasizing the need for targeted interventions to enhance physician well-being in Turkish healthcare settings. By providing a reliable measure of professional fulfillment and burnout, the T-PFI can guide healthcare organizations in developing programs to improve physicians' job satisfaction and overall well-being.

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Use of Parenteral Antibiotics in Emergency Departments: Practice Patterns and Class Concordance

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Introduction: We aimed to assess antibiotic stewardship by quantifying the use of first-dose intravenous (IV) vs oral-only antibiotics and the frequency with which antibiotic class was changed for discharged patients. Secondary aims included the following: evaluation of the relative length of stay (LOS); differences in prescribing patterns between clinician types; differences between academic and community settings; assessment of prescribing patterns among emergency department (ED) diagnoses; and frequency of return visits for patients in each group.

Methods: This was a retrospective cohort study including patients presenting to EDs with infections who were discharged from our Midwest healthcare system consisting of 17 community hospitals and one academic center. We included infection type, antibiotic class and route of administration, type of infection, LOS, return visit within two weeks, clinician type, and demographics. Data were collected between June 1, 2018–December 31, 2021 and analyzed using descriptive statistics.

Results: We had 77,204 ED visits for patients with infections during the study period, of whom 3,812 received IV antibiotics during their visit. There were more women (62.4%) than men included. Of the 3,812 patients who received IV antibiotics, 1,026 (34.3%) were discharged on a different class of antibiotics than they received. The most common changes were from IV cephalosporin to oral quinolone or penicillin. Patients treated with IV antibiotics prior to discharge had a longer LOS in the ED (median difference of 102 minutes longer for those who received IV antibiotics). There was not a significant difference in the use of IV antibiotics between the academic center and community sites included in the study.

Conclusion: Administering IV antibiotics as a first dose prior to oral prescriptions upon discharge is common, as is shifting classes from the IV dose to the oral prescription. This offers an opportunity for intervention to improve antibiotic stewardship for ED patients as well as reduce cost and length of stay. [West J Emerg Med. 2024;25(6)966–974.]

INTRODUCTION

Background

Acute infections are a common reason for patients to present to the emergency department (ED). There were approximately 130 million ED visits in 2018 within the United States. Acute infections account for approximately 15 million visits to the ED annually.[1,2] Acute respiratory infections, skin infections (eg, cellulitis and subcutaneous abscess), and urinary tract infections (UTI) are among the most common infections evaluated in the ED in recent years.[3]

Prior work has addressed inpatient concerns about transitioning from intravenous (IV) to oral antibiotics, some of which are applicable to the ED setting. These include

concerns for no clear benefit; reduced bioavailability; inapplicability of bioavailability studies performed on healthy individuals; improved clinical outcomes with IV therapy; and concern that an oral route of administration may contribute to an infection lingering. These concerns are systematically addressed and include commentary on the bioavailability of most antibiotics, which is greater than 90%. Many of the classes can achieve a serum concentration that is the same via oral or IV routes. Treatment with IV antibiotics compared with oral antibiotics has been noted to be more expensive than oral antibiotics alone, and IV antibiotics also have the risk of possible complications associated with IV-line insertion and use.[4] Cephalosporins are a notable exception and have been studied in the setting of pyelonephritis with recommendations for a single IV dose in the ED prior to dismissal (Gupta et al, below). However, the serum concentration achievable via oral administration is adequate to treat mild and moderate infections,[5] as we would expect to see in a patient who is discharged home.

Population Health Research Capsule

What do we already know about this issue?
Antibiotic stewardship is imperative due to rising rates of antibiotic-related infections and resistance; it is crucial that antibiotics be prescribed appropriately.

What was the research question?
We quantified the use of first-dose IV vs oral-only antibiotics and the frequency that antibiotic class was changed.

What was the major finding of the study?
Of 3,812 patients (4.9%, 95% CI 4.8–5.1%) who received IV antibiotics in the ED, 1,273 (33.4%, 95% CI 31.9–34.9%) were prescribed a different antibiotic class when discharged.

How does this improve population health?
By recognizing inconsistencies in patients treated with antibiotics in the ED prior to discharge, this presents future opportunities to improve upon antibiotic stewardship.

Importance

Antibiotic stewardship is increasingly important due to the rising rates of antibiotic resistance including methicillin-resistant *Staphylococcus aureus* and multidrug resistant bacteria in the setting of pneumonia and UTIs.[6–8] There are also risks of antibiotic-related complications such as *Clostridioides difficile* colitis. It is, therefore, imperative that antibiotics be administered for the shortest duration required, through an appropriate route, and prescribed only when necessary.[9] There is scant information regarding the concordance between first dose of IV antibiotics and subsequent prescription from the ED. There are differences in the financial burden and time associated with the administration route of antibiotics. Oral antibiotics are more cost effective than IV antibiotics and often provide similar microbial coverage.[4] Multiple studies have compared oral and IV antibiotics when treating UTIs, cellulitis, or pneumonia separately, but studies are lacking that evaluate oral and IV antibiotics for treating infections in a broader sense.[10–12] In many cases, oral antibiotics may be appropriate and as efficacious as IV antibiotics, providing more time-efficient and cost-effective care for patients who are discharged from the ED.

Goals of This Investigation

Our primary aim was to determine whether we adhere to best practices in prescribing antibiotics for common infectious conditions being treated on an outpatient basis after an ED visit. This includes the route of administration and concordance between any doses given in the ED and subsequent prescriptions. Secondary aims included the following: evaluation of the relative length of stay (LOS) for patients receiving a dose of IV antibiotics who are subsequently discharged compared to those given oral antibiotics only; differences in prescribing patterns between clinician types (physician, physician assistant/nurse practitioner) and in academic vs community settings; assessment of prescribing patterns among ED diagnoses (eg, skin/soft tissue, urinary, pulmonary); and patterns of return visits for patients receiving a dose of parenteral vs oral antibiotics only.

METHODS

Study Design and Setting

This study adheres to the STROBE guidelines for reporting observational studies.[13] This was a multicenter retrospective cohort study. We included patients in a single academic center and 17 community EDs affiliated with our institution located throughout the Midwest.

Selection of Participants

We included patients who were evaluated and discharged from the ED with a diagnosis of infection, based on International Classification of Diseases (ICD-10) codes, and were prescribed oral antibiotics upon discharge from the ED. Some patients received oral antibiotics following a dose of IV antibiotics provided prior to discharge. Patients who were admitted to the hospital or placed in ED observation during their first ED visit were excluded from our analysis.

Measurements

Our dataset included the following: visit identifier; legal gender; gender identify; primary language; age at visit; antibiotics given in ED (yes/no); allergies; ED location; ED arrival time; ED departure time; chief complaint; primary diagnosis; diagnosis list; final disposition; first attending, last attending, resident, advanced practice practitioner (APP), primary nurse; return visit identifier; return visit location; days between return visits; return visit arrival time; return visit departure time; return visit chief complaint; return visit primary diagnosis; return visit disposition; antibiotic order identification; outpatient antibiotic order date; outpatient antibiotic prescription; and outpatient antibiotic prescriber and specialty.

We categorized antibiotics by their route of administration (parenteral vs oral) and by pharmacologic class (aminoglycoside, carbapenem, cephalosporin, epoxide, glycopeptide, lincomycin, macrolide, nitrofurantoin, nitroimidazole, penicillin, quinolone, sulfa, or tetracycline). Topical is included among the classes of antibiotics due to its distinct use. Antibiotics were considered concordant if the antibiotic provided parenterally was in the same class as the oral antibiotic prescribed upon discharge. Prescribing patterns were evaluated based on credentials with subgroups of physicians (MD/DO/MBBS) and advanced practice providers (nurse practitioner [NP]/physician assistant [PA]). Practice settings were defined as an academic center that includes an emergency medicine residency program and community-based settings. The ICD-10 diagnoses were grouped based on organ system with presumed bacterial etiology (urinary, skin/soft tissue, pulmonary, gastrointestinal, otolaryngological, animal bite, insect bite, dental, orthopedic, ophthalmologic, osteomyelitis) and/or organism type (fungal and parasitic) and categories for fever of unknown origin, postoperative infections, prophylaxis, and other infections, which is a catch-all for uncommon diagnoses. A complete list of the ICD-10 associated diagnoses included within the study is available in Appendix A. Length of stay (LOS) is measured in time elapsed from presentation to the ED until the time of discharge. Return visits were considered potentially related to the index visit for infection if they occurred within two weeks.

Outcomes

The primary outcome was the route of administration of antibiotics for a diagnosed infection and concordance of prescription oral antibiotics with any parenteral treatment given. Secondary outcomes included LOS within the ED, differences in prescribing IV or oral antibiotics between physicians and APPs, differences between academic and community setting, and association between treatment and ED return visits.

Analysis

We summarized continuous features were summarized with means with standard deviations, as well as medians with interquartile ranges; categorical features were summarized with frequency counts and percentages. We calculated confidence intervals (CI) for percentages using an exact binomial distribution. Demographics and visit characteristics were compared between patients who received IV antibiotics and patients who did not, using Wilcoxon rank-sum tests and chi-squared tests.

For the main outcomes of interest, we compared the rates of treatment with IV antibiotics by ED practice and clinician type using chi-squared tests. Similarly, the rate of two-week ED returns was compared between patients treated with both IV and prescription antibiotics and patients treated only with prescription antibiotics, using chi-squared tests. We compared ED LOS between patients receiving IV antibiotics in the ED and patients not treated with IV antibiotics, using Wilcoxon rank-sum tests. Test results were reported with the median difference in LOS times along with 95% CIs calculated by bootstrap resampling. All tests were two-sided and P-values less than 0.05 were considered significant. Analysis was performed using R version 4.1.2 (R Foundation for Statistical Computing, Vienna, Austria).[14]

RESULTS

Characteristics of Study Subjects

Patient demographics and visit characteristics are summarized in Table 1. Of note, there were significantly more female than male subjects (62.4% vs 37.6%). The median age of patients was different between patients who did and did not receive IV antibiotics. There was a median age of 50.0 years for those who did not receive IV antibiotics compared to a median age of 55.5 years for those who did. The majority of the patients included within the study were English speaking (97.2%).

Main Results

A total of 77,204 ED visits for patients with infections occurred between June 1, 2018–December 31, 2021 among all sites and were included for analysis. There were 3,812 patients (4.9%, 95% CI 4.8–5.1%) who received IV antibiotics in the ED. Nearly all the patients who received IV antibiotics within the ED received cephalosporins (3,637 patients, 95.4%), with penicillins (114 patients, 3.0%) and glycopeptides (32 patients, 0.8%) being the next most common. The primary infectious diagnoses are summarized within Table 2. Patients diagnosed with a UTI were the largest group treated with IV antibiotics (63.3%). When comparing pyelonephritis with other UTIs, pyelonephritis was much more likely to be treated with IV antibiotics than all other UTIs (28.3% vs 6.5%, $P < 0.001$). Insect bites (0.2%) and bite wounds (33 of 4,047 visits, 0.8%) received IV antibiotics the least often.

Table 1. Demographics and visit characteristics.

	No IV Abx in the ED (N = 73,392)	IV Abx in the ED (N = 3,812)	*P*-value
Patient gender			< 0.001
Female (n = 48,157)	45,600 (62.1%)	2,557 (67.1%)	
Male (n = 29,045)	27,790 (37.9%)	1,255 (32.9%)	
Unknown	2 (0.0%)	0 (0.0%)	
Patient age			< 0.001
Mean (SD)	49.2 (24.5)	53.4 (23.6)	
Median (Q1, Q3)	50.0 (29.0, 69.0)	55.5 (33.0, 73.0)	
Primary language			< 0.001
English	71,389 (97.3%)	3,686 (96.7%)	
Non-English	1,918 (2.6%)	121 (3.2%)	
Unknown/did not disclose	85 (0.1%)	5 (0.1%)	
ED practice type			0.14
Academic center	22,591 (30.8%)	1,130 (29.6%)	
Community practice	50,801 (69.2%)	2,682 (70.4%)	
Clinician type			< 0.001
NP/PA	28,976 (39.5%)	1,231 (32.3%)	
Physician	44,314 (60.5%)	2,578 (67.7%)	
ED length of stay			< 0.001
Mean (SD)	164.3 (128.8)	278.3 (183.6)	
Median (Q1, Q3)	139.0 (76.0, 219.0)	241.0 (180.0, 314.0)	
Change in antibiotic class			< 0.001
No IV antibiotics	73,392 (100.0%)	–	
Changed antibiotics	0 (0.0%)	1,273 (33.4%)	
Same antibiotics	0 (0.0%)	2,539 (66.6%)	

IV, intravenous; *Abx*, antibiotics; *ED*, emergency department; *Q1*, first quartile; *Q3*, third quartile; *NP/PA*, nurse practitioner or physician assistant.

Table 3 compares the IV antibiotic administered in the ED to oral antibiotic prescribed upon discharge. The most common changes in antibiotic class were from IV cephalosporin to oral quinolone (304 visits, 23.9% of changes) and from IV cephalosporin to oral penicillin (231 visits, 18.1% of changes). The most common oral antibiotic class prescribed at discharge from the ED was cephalosporin. The most commonly prescribed topical antibiotic was within the class of cephalosporins as well. The type of antibiotic prescribed to patients treated parenterally was different from the those prescribed for oral-only treatment ($P < 0.001$). Among the patients treated with IV antibiotics, 1,273 (33.4%, 95% CI 31.9–34.9%) received a prescription for a different antibiotic class at discharge.

Secondary outcomes

For our secondary end points, we found that patients treated with IV antibiotics prior to discharge had a longer LOS within the ED (median difference 102 minutes longer for those who received IV antibiotics; 95% CI 97–106 minutes; $P < 0.001$). Physicians were more likely to treat patients with IV antibiotics compared to APPS (5.5% vs 4.1%; $P < 0.001$). While this is statistically significant, the overall percentage difference is small. There was no significant difference in the use of IV antibiotics between the academic center and community sites (4.8% vs 5.0%; $P = 0.14$).

When we assessed diagnosis-based patterns, we found that among patients given IV antibiotics during the ED visit, the group most likely to be prescribed a different class of antibiotic was those with pulmonary infections (279 of 361 visits, 77.3%) followed by gastrointestinal (54 of 87 visits, 62.1%). There was one patient with an ophthalmologic infection, and the class of antibiotics was changed upon dismissal (Table 4). Patients treated with IV antibiotics for UTIs were least likely to change antibiotic class at dismissal (20.7% of 391 visits). The IV and oral antibiotics class administered based on the infection type is summarized

Table 2. Summary of antibiotic, antifungal, antiparasitic treatment type for emergency department infections.

Primary ED diagnosis	IV Abx in the ED (N = 2,989)	No IV Abx in the ED (N = 56,289)	Percent of diagnosed with IV Abx in the ED
UTIs not diagnosed as pyelonephritis	1,145 (38.3%)	16,591 (29.5%)	6.5%
Pyelonephritis	747 (25.0%)	1,888 (3.35%)	28.3%
Skin/soft tissue infection	540 (18.1%)	20,109 (35.7%)	2.6%
Pulmonary infection	361 (12.1%)	6,708 (11.9%)	5.1%
Gastrointestinal infection	87 (2.9%)	4,211 (7.5%)	2.0%
ENT infection	36 (1.2%)	667 (1.2%)	5.1%
Bite wound	33 (1.1%)	4,014 (7.1%)	0.8%
FUO	15 (0.5%)	207 (0.4%)	6.8%
Other infection	10 (0.3%)	66 (0.1%)	13.2%
Dental infection	9 (0.3%)	454 (0.8%)	1.9%
Insect bite	2 (0.1%)	1,096 (1.9%)	0.2%
Orthopedic infection	2 (0.1%)	62 (0.1%)	3.1%
Ophthalmologic infection	1 (0.0%)	68 (0.1%)	1.4%
Fungal infection	1 (0.0%)	61 (0.1%)	1.6%
Prophylaxis	0 (0.0%)	52 (0.1%)	0%
Post-op infection	0 (0.0%)	22 (0.0%)	0%
Parasitic infection	0 (0.0%)	8 (0.0%)	0%
Osteomyelitis	0 (0.0%)	4 (0.0%)	0%

IV, intravenous; *Abx*, antibiotic/antifungal/antiparasitic; *ED*, emergency department; *UTI*, urinary tract infection; *ENT*, otolaryngological; *FUO*, fever of unknown origin.

Table 3. Comparison of intravenous and prescription antibiotics, antifungals, and antiparasitic agents.

		IV antibiotic class administered in the ED							
		Amino-glycoside (N = 2)	Carba-penem (N = 6)	Cephalo-sporin (N = 3,637)	Glyco-peptide (N = 32)	Lincomycin (N = 1)	PCN (N = 114)	Sulfa (N = 1)	Tetra-cycline (N = 19)
Oral antibiotic class prescribed at discharge	Aminoglycoside	0 (0%)	0 (0%)	1 (0.0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Carbapenem	0 (0%)	3 (50%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Cephalosporin	0 (0%)	0 (0%)	2,431 (66.8%)	6 (19%)	0 (0%)	4 (3.5%)	0 (0%)	3 (16%)
	Epoxide	0 (0%)	1 (17%)	1 (0.0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Glycopeptide	0 (0%)	0 (0%)	2 (0.1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Lincomycin	0 (0%)	0 (0%)	25 (0.7%)	6 (19%)	1 (100%)	5 (4.4%)	0 (0%)	0 (0%)
	Macrolide	0 (0%)	0 (0%)	172 (4.7%)	0 (0%)	0 (0%)	4 (3.5%)	0 (0%)	0 (0%)
	Nitrofuran	1 (50%)	0 (0%)	86 (2.4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Nitroimidazole	0 (0%)	0 (0%)	50 (1.4%)	0 (0%)	0 (0%)	1 (0.9%)	0 (0%)	1 (5.3%)
	PCN	0 (0%)	0 (0%)	231 (6.4%)	2 (6%)	0 (0%)	88 (77.2%)	0 (0%)	0 (0%)
	Quinolone	0 (0%)	2 (33%)	304 (8.4%)	3 (9%)	0 (0%)	5 (1.8%)	0 (0%)	0 (0%)
	Sulfa	1 (50%)	0 (0%)	179 (4.9%)	8 (25%)	0 (0%)	2 (1.8%)	1 (100%)	0 (0%)
	Tetracycline	0 (0%)	0 (0%)	153 (4.2%)	6 (19%)	0 (0%)	4 (3.5%)	0 (0%)	15 (79%)
	Topical	0 (0%)	0 (0%)	2 (0.1%)	1 (3%)	0 (0%)	1 (0.9%)	0 (0%)	0 (0%)

Shaded cells indicate concordant intravenous and prescription antibiotic class.
IV, intravenous; *ED*, emergency department; *PCN*, penicillin.

Table 4. Change in antibiotics and antifungals by infection diagnosis.

Primary diagnosis	Changed antibiotics (N = 1,026)	Same antibiotics (N = 1,963)
Ophthalmologic infection	1 (100%)	0 (0.0%)
Pulmonary infection	279 (77.3%)	82 (22.7%)
Gastrointestinal infection	54 (62.1%)	33 (37.9%)
ENT infection	21 (58.3%)	15 (41.7%)
Insect bite	1 (50.0%)	1 (50.0%)
Other infection	5 (50.0%)	5 (50.0%)
Orthopedic infection	1 (50.0%)	1 (50.0%)
Skin/soft tissue infection	256 (47.4%)	284 (52.6%)
Dental infection	4 (44.4%)	5 (55.6%)
FUO	6 (40.0%)	9 (60.0%)
Bite wound	7 (21.2%)	26 (78.8%)
Urinary infection	391 (20.7%)	1,501 (79.3%)
Fungal infection	0 (0.0%)	1 (100%)
Prophylaxis	0 (0.0%)	0 (0.0%)
Post-op infection	0 (0.0%)	0 (0.0%)
Parasitic infection	0 (0.0%)	0 (0.0%)
Osteomyelitis	0 (0.0%)	0 (0.0%)

[1]Percentages are calculated row-wise, relative to the total number of patients within each primary diagnosis group.
ENT, otolaryngological; *FUO*, fever of unknown origin.

within Table 5. Among the 3,812 patients who received parenteral antibiotics during their ED visit, 749 (19.6%), had a return visit within two weeks compared to 11,601 (15.8%) of 73,392 patients who received only oral antibiotics ($P < 0.001$).

DISCUSSION

Our analysis of ED visits by patients with common infectious diseases who were treated with antibiotics revealed that there are opportunities for improvement in selection of antibiotics in terms of administration route and home-going prescriptions in our hospital system. Recommendations from the Infectious Disease Society of America (IDSA) are available for the three most common areas of infection among our patients: urinary; skin; and pulmonary sources. The IDSA guidelines regarding treatment for UTIs recommend oral treatment for uncomplicated cystitis, and while oral antibiotics are also appropriate for acute pyelonephritis, there is an option to provide a one-time IV dose of antibiotics, such as a long-acting cephalosporin, prior to initiation of oral therapy.[15] For skin infections, the IDSA guidelines use a mild, moderate, and severe grading for cellulitis. Only mild is categorized as appropriate for oral therapy; moderate and severe are recommended to receive IV antibiotics. There are multiple appropriate oral and IV options for treatment of bite wounds.[16] First-line treatment options for outpatient community-acquired pneumonia include oral amoxicillin, macrolides, and doxycycline for patients with few risk factors, and amoxicillin-clavulanate in conjunction with atypical coverage.[17] Healthcare-associated pneumonia treatment recommendations often include multiple medications typically including a required IV agent, such as vancomycin, precluding discharge.[18]

Patients who present to the ED for care are often complex; clinical assessment of multiple factors including clinical gestalt, in addition to laboratory and imaging findings, may cue a clinician to have a higher suspicion for a severe infection, thus prompting them to provide IV treatment. Additionally, there could be some diagnostic uncertainty prompting a desire to initiate empiric treatment prior to attaining a definitive diagnosis. Patients often improve while under our care, and it is possible that a patient is expected to be admitted to the hospital and provided IV antibiotics and either improves enough for dismissal, or perhaps they do not want to be admitted. The number of scenarios is nearly limitless. There is no clear answer as to how decisions are made to deviate from recommendations, and it may be an area ripe for additional research to understand the basis.

We identified that for UTIs, we had the highest concordance rate when an IV dose of antibiotics is prescribed. This is an opportunity to explore the relative cost of IV vs oral therapies. Using drugs.com, we found that an IV dose of 1 gram ceftriaxone costs approximately $11.47, prior to reconstitution. A dose of oral cefdinir costs under $2. In addition to the cost of the medications, there are additional

Table 5. Intravenous antibiotics and antifungals administered by infection type.

	IV antibiotics in the ED				
Primary diagnosis	**Cephalosporin (N = 2,830)**	**PCN (N = 103)**	**Glycopeptide (N = 29)**	**Tetracycline (N = 17)**	**Other Abx (N = 10)**
FUO	15 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Other infection	10 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Orthopedic infection	2 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Insect bite	2 (100%)	0 (0.0%)	0 (0%)	0 (0%)	0 (0%)
Fungal infection	1 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Urinary infection	1,879 (99.3%)	4 (0.2%)	2 (0.1%)	0 (0%)	7 (0.4%)
Pulmonary infection	354 (98.1%)	5 (1.4%)	0 (0%)	2 (0.6%)	0 (0%)
GI infection	74 (85.1%)	12 (13.8%)	0 (0%)	0 (0%)	1 (1.1%)
Skin/soft tissue Infection	462 (82.6%)	38 (7.0%)	26 (4.8%)	13 (2.4%)	1 (0.2%)
ENT infection	22 (61.1%)	13 (36.1%)	0 (0%)	0 (0%)	1 (2.8%)
Dental infection	2 (22.2%)	6 (66.7%)	1 (11.1%)	0 (0%)	0 (0%)
Bite wound	7 (21.2%)	24 (72.7%)	0 (0%)	2 (6.1%)	0 (0%)
Ophthalmologic infection	0 (0%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)

[1]Percentages are calculated row-wise, relative to the total number of patients within each primary diagnosis group.
IV, intravenous; *ED*, emergency department; *GI*, gastrointestinal; *ENT*, otolaryngological; *FUO*, fever of unknown origin; *Abx*, antibiotics.

charges associated with IV catheter placement and medication administration.[19]

Use of a single-dose glycopeptide (vancomycin) is one of the more problematic examples within our study. Unsurprisingly, we found that there were no episodes of concordance between IV and oral administration for vancomycin. The cost for vancomycin is approximately $200 for IV solution.[19] In addition to the cost for the medication and administration, the cost of time increases with vancomycin, given its longer administration time compared to other IV antibiotics or oral-only therapy.

Our study showed that there is a significant difference in LOS, which impacts ED throughput and crowding, as well as patient quality of life. We cannot attribute this difference solely to the provision of IV antibiotics, and it may be due to other confounding factors. However, in a time in which ED crowding and prompt throughput is a matter of patient safety, it should not be neglected. There is an additional cost to the institution for the occupancy of a bed in the ED. Schreyer et al calculated the personnel cost for a single bed-hour in the ED to be $58.20.[20] While over 3,000 patients who received IV antibiotics have an average LOS of 100 minutes greater than the patients treated with oral antibiotics, we find a substantial financial impact in addition to a quality-of-care effect.[20]

We found no difference in prescribing patterns between community and academic settings and only a small difference between physician and APPs. This may reflect practice patterns established by institutional norms, training programs that perpetuate a similar culture being passed on from supervisor to trainee, or simply common practices in emergency medicine.

The final outcome we examined was the likelihood to have a second visit within two weeks and whether there was a difference in the IV-oral vs oral-only groups (19.6% vs 15.8%). We were surprised to find that the patients who received IV antibiotics were more likely to return. This could have been related to discordance between IV antibiotics administered within the ED and oral antibiotics that patients received upon discharge. Or it may reflect a more severe disease than was appreciated by the treating team, resulting in the administration of IV antibiotics, or patients who declined admission. Further investigation into the course of these patients may shed additional light on the clinical decision-making around medication administration, prescription, and anticipated trajectory of their illness.

An additional finding that we discovered was the predominance of women as recipients of IV antibiotics. This is consistent with the higher incidence of UTIs in women as compared to men,[21] which in combination with the high numbers of patients who received IV antibiotics with UTI/pyelonephritis could account for this finding. Given the higher cost of care due to IV medication administration and longer duration of time spent in the ED, it is important to consider the disparities in downstream effects of treatment between genders.

Future Opportunities

Opportunities for further research include investigating any variation in average duration of illness, cost of care, or patient satisfaction between patients who receive oral antibiotics alone compared with patients who initially receive IV antibiotics. Evaluating the reasons for administering IV antibiotics initially and the reason for changing from one class of IV antibiotics to another class of oral antibiotics in the ED setting is worth further inquiry as well. Identifying the underlying cause for prescribing behaviors that are not adherent to recommended best practices will reveal opportunities for education and intervention. Providing education regarding oral bioavailability and efficacy of appropriate antibiotics may be helpful. These may include education on pharmacokinetics, implementation of electronic health record decision support, processes for prescriber and pharmacist collaboration, and more. Additionally, clarification of the IDSA guidelines around first-line treatment may result in improved LOS in the ED and other patient-oriented outcomes. In particular, the use of an IV dose of vancomycin prior to dismissal on other agents is a prime area for intervention with its associated costs and duration of administration.

LIMITATIONS

This was a retrospective cohort study, which has the associated limitations related to bias. Our study sample was found to be skewed toward female gender compared to the general population. Additionally, the large number of primary English-speaking patients may be an indicator that this study is not generalizable to EDs in more diverse settings. Our data was not able to detect the clinical significance related to the return visits. More patients who received IV antibiotics returned to the ED, but it is not clear whether this was related to the underlying infection, whether IV antibiotics were prescribed due to a clinical judgment that the patient appeared more ill and was at higher risk of disease progression, or whether other factors influenced this trajectory. No surrogates for patient acuity were included in our analysis. Inclusion of an illness severity score could improve the ability to understand the decision to provide parenteral antibiotics, as well as inform the context regarding return visits and provide additional understanding of the difference in LOS. When comparing prescribing differences between physicians and APPs we did not control for practice setting, which ranges from a NP/PA with independent practice at a critical access hospital or within an academic ED and may or may not include direct on-site supervision. Neither did we control for the presence of an ED-based pharmacist to assist with prescribing recommendations.

CONCLUSION

We found that patients within our analysis who were treated with intravenous antibiotics in the ED often received a different class of oral antibiotics upon discharge. We also found that administering IV antibiotics as a first dose prior to an oral antibiotic being prescribed upon discharge from the ED was common but may not be necessary. By recognizing these inconsistencies, there are future opportunities to improve upon antibiotic stewardship and adherence for prescribing oral antibiotics that are concordant with IV antibiotics that are administered.

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Diagnostic and Prognostic Value of SCUBE-1 in COVID-19 Patients

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Introduction: The workload of physicians increased due to the number of patients presenting with suspicion of coronavirus 2019 (COVID-19) and the prolonged wait times in the emergency department during the COVID-19 pandemic. Signal peptide-CUB-EGF domain-containing protein 1 (SCUBE-1) is a protein present in platelets and endothelial cells; it is activated by inflammation from COVID-19 and may be associated with COVID-19's known thrombotic risk. We aimed to determine whether SCUBE-1 levels are diagnostically correlated in suspected COVID-19 patients, and whether SCUBE-1 correlated with severity of disease and, therefore, might be useful to guide hospitalization/discharge decisions.

Methods: The suspected COVID-19 patients cared for at tertiary healthcare institutions for one year between May 2021–May 2022 were examined in this study. The subjects were both suspected COVID-19 patients not ultimately found to have COVID-19 and those who were diagnosed with COVID-19. By modifying the disease severity scoring systems present in COVID-19 guidelines in 2021, the COVID-19-positive patient group was classified as mild, moderate, severe, and critical, and compared using the SCUBE-1 levels. Moreover, SCUBE-1 levels were compared between the COVID-19 positive group and the COVID-19 negative group.

Results: A total of 507 patients were considered for the present study. After excluding 175 patients for incomplete data and alternate comorbid organ failure. we report on 332 patients (65.5%). Of these 332 patients, 80 (24.0%) were COVID-19 negative, and 252 (76.0%) were COVID-19 positive. Of 252 (100%) patients diagnosed with COVID-19, 74 (29.4%) were classified as mild, 95 (37.7%) moderate, 45 (17.8%) severe, and 38 (15.1%) critical. The SCUBE-1 levels were statistically different between COVID-19 positive (8.48 ± 7.42 nanograms per milliliter [ng/mL]) and COVID-19 negative (1.86 ± 0.92 ng/mL) patients ($P < 0.001$). In the COVID-19 positive group, SCUBE-1 levels increased with disease severity (mild = 3.20 ± 1.65 ng/mL, moderate = 4.78 ± 2.26 ng/mL, severe = 13.68 ± 3.95 ng/mL, and critical = 21.87 ± 5.39 ng/mL) ($P < 0.001$). The initial SCUBE-1 levels of discharged patients were significantly lower than those requiring hospitalization (discharged = 2.89 ng/mL [0.55–8.60 ng/mL]; ward admitted = 7.13 ng/mL [1.38–21.29 ng/mL], and ICU admitted = 21.19 ng/mL [10.58–37.86 ng/mL]) ($P < 0.001$).

Conclusion: The SCUBE-1 levels were found to be differentiated between patients with and without COVID-19 and to be correlated with the severity of illness. [West J Emerg Med. 2024;25(6)975–984.]

INTRODUCTION

The coronavirus 2019 (COVID-19) pandemic has had a huge impact[1,2] with more than 770 million confirmed cases and more than 6.9 million deaths reported worldwide as of September 2023.[3] Although hospital and emergency department (ED) admission rates decreased in the first period of the COVID-19 pandemic, these rates returned to pre-pandemic levels over time. Previous studies showed that the duration of time spent by patients in the ED increased during the pandemic period.[4,5] This led to ED crowding, which in turn contributed to increased inhospital mortality.[6] For this reason, it would be useful to determine which patients can be managed as outpatients, and which need admission and to what level of care. It is also crucial to promptly diagnose and provide treatment for this patient group to manage disease-related prognosis because the mortality rate of patients who visit hospitals with COVID-19 and require intensive care admission is high.[7]

As a member of the signal peptide-CUB-epidermal growth factor domain-containing protein (SCUBE) gene family, SCUBE-1 is a cell surface glycoprotein predominantly located in platelets and, to a lesser extent, in endothelial cells. The SCUBE-1 is stored in the alpha granules of inactive platelets and migrates to the platelet surface after activation by thrombin and released as small soluble particles that are incorporated into the thrombus. Unlike other members of the SCUBE gene family, SCUBE-1 tends to cause inflammation and thrombosis and can be evaluated as a prognostic factor in platelet activation and thrombotic diseases.[8,9] Infection with COVID-19 predisposes patients to venous and arterial thromboembolisms due to excessive inflammation, hypoxia, immobilization, and disseminated intravascular coagulation.[10] Previous studies have shown that the thrombotic complication rate increases with increasing severity of the disease.[1,2,11,12]

We aimed to determine whether SCUBE-1 levels are diagnostically correlated in suspected COVID-19 cases and to determine whether SCUBE-1 correlated with severity of disease and, therefore, might be useful to guide hospitalization/discharge decisions.

Population Health Research Capsule

What do we already know about this issue?
During the pandemic, the increase in the length of time that patients spent in the ED and the resultant crowding led to higher mortality.

What was the research question?
Can SCUBE-1 levels serve as a diagnostic marker in COVID-19 and be correlated with the severity of the disease?

What was the major finding of the study?
SCUBE-1 levels were higher in COVID-19 positive patients ($P < 0.001$) and increased with disease severity ($P < 0.001$).

How does this improve population health?
Using SCUBE-1 as a biomarker enables timely diagnosis of COVID-19 and severity assessment when RT-PCR results are delayed.

METHODS

Study Design

The study had a prospective and observational cohort design and recruited patients with suspected COVID-19 who visited tertiary healthcare institutions that managed patients with COVID-19, for one year between May 2021–May 2022. The patients in the COVID-19 (+) group were suspected of having COVID-19 and were diagnosed with COVID-19 by laboratory tests, imaging, and real-time polymerase chain reaction (RT-PCR) testing. The COVID-19 (−) group were those patients who had symptoms but did not have COVID-19 and were discharged. Patient exclusion criteria were as follows: incomplete data records; lack of consent; aged <18 years; and conditions that may alter SCUBE-1 levels due to predisposition to thrombosis, including pregnancy, acute renal failure, acute myocardial infarction, acute ischemic cerebrovascular disease, acute mesenteric ischemia at the time of diagnosis, peripheral arterial disease, liver failure, heart failure, or malignancy.

The disease severity of patients in the COVID-19 (+) group was determined in June 2020 using the classification introduced in guidelines published by the US National Center for Immunization and Respiratory Diseases, Division of Viral Diseases.[13] Using these guidelines, patients are classified as, 1-mild to moderate, 2-severe, or 3-critical. To determine whether there was a difference between "mild" and "moderate," patients in the "mild to moderate" group based on the SCUBE-1 level were classified further as "mild" vs "moderate" in July 2023 by following the "COVID-19 Treatment Guide" published by the US National Institutes of Health.[14]

As our goal in this study was to determine whether there were differences in the SCUBE-1 level, based on severity of disease, we made several modifications to the scoring systems from the guidelines and classified patients as 1-mild, 2-moderate, 3-severe, or 4-critical. Accordingly, taking into account the clinical symptoms and radiographic findings of

the patients, the COVID-19 (+) group was classified as "mild" (individuals who had any of the signs or symptoms of COVID-19 [eg, fever, cough, sore throat, malaise, headache, muscle pain, nausea, vomiting, diarrhea, loss of taste and smell] but no shortness of breath, dyspnea, or abnormal chest imaging); "moderate" (individuals who showed evidence of lower respiratory disease during clinical assessment or imaging and who had an oxygen saturation measured by pulse oximetry [SpO_2] of 94% or higher on room air at sea level); "severe" (individuals who had SpO_2 <94%, respiration rate >30 breaths per minute, or >50% lung involvement on imaging); and "critical" (individuals who had respiratory failure, septic shock, and/or multiple organ dysfunction).[13,14]

Patients who had "mild" disease, were to be discharged so that their treatment would continue at home. For those who had "moderate" disease, treatment was to be at home or in hospital. For those with "severe" disease, treatment was planned as admission to the COVID-19 ward, and for those with "critical" disease, treatment was planned as admission to the COVID-19 intensive care unit (ICU). Hospital length of stay, ICU stay, requirement for mechanical ventilation, high-flow oxygen, positive inotropic support, and outcomes were recorded during hospitalization of the patients admitted to the ward or the ICU.

For the present study, based on G*Power analysis, it was determined that the COVID-19 (−) group would have 100 participants and the COVID-19 (+) group would have 280 patients. The patients in the COVID-19 (+) group were divided into four groups based on disease severity, with 70 in each group. Before the study commenced, ethical approval was received (Approval No: 2021/137).

Biochemical Measurements

Blood samples

After consent for participation in the study was obtained, blood samples were collected in biochemistry tubes with separator gels and routine blood tests (complete blood count, urea, creatinine, sodium, potassium, aspartate aminotransferase, alanine transaminase, total bilirubin, lactate dehydrogenase [LDH], creatinine phosphokinase, D-dimer, ferritin, troponin, and C-reactive protein [CRP]) were performed. To measure the SCUBE-1 level, the tubes were centrifuged at 1800 × g for 10 minutes after clotting at room temperature for 20 minutes, and serum portions were carefully transferred to 1.5-milliliter (mL) capped tubes, and stored at −80°C until analyzed.

Determination of the SCUBE-1 Level

In human sera, the SCUBE-1 level was determined using an enzyme-linked immunosorbent assay (ELISA) kit (Elabscience, Wuhan, Hubei, China; Cat No: E-EL-H5405, Lot: UPJ28DN4SW), according to the manufacturer's recommendations.

Transferring the Samples to ELISA Plates and Preparing for Measurements

Serum samples stored at −80°C were thawed at room temperature. The SCUBE-1 standards were prepared following the kit procedures, and 100-microliter (μL) samples were added to the wells and to the test serum samples. The plate was covered with foil and incubated on a shaker at 37°C for 90 minutes. After the liquid in the plate was removed, 100 μL of biotinylated-Ab/Ag SCUBE-1 solution was added to each well. The plate was then covered with foil and incubated on a shaker at 37°C for 60 minutes. After incubation, the liquid was removed, and the plate was washed three times with buffer using a plate washer. Then, 100 μL of streptavidin-HRP solution was added to each well. After incubation, the liquid was removed, and the plate was washed five times with buffer using a plate washer.

Staining of Samples and Measurements

For staining, 90 μL of substrate solution was added to each well and incubated for 15 minutes in a dark environment at 37°C. Then, 50 μL of counter-staining solution was added to each well, and transformation to the color yellow was observed in each sample and the standards. The absorbance of the samples was measured at 450 nanometers on a VERSA microplate reader (Molecular Devices, LLC, San Jose, CA), and the results were recorded in nanograms (ng) per mL.

Statistical Analysis

We used the Statistical Package for Social Sciences 23.0 (SPSS Statistics, IBM Corp, Armonk, NY) for data analysis. Categorical data are presented as numbers and percentages. The Kolmogorov-Smirnov test determined normality of the numerical data distributions. Data with a normal distribution are shown as mean ± standard deviation, and non-normally distributed data are shown with median and quartile values. We used the chi-square test in the analysis of categorical data. In the analysis of numerical data conforming to normal distribution, the Student *t*-test was used to compare two groups. In the analysis of non-normally distributed numerical data, we used the Mann-Whitney U test for two-group comparisons and the Kruskal- Wallis test with Bonferroni correction for multiple-group comparisons. The diagnostic value of the SCUBE-1 level was examined using receiver operating curve (ROC) analysis.

RESULTS

A total of 507 patients were considered for this study. After excluding 175 patients (23 with incomplete data, two who withdrew, four with acute myocardial infarction, eight with acute stroke, 35 with acute kidney failure, one with peripheral artery disease, two with liver failure, 48 with heart failure, 48 with malignancy, two <18 years, and two pregnant patients), we completed the study with 332 patients.

Among these 332 patients, 80 were COVID-19 (−) and 252 were COVID-19 (+). Among the 252 patients diagnosed with COVID-19, 74 (29.4%) were classified as mild, 95 (37.7%) as moderate, 45 (17.8%) as severe, and 38 (15.1%) as critical. Demographic and clinical characteristics, vaccination status, laboratory results, and comparisons between COVID-19 (−) and COVID-19 (+) patients are shown in Table 1.

The comparison of the SCUBE-1 level between the COVID-19 (−) and COVID-19 (+) groups is presented in Table 2. There was a significant difference in the diagnostic value of SCUBE-1 for COVID-19 between the COVID-19 (−) and COVID-19 (+) groups ($P < 0.001$). The COVID-19 (+) patients (8.48 ± 7.42) had a higher mean SCUBE-1 level than COVID-19 (−) patients (1.86 ± 0.92) (Table 2). The ROC analysis and initial SCUBE-1 level cut-off values for COVID-19 diagnosis (area under the curve [AUC] 0.891, confidence interval [CI] 0.852–0.922, $P < 0.001$) are shown in Figure 1 and Table 3. For the COVID-19 (+) group (n = 252) the SCUBE-1 level increased with an increase in disease severity ($P < 0.001$). Comparisons between SCUBE-1 levels for COVID-19 (+) patients, classified according to disease severity, are shown in Table 2 and Figure 2.

Among the 252 patients in the COVID-19 (+) group, 118 were admitted to the COVID-19 ward and 38 to the COVID-19 ICU, in line with current guidelines and the protocol published by the Republic of Türkiye Ministry of Health. Ninety-six patients, who were COVID-19 (+) and did not require hospitalization based on the clinical and laboratory examinations, were discharged. Thirteen of the 96 discharged patients (13.5%) returned to the ED within 14 days after discharge, but only two of these 13 were hospitalized. These two patients were added to the hospitalized patient group for the statistical analysis. Therefore, although 94 patients were discharged, 120 patients were considered to be hospitalized because of COVID-19. The mean SCUBE-1 level of the discharged patients was significantly lower than that of patients requiring hospitalization ($P < 0.001$). The COVID-19 (+) patients were divided into three groups based on their outcomes: discharged; admitted to the ward; and admitted to the ICU. The SCUBE-1 levels and comparisons by patient outcomes are presented in Table 2. The cut-off values for the safe discharge of patients were determined with ROC analysis (AUC 0.868, CI 0.820–0.907, $P < 0.001$) (Figure 3). The ROC curves and optimal cut-off values are shown in Table 4 and Figure 3.

DISCUSSION

The results from this study show that the mean SCUBE-1 level of COVID-19 (+) patients was higher than for COVID-19 (−) patients and that the SCUBE-1 level increases with severity of the disease. Moreover, there was a significant difference between patients requiring hospitalization outcomes, such as discharged, admitted to the ward, admitted to the ICU, and the SCUBE-1 level.

Many studies have examined the diagnostic and prognostic effectiveness of reverse transcription-polymerase chain reaction (RT-PCR) using immunological, biochemical, and hematological parameters in patients with COVID-19, and differences between studies have been reported. Although RT-PCR is known as the gold standard diagnostic method to diagnose COVID-19, it has some drawbacks,[15,16] such as incorrect sample collection and low viral loads, which may cause false negative results.[15] Another study reported that 3% of patients presenting with COVID-19 symptoms had COVID-19-related tomography findings; however, while RT-PCR test results for these patients were negative, serial RT-PCR tests during follow-up of these patients were positive.[17] Considering that the average six-day incubation period of the severe acute respiratory coronavirus 2 (SARS-CoV2), RT-PCR results in the early symptomatic period or during the recovery period may yield negative results.[18] In both cases, it may become difficult to control the infection and prevent a pandemic because contagiousness continues, which may cause delayed treatment in patients.[19] Moreover, the diagnosis requires a longer period, and serial testing is expensive. Therefore, simpler diagnostic tests are required in resource-limited regions where RT-PCR cyclers and highly trained technicians are not employed.

The effectiveness of IgM and IgG antibodies detection in the diagnosis of COVID-19 has been investigated previously, and it was shown in serology-based tests that sensitivity increased as the time from symptom onset increased, and sensitivity was relatively lower before seven days.[20–23] Furthermore, the diagnostic value of biochemical and hematological biomarkers (eg, D-dimer, CRP, procalcitonin, LDH, ferritin, lymphocyte count, and leukocyte count) was examined for COVID-19, and these biomarkers were shown to have low diagnostic efficiency and higher prognostic value than diagnostic value.[24–31] The data obtained suggests that low-cost, easy-to-obtain, and easy-to-use biomarkers that provide results in a short time and offer high diagnostic efficiency are required.

The SCUBE-1 is highly expressed in vascular endothelial cells and platelets and is known to increase in thrombotic diseases with platelet and endothelial activation.[32,33] Therefore, SCUBE-1 has been used for diagnostic or prognostic evaluation of many thrombotic diseases. In a previous study, the SCUBE-1 level in patients diagnosed with pulmonary embolism was higher than in the control group, and it was stated that the SCUBE-1 level could be used for the diagnosis of pulmonary embolism at a cut-off point of >46 ng/mL with 82% sensitivity and 91% specificity.[34] Similarly, Xiao et al reported that SCUBE-1 may be a potential biomarker for the diagnosis of pulmonary embolism.[35] Cakir et al determined the diagnostic value of SCUBE-1 in aortic dissection and reported that it could be used for the diagnosis of aortic dissection in patients with aortic dissection at levels >19.75 ng per deciliter with 95%

Table 1. The demographic, clinical, and biochemical characteristics of COVID-19 negative and COVID-19 positive groups.

Variables	COVID-19 negative (n:80, %24.1)		COVID-19 positive (n:252, %75.9)		*P*-value
Demographics					
Age, years	65.0	(24.0–95.0)	63.0	(18.0–92.0)	0.73
Sex, male, n (%)	36	(45.0)	104	(41.3)	0.56
Medical history					
Diabetes mellitus, n (%)	20	(25.0)	55	(21.8)	0.55
Hypertension, n (%)	37	(46.3)	114	(45.2)	0.87
CVA, n (%)	7	(8.8)	12	(4.8)	0.18
CAD, n (%)	6	(7.5)	31	(12.3)	0.23
Asthma/COPD, n (%)	19	(23.8)	34	(13.5)	0.03
Smoking, n (%)	13	(16.3)	38	(15.1)	0.80
Symptoms					
Fever, n (%)	18	(22.5)	54	(21.4)	0.84
Cough, n (%)	28	(35.0)	165	(65.5)	<0.001
Dyspnea, n (%)	33	(41.3)	153	(60.7)	0.002
Runny nose, n (%)	5	(6.3)	7	(2.8)	0.15
Anorexia, n (%)	9	(11.3)	48	(19.0)	0.11
Loss of taste, n (%)	0	(0.0)	6	(2.4)	0.16
Loss of smell, n (%)	0	(0.0)	1	(0.4)	0.57
Myalgia, n (%)	24	(30.0)	93	(36.9)	0.26
Fatigue, n (%)	38	(47.5)	143	(56.7)	0.15
Headache, n (%)	19	(23.8)	52	(20.6)	0.55
Nausea/vomiting, n (%)	18	(22.5)	45	(17.9)	0.36
Diarrhea, n (%)	14	(17.5)	7	(2.8)	<0.001
Vaccination, n (%)	51	(63.7)	161	(63.9)	0.98
Laboratory results					
Creatinine, (mg/dL)	1.07 ± 0.4		1.09 ± 0.7		0.23
Uric acid, (mg/dL)	23.7 ± 15.7		24.5 ± 20.0		0.78
Albumin, (mg/dL)	39.5	(25.0–49.0)	39.7	(21.0–59.0)	0.06
LDH, (mg/dL)	262.5 ± 123.8		340.2 ± 163.8		0.03
CRP, (mg/dL)	74.8 ± 71.3		74.2 ± 71.6		0.05
PCT, (μg/L)	0.92 ± 2.5		2.34 ± 12.4		0.12
WBC, ($\times 1000/mm^3$)	7.7	(3.0–20.8)	7.0	(1.2–147.0)	<0.001
Lymphocyte, ($\times 1000/mm^3$)	1.74 ± 1.69		1.39 ± 1.93		0.009
Neutrophil, ($\times 1000/mm^3$)	5.2	(0.4–13.6)	4.7	(12.7–118.0)	0.004
Hemoglobin, (mg/dL)	12.8	(9.8–16.3)	13.4	(5.5–18.4)	0.24
Platelet count, ($\times 1000/mm^3$)	215.5	(123.0–417.0)	189.0	(55.0–537.0)	0.001
Fibrinogen, (mg/dL)	394.9	(201.0–735.0)	418.0	(146.0–6011.0)	0.14
D-dimer, (mg/L)	1.39 ± 1.9		1.6 ± 3.8		0.17
N/L ratio	5.9 ± 4.7		11.4 ± 27.8		0.35
Ferritin, (μg/L)	177.6 ± 164.6		621.4 ± 1022.3		<0.001

Values are expressed as mean ± SD, n (%) or median (interquartile range) unless otherwise stated.
CAD, coronary artery disease; *COPD*, chronic obstructive pulmonary disease; *CRP*, C-reactive protein; *CVA*, cerebrovascular accident; *LDH*, lactate dehydrogenase; *N/L* ratio, neutrophil/lymphocyte ratio; *PCT*, procalcitonin; *WBC*, white blood cell.

Table 2. The SCUBE-1* levels of COVID-19 negative and COVID-19 positive groups according to disease severity and patient outcomes.

		SCUBE-1 levels (ng/mL)	*P*-value
	COVID-19 (–), (n = 80)	1.86 ± 0.92	<0.001*
	COVID-19 (+), (n = 252)	8.48 ± 7.42	
COVID-19 (+) (n = 252)	Mild, (n = 74)	3.20 ± 1.65	<0.001¥
	Moderate, (n = 95)	4.78 ± 2.26	
	Severe, (n = 45)	13.68 ± 3.95	
	Critical, (n = 38)	21.87 ± 5.39	
COVID-19 (+) (n = 252)	Discharged, (n = 94)	2.89 (0.55–8.60)	<0.001¥
	Ward-admitted, (n = 120)	7.13 (1.38–21.29)	
	ICU-admitted, (n = 38)	21.19 (10.58–37.86)	

*Mann-Whitney U test.
¥Kruskal-Wallis test with Mann-Whitney correction, results achieved from the comparison of the three groups were statistically significant.
*SCUBE-1, signal peptide-CUB-EGF domain-containing protein 1.

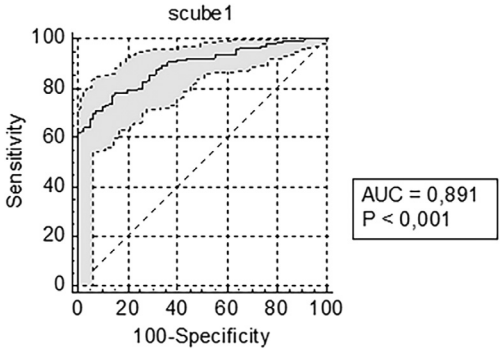

Figure 1. The initial SCUBE-1* level cut-off and confidence interval values for COVID-19 diagnosis.
*SCUBE-1, signal peptide-CUB-EGF domain-containing protein 1.
AUC, area under the curve; *NPV*, negative predictive value.

sensitivity and 76% specificity.[36] Furthermore, Dai et al concluded in their study that the SCUBE-1 level may have diagnostic value in patients with acute coronary syndrome and acute ischemic stroke.[37]

Studies that examined the diagnostic effectiveness of SCUBE-1 were based on the relationship between SCUBE-1 and thrombus formation due to endothelial dysfunction. SARS-CoV-2 does not possess procoagulant characteristics,[32,38] but vascular endothelial cell damage occurs due to an excessive inflammatory response triggered by COVID-19. The diagnostic relationship between SCUBE-1 and COVID-19 was determined in the present study because hypercoagulability, platelet activation, and endothelial dysfunction may develop with the resulting vasculopathy.[34,39,40] One of the main results of this study was that the SCUBE-1 level was higher in COVID-19 (+) patients than in COVID-19 (–) patients. In this context it showed that the SCUBE-1 level is an effective biomarker for the diagnosis of COVID-19, and it can be used to diagnose COVID-19 in EDs. However, the current assay studied here is complicated and labor intensive and would take at least 210 minutes to perform, even under optimum conditions.[41]

Clinical signs and symptoms (eg, cough, dyspnea, fever, diarrhea, nausea, vomiting, loss of taste and smell, respiratory rate, saturation, and radiographic findings) were used to determine the severity of COVID-19.[12] Many biochemical parameters (eg, elevated CRP, thrombocytopenia, and an elevated ferritin level) are poor prognostic factors in COVID-19, and they have not been used to define disease severity per the current literature.[42–44] In this context, determining the disease severity of patients at the time of admission by using a biochemical parameter, such as the SCUBE-1 level (with or without the present

Table 3. SCUBE-1* cut-off value of COVID-19 negative and COVID-19 positive groups.

	Sensitivity		Specificity		PPV		NPV	
SCUBE-1 cut-off value (ng/mL)	(%)	(95% CI)	(%)	(95% CI)	(%)	(95% CI)	(%)	(95% CI)
0.54	99.6	(97.8–100.0)	8.7	(3.6–17.2)	77.5	(76.3–78.7)	87.5	(46.6–98.2)
2.05	90.8	(86.6–94.1)	63.7	(52.2–74.2)	88.8	(85.5–91.4)	68.9	(59.2–77.2)
3.89	62.3	(56.0–68.3)	98.7	(93.2–100.0)	99.4	(95.7–99.9)	45.4	(41.5–49.4)

*SCUBE-1, signal peptide-CUB-EGF domain-containing protein 1.
CI, confidence interval; *NPV*, negative predictive value; *PPV*, positive predictive value.

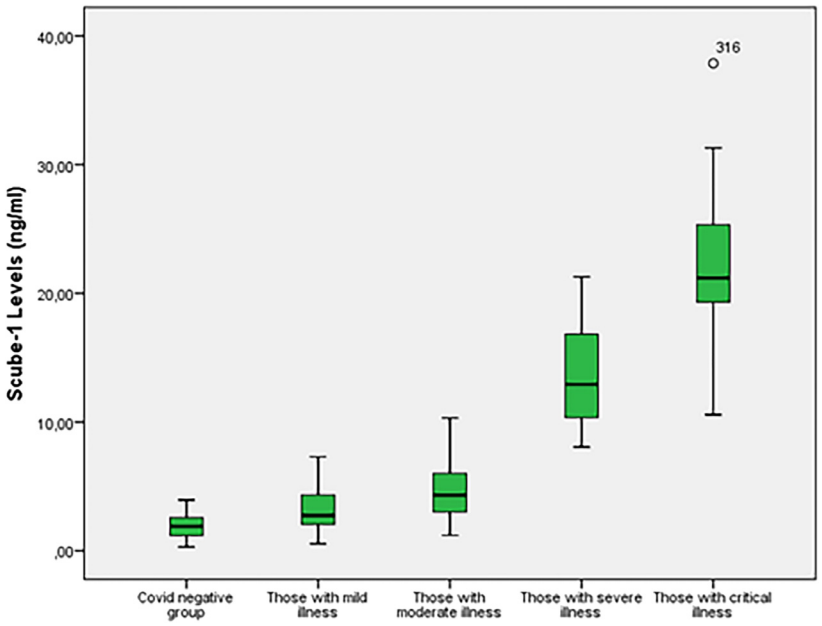

Figure 2. *SCUBE-1 levels of COVID-19 patients. All *P*-values <0.001.
*SCUBE-1, signal peptide-CUB-EGF domain-containing protein 1.

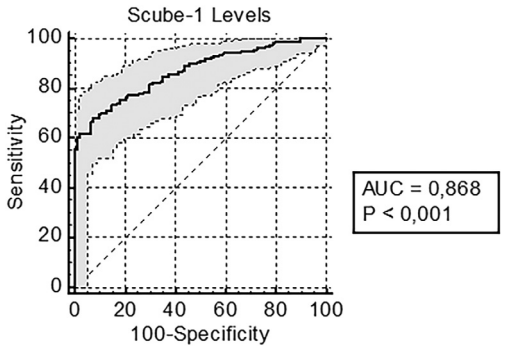

Figure 3. The cut-off and confidence interval values for the safe discharge of COVID-19 (+) patients according to ROC analysis. *ROC*, receiver operating characteristic curve; *SCUBE-1*, signal peptide-CUB-EGF domain-containing protein 1.

scoring systems), can be used at an early stage to distinguish between severe and critical patients with COVID-19 to reduce mortality and enable timely treatment. Microvascular and macrovascular thrombotic complications may develop in arterial, venous, and capillary vascular beds because thromboinflammatory processes intensify during COVID-19, particularly with increasing severity of the disease.[39,45] In a 2022 study conducted by Toprak et al, an elevated SCUBE-1 level was associated with thrombotic complications, disease severity, and inhospital mortality in patients with COVID-19.[46] In the present study, the SCUBE-1 level was elevated in patients with COVID-19, and as the severity of the disease increased the SCUBE-1 level also increased.

The study conducted by Calik et al reported a low mortality rate of patients who presented early to hospital and received early antiviral treatment.[47] Early diagnosis, appropriate triage, and early treatment of patients who present to healthcare institutions with symptoms of COVID-19 and are considered COVID-19 (+) may prevent the risk of contamination, reduce the need for intensive care, and reduce the need for hospitalization by enabling rapid decision-making in the best interests of patients. From this perspective, biomarkers are required to guide clinicians in

Table 4. Optimal SCUBE-1* cut-off values of COVID-19 positive patients according to patients requiring hospitalization outcomes.

Patients requiring hospitalization outcome	SCUBE-1 cut-off value (ng/mL)	Sensitivity		Specificity		PPV		NPV	
		(%)	(95% CI)	(%)	(95% CI)	(%)	(95% CI)	(%)	(95% CI)
Discharged	1.38	99.3	(96.5–100.0)	10.6	(5.2–18.7)	65.1	(63.5–66.7)	90.9	(56.5–98.7)
Ward admitted	3.05	89.8	(84.1–94.1)	54.2	(43.7–64.6)	76.8	(72.5–80.5)	76.1	(65.9–84.0)
ICU admitted	8.27	55.7	(47.6–63.6)	98.9	(94.2–100.0)	98.9	(92.6–99.8)	57.1	(52.7–61.3)

*SCUBE-1, signal peptide-CUB-EGF domain-containing protein 1.
CI, confidence interval; *ICU*, intensive care unit; *NPV*, negative predictive value; *PPV*, positive predictive value.

hospitalization/discharge decisions and ward/intensive care unit admission of patients diagnosed with COVID-19.[48,49] Such a biomarker may contribute to better decision-making at the ED or discharge stage and ED occupancy by reducing patient wait times.

In the present study, when the ED outcomes of the patients were grouped as discharge, ward admission, or intensive care admission, and when the SCUBE-1 levels were compared, the SCUBE-1 level of discharged patients was lower than that of patients who required hospitalization, and the SCUBE-1 level of patients who required ICU admission was higher than for the other groups. Given these results, it can be argued that the SCUBE-1 level may assist clinicians to predict disease severity and assist in making decisions regarding hospitalization or discharge. In addition, because of the risk of micro- and macrovascular thrombosis, a high SCUBE-1 level measured in the early stages of the disease may indicate the requirement for more intensive antithrombotic treatment to prevent thrombotic complications.

The RT-PCR is the gold standard for confirming the presence of SARS-CoV2, and the time to obtain the result for a single test is approximately two hours.[50] However, samples collected in hospitals were transported to specific laboratories because PCR tests could not be performed in every laboratory during the pandemic period,[51,52] which resulted in delays in receiving the test results. Previous studies have shown that the confirmation time of the SARS-CoV-2 virus using RT-PCR was 6–48 hours during the pandemic period.[53,54] In addition, tests such as the RT-PCR only identify SARS-CoV2 and do not provide data on the severity of COVID-19. Considering these limitations, the use of RT-PCR kits for surveillance or screening patients, preventing increased patient density in healthcare institutions, and reducing patient wait times may be difficult.[53] Therefore, there is a need for novel biomarkers to enable the rapid detection of individuals with COVID-19, even in primary healthcare institutions and to guide physicians regarding the discharge or hospitalization of patients according to cut-off values.

The test time of SCUBE-1 is approximately 3.5 hours, and the sample is easy to obtain from a blood sample, which enables the rapid identification of patients with COVID-19.[41] The present study also revealed that the SCUBE-1 level is associated with the severity of disease, which facilitates decision-making regarding discharge or admission to the ward or the ICU, which may assist in reducing patient density in healthcare institutions, reduce patient wait times, and effectively improve patient management.

LIMITATIONS

There were some limitations to this study. First, the targeted number of patients was not recruited owing to the decreased severity and incidence of COVID-19 worldwide. Second, because the number of SCUBE-1 kits was limited, SCUBE-1 measurements were limited to a single plasma sample. Serial SCUBE-1 measurements during patient treatment may have altered the correlation between the SCUBE-1 level and disease severity.

CONCLUSION

Even though RT-PCR testing usually produces a diagnosis of COVID-19 in a short time, the excessive sample load accumulated in laboratories during the pandemic increased the time to completion and increased patient wait times. In the present study, we found that the SCUBE-1 level differs between patients with and without COVID-19 and it was correlated with the severity of the disease. Accordingly, besides guiding physicians regarding the diagnosis of COVID-19 and the severity of the disease among patients who present at health facilities during pandemic periods where results of RT-PCR tests may be delayed, SCUBE-1 may assist clinicians in managing inflammatory diseases that predispose to thrombosis.

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Feasibility of Emergency Department-Initiated HIV Pre-Exposure Prophylaxis

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Introduction: Pre-exposure prophylaxis (PrEP) for HIV—using antiretroviral medication in non-infected individuals to prevent HIV—has immense potential to slow the spread of the virus. However, uptake has been insufficient, and stark racial disparities exist in both HIV acquisition and PrEP usage, making PrEP access a health equity issue. A promising venue to engage high-risk populations in PrEP care is the emergency department (ED); however, existing ED PrEP initiatives have been costly or have had limited success. We hypothesize that two strategies could overcome these barriers: prescribing PrEP during an ED visit and providing patients with an initial supply of PrEP medication in the ED. Here, we describe the results of a qualitative study exploring multidisciplinary emergency clinicians and HIV clinicians' needs and views about the feasibility of such an initiative.

Methods: We conducted 22 semi-structured interviews with multidisciplinary clinicians from an urban, safety-net medical center in the ED and the on-site HIV clinic that provides PrEP services. We performed thematic analysis to summarize challenges and potential solutions described by participants.

Results: Participants' responses fell into three thematic categories: operational challenges; patient-level considerations; and potential impacts. Operational challenges highlighted the difficulty of PrEP initiation in a busy ED and clinician support needs. Patient-level considerations included the complex psychosocial needs of ED patients who could benefit from PrEP. Finally, participants anticipated that an ED-based PrEP initiation program could positively impact both individual patients and public health.

Conclusion: Interviews with emergency department and HIV clinic staff revealed important considerations and potential solutions for ED-initiated PrEP workflows. Clinicians in both specialties were enthusiastic about such an initiative, which could facilitate its success. This study lays the groundwork for the future design of an efficient and innovative workflow to leverage the ED as an essential entry point into HIV prevention services. [West J Emerg Med. 2024;25(6)985–992.]

INTRODUCTION

Despite substantial progress in understanding and managing human immunodeficiency virus (HIV), the virus remains a pressing concern in the United States due to its persistent prevalence, associated multisystemic health impacts, and costs to the healthcare system.[1–4] This underscores the need for innovative approaches to prevention. HIV pre-exposure prophylaxis (PrEP)—the use of antiretroviral medication in non-infected individuals to prevent HIV acquisition—has emerged as a groundbreaking

strategy that drastically reduces the risk of contracting HIV and has received a Grade A recommendation from the US Preventative Services Task Force.[5,6]

While PrEP is a safe and effective HIV prevention tool, challenges persist that have limited its real-world impact on the HIV epidemic. Uptake has been poor: just 36% of people at risk for HIV with a PrEP indication were prescribed the medication in 2022.[7] Wide racial and socioeconomic disparities exist in both HIV acquisition and PrEP uptake in the US,[8–10] leaving vulnerable populations disproportionately exposed to the risk of HIV infection. Addressing these disparities necessitates innovative approaches that extend beyond traditional sexual health clinic settings. Emergency departments (ED) are often the only healthcare access point for underserved populations and have been identified as a promising venue to engage high-risk populations in HIV prevention services.[11] Research in an urban, county-run ED estimates that at least 1 in 20 ED patients are PrEP-eligible, and of the PrEP-eligible participants who had previously heard of PrEP, 75% were willing to start at that visit.[12] Other studies have similarly demonstrated PrEP's acceptability among ED patients.[13,14]

While many ED patients could benefit from PrEP, connecting them to longitudinal care at PrEP clinics remains challenging. A study in a high-volume urban ED showed that while 68.6% of patients who completed an HIV risk assessment were interested in PrEP, 11% of those interested were able to start PrEP medication after speaking with a PrEP educator, and 3% of interested patients who were provided with information about drop-in PrEP clinic hours received a prescription.[14] Other EDs have similarly implemented ED-based PrEP educators or navigators with varying degrees of success.[15,16] However, this strategy may be cost-prohibitive for many safety-net EDs, as they may not be able to fund or staff PrEP-specific positions to assist with linkages. More work is needed to determine how to address low PrEP initiation rates, while leveraging existing resources and interdisciplinary personnel to provide equitable, high-value care.

We have identified two strategies studied in other contexts that could be adapted to address barriers faced by previously reported ED-based PrEP programs. First, research in drop-in sexual health clinics shows that prescribing PrEP during a patient's initial visit ("same-day PrEP initiation"), before receiving all lab results, increases the likelihood of PrEP initiation and continuation without compromising patient safety, compared to the standard model of requiring multiple visits for testing and counseling before prescribing PrEP medication.[17] Second, providing a 14-day supply of antiretroviral medication "starter packs" to patients who test positive for HIV in the ED has been shown to increase the likelihood of engagement in follow-up HIV care, compared to patients who did not receive medication starter packs.[18] We hypothesize that adapting both of these strategies to create a workflow that employs "same-day PrEP initiation" within the initial ED visit and PrEP "starter packs" could overcome challenges and financial barriers faced by previously described programs solely focused on counseling and referral to services. However, the feasibility and acceptability of such a workflow among ED and HIV clinic staff is unknown.

Population Health Research Capsule

What do we already know about this issue?
The emergency department is a promising venue for the initiation of HIV pre-exposure prophylaxis (PrEP) for underserved populations.

What was the research question?
What challenges and facilitators exist for the creation of an ED-based PrEP initiation and care linkage program?

What was the major finding of the study?
Busy EDs with limited clinician support and patients' complex psychosocial needs are factors to consider in the creation of an ED-based PrEP initiative.

How does this improve population health?
Prescribing PrEP during a patient's initial ED visit before receiving all lab results could increase the likelihood of PrEP initiation and continuation in marginalized communities.

In this paper, we present a qualitative study investigating the feasibility of, and identifying barriers and facilitators to, the implementation of a same-day PrEP initiation workflow in the ED via thematic analysis of interviews conducted with multidisciplinary clinicians from an urban ED and a safety-net HIV clinic that provides comprehensive PrEP services. This exploratory study lays the groundwork for creation and evaluation of such a workflow.

METHODS

Study Design and Participant Selection

We conducted 22 half-hour interviews at a large, urban, safety-net medical center in a major California city with 15 multidisciplinary clinicians in the ED and seven in the on-site HIV clinic between May 25–July 12, 2023 and July 15–July 24, 2024. We chose this site because it is a county-run, safety-net institution that has both an ED and HIV clinic on the same campus and serves mainly publicly insured and uninsured patients. Moreover, many of this center's patients

experience psychosocially complex circumstances such as houselessness or substance use disorders and are at high risk for HIV from sharing injection drug equipment, engaging in sex work, or having condomless anal sex with multiple partners. We identified participants by purposive sampling, collaboratively drafting a list of potential subjects to represent a diverse array of professional experiences, years of practice, and degree of past involvement in harm reduction initiatives.

We intentionally recruited subjects who serve in a variety of clinical roles to identify opportunities for interprofessional collaboration and staffing efficiency. Additionally, participants were identified by snowball sampling by asking participants to refer additional staff members who could add a unique perspective to the dataset. Recruitment continued iteratively in this way until thematic saturation was reached, meaning that interviewers agreed that interviews were yielding similar data. Participants received $25 gift cards for their participation. Our institution's institutional review board determined this study to be exempt.

Interventions

Interviews were semi-structured, using an interview guide created collaboratively by authors EBR and KJ and iteratively modified by all authors (Supplemental Table 1). The interview guide invited participants to discuss their role in the ED, previous experience with ED-based HIV prevention interventions, perceived need for HIV prevention interventions among their patient population, and anticipated barriers and solutions for successful PrEP initiation and linkage to care. All participants provided verbal consent to participate in the study (Supplemental Table 2). Besides role, no identifying information was collected. All interviewers (EBR, KP, and KJ) have experience creating curriculum or workflows for medical professionals and students on topics related to the needs of marginalized populations. We considered how interviewer positionality could potentially impact participants' responses; no issues were found, and none of the interviewers had supervisorial responsibilities over the participants they interviewed. EBR conducted 14 interviews; KP conducted six interviews, and KJ conducted two interviews. Interviews were recorded and transcribed using Zoom teleconferencing software v5.13.11 (Zoom Video Communications, Inc, San Jose, CA), and transcripts were reviewed for accuracy by EBR. Recordings and transcripts were stored securely within our institution's approved secure, enterprise, cloud-based file collaboration software. Sampling and interviews were conducted until no new information was generated, indicating that thematic saturation was reached.

Analysis

We performed inductive thematic analysis of interview transcripts after completing interviews following the grounded theory approach. Allowing participants' responses to guide theme development enabled us to prioritize problem areas not already explored in the literature.[19] Analysis was conducted from July 15–August 15, 2023 and July 25–August 2, 2024. At the initial stage, authors EBR, KP, and KJ inductively developed a preliminary codebook by reflecting on interviews and analyzing one full transcript together. This codebook was iteratively revised during coding in discussion with the research team. EBR coded 12 interviews and KP coded 10 interviews using ATLAS.ti web software v5.11.0-2023-08-02) (ATLAS.ti GmbH, Berlin, Germany). After independently reviewing each other's codes, EBR and KP reconciled any discrepancies by discussing them within the context of the full interview transcript, and KJ arbitrated disagreements. There was a high degree of concordance between coders, and complete agreement regarding codes and themes was reached. Throughout this process, higher order themes were developed through iterative discussions among the research team. Frequent meetings at each analytic step enhanced consistency of coding and analysis. Funders did not participate in any portion of data collection or analysis.

In this paper, we use "HIV clinic" to describe the study site at which interviews took place, and "PrEP clinic" to indicate any clinic that could form partnerships with EDs to facilitate follow-up PrEP care.

RESULTS

Our sample included eight attending physicians (five in the ED and three in the HIV clinic); four resident physicians and fellows (three in the ED and one in the HIV clinic); one nurse practitioner in the ED; five registered nurses (three in the ED and two in the HIV clinic); two social workers in the ED; and two pharmacy staff (one in the ED, and one in the HIV clinic) (Table 1).

Participants self-identified their experience with delivering PrEP as "none," "limited," or "extensive." "Limited" PrEP experience is defined as not within the healthcare professional's usual scope of practice, but they have been involved in connecting ED patients to PrEP at least once. "Extensive" PrEP experience indicates that they have been involved in ED-prescribed PrEP multiple times and are comfortable in this practice. Thirteen participants had no experience delivering PrEP (nine in the ED and four in the HIV clinic); six had limited experience (five in the ED and one in the HIV clinic); and three had extensive experience (one in the ED and two in the HIV clinic). Themes discussed by participants fell into three distinct categories: operational challenges; patient-level considerations; and potential impacts of an ED-initiated PrEP workflow.

Operational Challenges

Operational challenges to implementing an ED-based PrEP initiation workflow were reported consistently by participants from both the ED and the HIV clinic (Table 2).

Table 1. Participant demographics among 22 healthcare professionals from the emergency department (ED) and HIV clinic at Zuckerberg San Francisco General Hospital, an urban safety-net medical center.

	Emergency department	HIV clinic	Total
Role			
Attending physician	5	3	8
Resident physician/ fellow	3	1	4
Nurse practitioner	1	0	1
Registered nurse	3	2	5
Social Worker	2	0	2
Pharmacist/pharmacy technician	1	1	2
Total	15	7	22
Years of practice			
1–5 years	3	2	5
6–10 years	4	3	7
11+ years	8	2	10
Experience with PrEP in the ED			
None	9	4	13
Limited*	5	1	6
Extensive**	1	2	3

*Limited PrEP experience is defined as "not within the clinician's usual scope of practice, but they have been involved in connecting ED patients to PrEP at least once."
**Extensive PrEP experience is defined as having been "involved in ED-prescribed PrEP multiple times and is comfortable in this practice."
ED, emergency department; *PrEP*, pre-exposure prophylaxis.

The main concerns participants identified were time, capacity, and resource constraints in the ED. Emergency clinicians were wary of initiating conversations about preventative health unrelated to the patient's chief concern, as doing so could extend ED length of stay and impede ED operations. One emergency physician expressed trepidation about clinicians' ability to have "meaningful conversations [about sexual health and HIV risk] while trying to care for [many] people in the waiting room at the same time". Needing to conduct lengthy searches for clinical guidelines from multiple sources was also a recurring factor.

To circumvent these time and capacity constraints, nearly all participants discussed electronic health record (EHR) tools or electronically accessible workflows as factors that could facilitate rapid PrEP prescription and decrease the "knowledge base needed [to correctly prescribe PrEP]" (HIV Clinic physician). The EHR tools included premade order sets to facilitate ordering of all required labs, prescription formulations, and referrals; a checklist of topics to review with patients integrated into medical note templates; and pre-written notes and discharge instructions. Integrating these tools into one page in the EHR or electronically accessible workflow system could allay concerns over the cognitive burden of implementing this workflow that some emergency clinicians considered to be outside their routine scope of practice.

Interdisciplinary collaborations were commonly discussed. The emergency physicians highlighted the importance of interdisciplinary collaborations between physicians, nurses, pharmacists, social workers, and patient navigators, "so that the burden isn't solely on [one clinician] to explain everything to the patient" (emergency medicine resident). Many felt that this could ease the time and capacity constraints felt by physicians in their daily practice. This

Table 2. Representative quotes from participant interviews illustrating operational challenges to implementing an emergency department-initiated pre-exposure prophylaxis workflow.

Sub-themes within operational challenges	Associated quotations
Time and capacity constraints for PrEP care within the ED	"This proposed project is coming at a . . . national crisis of ED crowding . . . so there's really little excess capacity anywhere in, in and outside the ED for additional tasks, without more resources." (EDMD-01) "We're usually short staffed, and there's . . . competing priorities usually during the shift, and something like this will probably fall to the wayside in terms of priority list, but not to say it's not important." (EDRN-3)
Challenges associated with equitably identifying high-need PrEP candidates	"I need [clinicians] to offer this to people, but not just those who[m] you assume are at risk, because . . . we have a lot of patients who are sex workers, and they don't necessarily tell us they're sex workers." (EDNP-01)
Need for staff education	"I think I would just need a bit more information myself . . . I have no real expertise in this area. And so, I would definitely want to have a better understanding of . . . what I was looking for . . . Then I would feel pretty comfortable having a conversation as long as . . . I was educated enough." (EDSW-02)

ED, emergency department; *EDMD*, emergency physician; *EDRN*, registered nurse in the ED; *EDSW*, ED social worker; *PrEP*, pre-exposure prophylaxis.

sentiment was similarly echoed by the nurses, pharmacists, and social workers interviewed who felt their participation could strengthen the program. One nurse noted that, although discharge planning is coordinated by prescribers, these plans sometimes result "from the advocacy of bedside nurses" (ED nurse); formalizing and encouraging interdisciplinary collaboration could increase patient identification and linkage. However, another nurse noted that putting too much burden on already busy nursing staff would limit the success of the program.

Participants anticipated challenges in identifying patients who would be ideal PrEP candidates. Some worried about the potential "bias of who [clinicians] think is at risk" (ED nurse practitioner), reinforcing stereotypes, or incomplete identification of need based on patient reluctance to disclose risky behaviors. However, many had mixed feelings about the solutions they identified. While many participants suggested automated EHR pop-up reminders triggered by certain chief concerns or charted risk factors, they anticipated that these reminders may be ignored by clinicians inundated by a burgeoning number of similar alerts. Some suggested universal screening for HIV risk factors to avoid biased PrEP offering but anticipated feasibility and privacy issues. Finally, many suggested posters encouraging patients to self-identify as PrEP candidates, but others felt this strategy would miss high-need patients with limited health literacy or reluctance to disclose risk factors.

Participants emphasized the importance of staff education, with many reporting that their comfort with the program would be contingent on adequate staff training. There was no consensus on ideal length and modality of educational session, and some emphasized the need for a variety of training formats—live lectures, team huddles, emails, posters—to meet the needs of staff with a variety of learning styles and schedules. With regard to training content, emergency clinicians desired more information about the potential harm that PrEP therapy could cause patients, particularly related to liver and kidney health. However, HIV clinic staff consistently emphasized that ED staff training should highlight that PrEP carries a low risk for severe injury if clinicians adhere to prescriber guidelines.

Patient-Level Considerations

In addition to operational concerns, participants frequently reported that an ED-based PrEP initiation program must address factors that influence patients' ability to enter and maintain engagement with longitudinal PrEP care (Table 3). The need for mechanisms for reliable connection to follow-up care, including plans for patients who present after business hours, was discussed ubiquitously. Multiple HIV clinic participants emphasized collecting alternate forms of contact information that might not usually be asked about during triage, including email addresses, friends' or case workers' contact information, and campsite locations for unhoused patients. Many from both the ED and HIV clinic emphasized the importance of having a clearly defined follow-up structure or specific person to conduct outreach to patients with abnormal lab results that resulted after discharge from the ED.

Patient navigators were discussed as an essential resource to facilitate connection to care. Multiple participants from the HIV clinic mentioned the value of having a navigator based at the HIV clinic meet the patient in the ED, as opposed to relying on ED-based support staff for connection to care. They felt that this could build therapeutic rapport, decrease patient anxiety associated with seeking services in a new healthcare setting as "the ice is already broken" (HIV Clinic physician), and increase likelihood of retention in care.

Due to the psychosocial complexity of the target patient population, participants proposed three components of a PrEP initiation workflow that are essential for success. First, many participants discussed the need to provide patients an initial supply of PrEP in the ED, as opposed to sending the prescription to a pharmacy for the patient to pick up after discharge. Participants reported having experienced greater success in discharge medication initiation when this strategy was employed in similar initiatives. Second, participants emphasized the importance of EDs partnering with PrEP clinics that could meet additional psychosocial needs "that

Table 3. Representative quotes from participant interviews illustrating patient-level considerations when implementing an emergency department-initiated pre-exposure prophylaxis workflow.

Sub-themes within patient-level considerations	Associated quotations
Ensuring adequate follow-up	"In terms of obtaining good contact information from people—and I don't just mean phone numbers by that. So, it could be campsites, places they frequent, friends' contact numbers if somebody doesn't have a reliable means of communication, because we certainly don't want to create barriers for the people who need PrEP the most." (IDMD-03)
Anticipated barriers to accessing and adhering to medications	"I do worry that many patients who are at risk for HIV may not have the faculties to be able to take a daily medication." (EDMD-05)

EDMD, emergency physician; *IDMD*, infectious diseases physician; *PrEP*, pre-exposure prophylaxis.

are really at the forefront of [the patient's] life" (HIV Clinic nurse). For example, many participants from both the ED and HIV clinic anticipated that a PrEP clinic that provides substance use disorder support and wrap-around services could better address barriers to adherence in high-risk patients than a clinic that only offers basic sexual health care. Third, participants discussed the importance of language-inclusive patient education materials and staff for patients with limited English proficiency, as well as patient education materials that use simple language.

Potential Impacts

Participants near universally anticipated a high need for an ED-based PrEP initiation workflow, and the majority were noticeably excited for the potential rollout of such an initiative (Table 4). Participants stated that this initiative could have a significant impact on patients who are at high risk for HIV infection and have high levels of psychosocial complexity, especially unhoused patients and those with substance use disorders. Furthermore, participants anticipated that this program could have positive implications on population-level health disparities in HIV acquisition by reaching high-risk groups that current HIV prevention initiatives have not been able to engage.

Participants had differing views on the effect that this program could have on ED staff and operations. Both ED and PrEP clinic participants worried that emergency clinicians would resist the additional tasks required for this program and find it incompatible with an acute care setting. One emergency attending physician, speaking to her previous experience leading an ED-based harm reduction initiative, noted that considerable educational interventions were needed to "change the [ED] culture and make [prescribing harm reduction medication] something that was within the purview of the emergency team." However, many ED staff anticipated that their colleagues would find fulfillment in the opportunity to engage patients in preventative medicine as a respite from managing frequent acute crises. Additionally, some ED participants viewed this proposed workflow as part of a larger perceived culture shift in EDs to consider upstream factors that cause patients to seek out acute care, even fulfilling a moral obligation: "We owe it to our community to be able to provide [PrEP in the ED]" (emergency medicine resident).

DISCUSSION

This study demonstrated that staff at both a busy, urban medical center ED and safety-net HIV clinic see the need for HIV prevention services among ED patients and are amenable to the creation of a workflow to engage at-risk patients in care while in the ED, assuming that described challenges are addressed. We integrated themes that arose into a cohesive framework that could be used to guide workflow development (Figure).

Our data provides valuable insight into potential interventions to prepare and prime ED staff to consider PrEP as an option for patients. For example, discordant views on PrEP safety and side effects between ED and HIV clinic staff demonstrate the need for educational interventions targeted at this subject. Furthermore, the perspectives of ED staff excited about the potential workflow—such as finding fulfillment in connecting patients with PrEP or evoking a moral obligation among staff—could be incorporated into

Table 4. Representative quotes illustrating participant-reported potential impacts of an emergency department-initiated pre-exposure prophylaxis workflow.

Sub-themes within Potential Impacts	Associated quotations
Individual and public health benefits of engaging at-risk populations in HIV prevention services	"A lot of people come to our emergency department, I say sometimes as a last resort, but also as a first resort, because they don't know where else to go . . . and I think that it will touch a lot more people than I think we think it will at this point." (EDRN-01)
Impacts on staff	"I think that [clinicians] are going to love being able to provide people with a wellness act instead of meeting people in their moment of crisis. Because that's what we do all the time. So how great is it that we can actually help people that want to help themselves to stay healthy." (EDRN-01)
Differing views on the ED's evolving role in the healthcare system	"Some people literally don't see this as the role of the ER, and it's going to take some, like, arm twisting." (EDNP-01) "And especially here the context of . . . a community hospital, . . . a lot of people who choose to work here know that [community protection is] part of our emergency department job." (EDRN-02) "I think most people in emergency medicine recognize that our role as emergency physicians is constantly expanding and contracting in relationship to what is happening in the world." (EDMD-04)

ED, emergency department; *EDMD*, emergency physician; *EDNP*, nurse practitioner in the ED; *EDRN*, registered nurse in the ED.

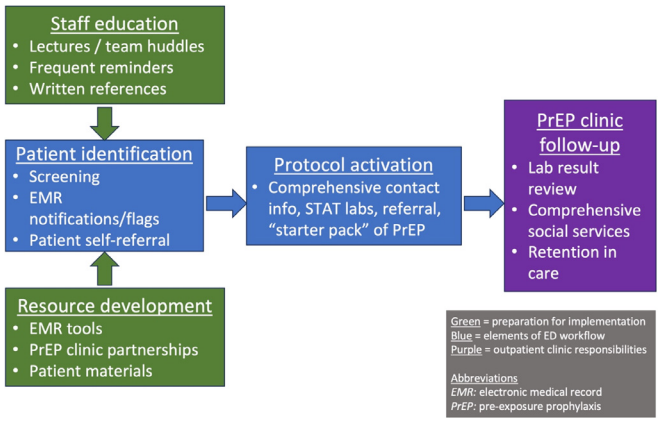

Figure. Themes integrated into a cohesive framework to guide the creation and implementation of an emergency department-based PrEP initiation workflow.
ED, emergency department; *EHR*, electronic health record; *PrEP*, pre-exposure prophylaxis.

interventions designed to shift ED culture to be more amenable to prescribing PrEP.

In our interviews, EHR tools surfaced as a promising intervention to address clinician concerns. Clinicians felt that order sets and templates could decrease the amount of time required for clinicians to find and follow up-to-date guidelines. Indeed, EHR templates have been shown to improve clinical guideline adherence for other health issues.[20,21] Electronic platforms that allow clinicians to access standardized workflows quickly, which emergency clinicians commonly requested, could further supplement these tools to increase clinician confidence with the program.[22]

Additionally, clinicians' concerns over equitable identification of PrEP candidates, as well as trepidation about EHR-based pop-up HIV risk alerts, are reflected in research. A study conducted in a large, managed care health system showed that an EHR-based HIV risk predictive model based solely on PrEP guidelines from the Centers for Disease Control and Prevention (CDC) was less sensitive in identifying HIV risk in Black patients compared to White patients, whereas a multivariable algorithm generated through machine learning was equally sensitive among races.[23] This demonstrates the potential for EHR tools to ameliorate racial disparities in PrEP offer rate, as well as the need for thoughtful design of these tools to avoid exacerbating health disparities.

Whereas previous studies about PrEP in the ED focused only on referral to services,[11,14] ED and HIV clinic staff both anticipated that immediate PrEP initiation with a starter pack provided in the ED would increase chances of follow-up. This prediction is supported by existing literature; immediate PrEP initiation at the patient's first visit has been shown to facilitate increased PrEP uptake and persistence in drop-in sexual health clinic settings and is described as a tool to address PrEP access barriers in the 2021 CDC PrEP guidelines.[5,17] This strategy merits further investigation for adaptation to an acute care setting.

Furthermore, our data supports a partnership model between the ED and a single outpatient clinic. This could streamline the referral process and decrease costs by removing the need for an ED-based PrEP navigators or educators to guide patients through complex healthcare systems. Direct "warm handoffs" to PrEP clinic-based navigators could also facilitate the early development of therapeutic rapport with patients and promote retention in care, addressing the low-yield of programs based on providing resource sheets with PrEP clinic information.

As noted by participants, the services of the partnering PrEP clinic should match the needs of the target population served by the ED, including treatment for substance use disorder in localities disproportionately affected by the opioid epidemic. Additionally, EDs must equip their partnering PrEP clinics with the information needed to facilitate successful connection to the specific services provided by that PrEP clinic. For example, PrEP clinics that perform outreach to the unhoused may need information such as the location of patients' encampments, whereas clinics that do not offer these outreach services may not find this information useful. The local context of both services needed and services available should be taken into consideration when designing an ED-initiated PrEP program.

LIMITATIONS

To our knowledge, this exploratory study is the only one of its kind to evaluate the needs and viewpoints of multidisciplinary clinicians regarding an ED-initiated PrEP workflow. However, our study does not capture the patient perspective on a program in which a patient would initiate PrEP in the ED, an important topic for future research. Additionally, this study was conducted at a large medical center in a city with a robust social safety net and may not be generalizable to smaller community hospitals.

CONCLUSION

Our study describes anticipated challenges and facilitators of initiating of a pre-exposure prophylaxis workflow in the ED from the perspective of multidisciplinary emergency and HIV-clinic clinicians. The perspectives of the multidisciplinary participants interviewed are essential for developing a comprehensive, successful workflow. Recommendations described here provide a framework for the creation of a novel PrEP initiation program. Collaborations between the ED and preventative medicine programs may have profound implications for health equity as acute care facilities expand their role in the community to

facilitate access to preventative care to those who have no other source for these services.

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Emergency Department Food Insecurity Screening, Food Voucher Distribution and Utilization: A Prospective Cohort Study

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Objective: Food insecurity is a prevalent social risk among emergency department (ED) patients. Patients who may benefit from food insecurity resources may be identified via ED-based screening; however, many patients experience difficulty accessing resources after discharge. Co-locating resources in or near the ED may improve utilization by patients, but this approach remains largely unstudied. This study characterized the acceptance and use of a food voucher redeemable at a hospital food market for patients who screened positive for food insecurity during their ED visit.

Methods: This prospective cohort study, conducted at a single county-funded ED, included consecutive adult patients who presented on weekdays between 8 AM–8 PM from July–October 2022 and consented to research participation. We excluded patients who required resuscitation on arrival or could not provide written informed consent in English. Study participants completed a paper version of the two-question Hunger Vital Sign screening tool, administered by research staff. Participants who screened positive received a uniquely numbered $30 food voucher redeemable at the hospital's co-located food market. Voucher redemption was quantified through regular evaluation of market receipt records at 30-day intervals. The primary outcome was the proportion of redeemed vouchers. Secondary outcomes included the proportion of participants screening positive for food insecurity, proportion of participants accepting vouchers, and associated descriptive statistics.

Results: Of the 396 eligible individuals approached, 377 (95.2%) consented and completed food insecurity screening. Most were middle-aged (median 53 years, interquartile range 30–58 years), 191 were female (50.4%), 242 were Black (63.9%), and 343 were non-Hispanic (91.0%). Of the participants, 228 (60.2%) screened positive for food insecurity and 224 received vouchers (98.2%), of which 86 were redeemed (38.4%) a median of nine days after the ED visit.

Conclusion: A high proportion of participants screened positive for food insecurity and accepted food vouchers; however, less than half of all vouchers were redeemed at the co-located food market. These results imply ED food voucher distribution for food insecurity is feasible, but co-location of resources alone may be insufficient in addressing the social risk and alludes to a limited understanding of facilitators and barriers to resource utilization following ED-based social needs screening. [West J Emerg Med. 2024;25(6)993–999.]

INTRODUCTION

Social risks, defined as adverse social conditions associated with poor health, are common among emergency department (ED) patients and influence their health outcomes.[1,2] Food insecurity is one prevalent social risk among ED patients that is associated with progression and exacerbation of chronic disease, frequent acute care use, and increased all-cause mortality.[3–10] Previous studies of ED-based food insecurity screening and referral to resources identified patients with this social risk; however, many patients who received resource referrals had difficulty connecting to these resources after discharge.[11,12] Co-locating resources in or near the ED for patients who screen positive for food insecurity represents one potential solution that directly connects patients to targeted resources; however, little evidence supports this model.

Within the context of food insecurity resource co-location, case reports describe a "food bag program" piloted during the COVID-19 pandemic, which provided any discharged ED patient with a 1–2 day supply of shelf-stable food.[13] However, this was primarily an operational project that prioritized food distribution and was limited in its conclusions regarding food insecurity screening and resource uptake due to co-location.[13] Thus, it remains poorly understood whether co-locating resources in or near the ED to address this social risk lead to increased resource acceptance or utilization. In this study we sought to characterize the acceptance and use of a $30 food voucher redeemable at a hospital food market by study participants who screened positive for food insecurity during their ED visit.

Population Health Research Capsule

What do we already know about this issue?
Food insecurity is common among ED patients. Screening identifies individuals with this social risk, but little evidence guides referral.

What was the research question?
Will patients who screened positive for food insecurity in the ED accept a $30 food voucher redeemable at a co-located hospital market?

What was the major finding of the study?
98.2% of patients who screened positive for food insecurity accepted a voucher, but only 38.4% had redeemed them at a median of nine days later.

How does this improve population health?
Referral to co-located resources for food insecurity is feasible, but programs should consider accessibility and patient preferences in addressing social risks identified in the ED.

METHODS

Study Design, Setting, and Participants

This prospective cohort study screened consecutive consenting patients presenting to the ED for food insecurity and provided a food voucher to participants who screened positive. This study was approved by the Indiana University School of Medicine Institutional Review Board (IRB #13829).The study site was a 95-room county-funded ED with over 100,000 annual visits. All patients arriving to the ED are first triaged in the waiting room or ambulance bay by a nurse; patients who do not require emergent stabilization based on appearance and chief complaint are evaluated in one of 24 intake rooms. Intake rooms are private rooms where a complete nursing evaluation and the first patient-physician interaction takes place.

This study included ED patients aged ≥18 years who presented on weekdays between 8 AM–8 PM from July 1–October 31, 2022 and were evaluated in an intake room during their ED visit. The study protocol excluded patients who were minors, were placed in a non-intake room (due to requiring immediate resuscitation or a 1:1 nursing intervention), or who were unable to provide informed consent in English. Research assistants used the electronic health record to assess patients for eligibility upon their arrival in triage and approached eligible participants for consent once moved to a private intake room. Eligible participants were made aware of the purpose of the study and that their survey responses could make them eligible for a food voucher at the hospital food market.

Screening Tool Distribution and Screening Data Collection

Consented participants received a paper version of the US Department of Agriculture binary question Hunger Vital Sign screening tool ("Within the past 12 months we worried whether our food would run out before we got money to buy more," and "Within the past 12 months the food we bought just didn't last and we didn't have money to get more").[14] Participants used a provided writing instrument to check yes or no to each screening tool question. A paper version was chosen based on prior work by Gonzales et al (2021), which demonstrated that 75% of patients preferred food insecurity screening via paper as opposed to verbal responses; however, the consent process did notify participants that if they could not read or write, the research assistant (RA) could read the screening to questions to them.[15] If the patient declined assistance in reading or filling out the screening tool, the RA left the room for 10 minutes and returned to collect the completed screening tool. The RA directly entered screening

tool results into a predefined data collection instrument, REDCap. We collected and managed study data using REDCap electronic data capture tools hosted at Indiana University, which included the patient's health record number for longitudinal tracking. Paper screening tools were then destroyed via the hospital's confidential-document disposal system.

Intervention

If the participant screened negative for food insecurity, no further intervention was performed. If food insecurity was identified on the screening tool, the participant received a $30 food voucher redeemable at the hospital's co-located food market.[16] The "Fresh for You" hospital-based market was designed by the health system to address food insecurity by providing patients, visitors, and staff easy access to fresh produce, prepared foods, healthy snacks, convenience ingredients, kitchen utensils, and pantry staples at affordable prices and in a convenient location.[17] The food market is open weekdays from 10:30 AM–6 PM and is located approximately 600 feet from the ED entrance, positioned near a bus stop and the parking garage. Prior to this study, a similar screening tool and voucher referral system had been used in select outpatient practices; the value of the voucher was chosen as it was similar to the outpatient practices. Each food voucher had a random three-digit code on the back, and this was recorded in the RedCap database prior to distribution by the research staff. In addition to the food voucher (study intervention), participants screening positive for food insecurity also received resources that were standard of care prior to this study, which included printed community resources for food insecurity. If a food voucher was redeemed, it was marked with the date and time of redemption by market staff. At 30-day intervals, the study team queried hospital food-market receipt records to determine whether a voucher had been redeemed and secondarily performed patient chart review for primary care follow-up visits.

Outcomes

The primary outcome was the proportion of food vouchers redeemed by participants who screened positive for food insecurity. Secondary outcomes included the proportion of participants screening positive for food insecurity, proportion of individuals with outpatient follow-up after their ED visit, and demographic descriptions of these groups.

Statistical Methods

The analysis plan included descriptive data analysis with frequencies, proportions, and medians with interquartile range (IQR). We did not calculate an a priori sample size due to enrollment being limited by the number of available vouchers. A post hoc power calculation for detecting differences between participants who redeemed or did not redeem a food voucher demonstrated less than 80% power; thus, statistical comparison was not performed, and only descriptive statistics are reported. All statistical analyses were performed using STATA IC version 17 (StataCorp, LLC; College Station, TX).

RESULTS

Research assistants approached 396 eligible individuals, of whom 379 consented and completed the food insecurity screening tool (Figure 1). No individual was screened more than once during the study period. Most participants were middle-aged (median 53 years, IQR 30–58 years); 191 identified as female (50.4%); 242 as Black (63.9%); and 343 as non-Hispanic, (91.0%); 234 reported having a primary care physician (61.7%). Most participants (228) screened positive for food insecurity (60.2%) (Table 1). Of these, 194 participants (51.2%) worried about food running out before having money to buy more, 207 respondents (54.6%) reported food not lasting long enough and not having money for more, and 175 respondents (46.2%) reported both concerns. (Table 2).

The RAs distributed 224 vouchers (98.2% of participants who screened positive) and observed 86 (38.4%) redemptions within 30 days of distribution (Figure 2). The median time to voucher redemption was nine days (IQR 9–19 days). Of participants screening positive for food insecurity, 98 (43.0%) had primary care follow-up within 90 days of the ED visit. The median time to primary care follow-up was 41 days (IQR 21–67 days). Of note, 39 participants (17.1% of those who screened positive for food insecurity) neither redeemed a food voucher nor attended primary care follow-up (Table 3).

Demographic descriptions did not vary greatly between participants who redeemed a voucher compared to those who did not. However, food voucher redemption was affected by discharge time: participants discharged during market operating hours had a higher proportion of voucher redemption 66, 41.5%) compared to participants discharged when the market was closed (20, 30.8%) (Appendix 1).

DISCUSSION

In this prospective cohort study of adult patients seen at a county ED, a high proportion of respondents screened positive for food insecurity and accepted food vouchers; however, the redemption rate of food vouchers at the hospital's co-located food market was low and often occurred greater than one week after voucher distribution.

The observed proportion of participants screening positive for food insecurity in this study (61%) is greater than in prior studies of ED patients, which historically ranged from 16–51%.[6,9,15,18–21] Even when accounting for the effect of the COVID-19 pandemic, the observed proportion of participants screening positive for food insecurity in this

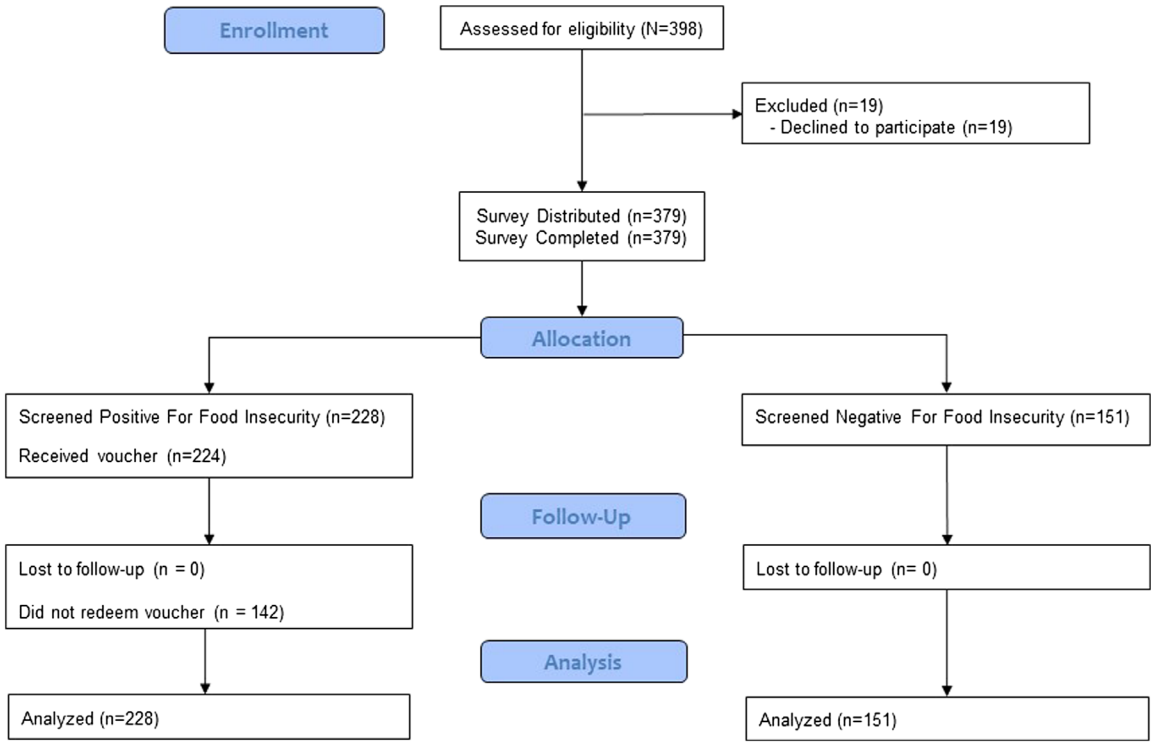

Figure 1. Study CONSORT diagram.

Table 1. Demographic description of enrolled participants, stratified by presence or absence of food insecurity.

Variable	All participants (N = 379)	Food insecurity present (n = 228)	Food insecurity absent (n = 151)
Gender, *n (column %)*			
Male	188 (49.6)	106 (46.5)	82 (54.3)
Female	191 (50.4)	122 (53.5)	69 (45.7)
Age, *median (IQR)*	53 (30–58)	45 (32–57)	40 (29–59)
Race, *n (column %)*			
Black	242 (63.9)	149 (65.4)	93 (61.6)
Native Hawaiian/Pacific Islander	1 (0.2)	1 (0.4)	0
White	133 (35.1)	78 (34.2)	55 (36.4)
Missing	3 (0.8)	0	3
Ethnicity, *n (column %)*			
Hispanic or Latino/a	34 (9.0)	20 (8.8)	14 (9.4)
Non-Hispanic	343 (91.0)	208 (91.2)	135 (90.6)
Missing	2	0	2
Access to care, *n (column %)*			
PCP prior to study	234 (61.7)	141 (62.4)	93 (61.6)

IQR, interquartile range; *PCP*, primary care physician.

study was higher than other studies during this period, including an identical screening process implemented in outpatient clinics at the study site (30–37%).[4,16] Participant acceptance of a voucher was also higher than the 65% acceptance rate in Aylmard's 2021 study and Bottino et al's 2017 study acceptance rate of 17%.[18,22] However, participant use of the food voucher resource was similar to prior acceptance rates for social services referrals and shows

Table 2. Hunger Vital Signs question responses and screening results (N = 379).

Question response	n (%)
"Within the past 12 months we worried whether our food would run out before we got money to buy more"	194 (51.2)
"Within the past 12 months the food we bought just didn't last and we didn't have money to get more"	207 (54.6)
Screening Result	
Screened positive for food insecurity	228 (60.2)
Answered yes to only one question	51 (22.4)
Answered yes to both questions	175 (76.8)
Screened negative for food insecurity	151 (39.8)

Table 3. Food insecurity after distribution, voucher redemption, and primary care physician follow-up (n = 228).

Variable	n (%)
Food voucher	
Vouchers distributed	224 (98.2)
Vouchers redeemed	86 (38.4)
Time-to-redemption, *median (IQR)*	9 days (9–19)
Follow-up	
PCP appointment within 90 days	98 (43.3)
Time-to-appointment, *median (IQR)*	41 days (21–67)
Food voucher and PCP follow up	
Both used	12 (5.3)
Neither used	39 (17.3)

IQR, interquartile range; *PCP*, primary care physician.

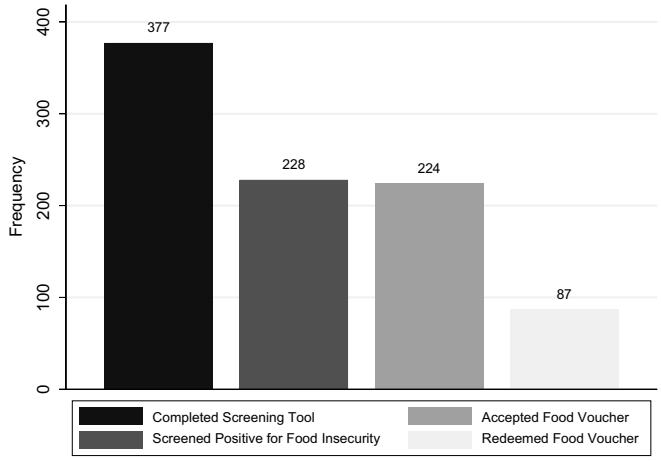

Figure 2. Frequency of screening tool completion, positive screening for food insecurity, voucher acceptance by patient, and voucher redemption.

similar utilization of summer food programs that addressed food insecurity at a children's ED.[18,23]

This study builds upon the work of Jahnes et al (2020), which addressed a similar problem through a different approach: the authors implemented a program in which patients were given a bag of food at the time of discharge without examination of eligibility criteria or further documentation. Bags included shelf-stable food as well as "no-cook bags" for individuals without cooking infrastructure. The first notable difference in results is that 3,000 food bags were distributed by Jahnes et al as opposed to 226 food vouchers in this study. While the monetary value of each food bag in Jahnes et al is not known, even if one assumed a cost of $10 per bag, more food was distributed in an operational program focused on food distribution rather than in this research study. The second notable difference was that this study's approach allowed participants to choose what options best served their needs, including the purchase of other cooking items (eg, cooking spray or utensils), if those were needed more than food items. Additionally, the study protocol allowed distribution of perishable food, which has rarely been offered in similar ED-based programs. These differences highlight key tradeoffs between two different approaches: the ease of pre-made, ED-distributed food bags vs the customizability of a patients shopping for themselves. Future work should further characterize patient preferences between these strategies to provide critical insights into the circumstances in which one is preferred over the other by patients with social needs.

It was unexpected that despite high acceptance rates of food vouchers, less than half of all participants redeemed a voucher at the co-located hospital food market. A conceptual explanation of this discrepancy could be social risk vs social need; while the screening identified a social risk (ie, an adverse social condition associated with poor health) and provided resources directed at reducing a social risk, participants may not have perceived food as a social need (ie, an adverse social determinant of health for which they would have liked assistance and viewed as a priority).[24] However, this is considered less likely due to the median redemption time of food vouchers of nine days, suggesting that using the voucher was important enough to return for redemption. A pragmatic explanation of the observed discrepancy is that the food market was initially designed for a food insecurity screening and intervention in the outpatient primary care setting (ie, weekdays, daytime hours), rather than the ED setting (ie, all days and hours). The misalignment between ED screening times and market hours appears to have modified the effect of food voucher distribution on redemption rates. The overall redemption rate was 38.9%; redemption rate for individuals discharged during market hours was 41.5%, while the redemption rate for individuals discharged after market hours was 30.8%). These results should prompt further consideration of unique

aspects of ED operations when designing future food insecurity interventions within a hospital system.

It was also surprising that nearly 60% of participants experiencing food insecurity had an established primary care doctor prior to their ED evaluation. This finding contrasts with Robinson et al's 2018 study, which found food insecurity was associated with lack of primary care.[3] While this study was not designed to determine whether previous primary care appointments had screened for or addressed food insecurity, participant willingness to disclose a social risk during the ED encounter aligns with Cullen et al's 2019 study, which found that families were more comfortable with social determinants screening in the ED rather than the primary care setting and supports ongoing efforts to screen for social needs in the ED.[25] The observed follow-up rate of less than 50% and time to primary care appointment exceeding one month are consistent with prior observations by Loo et al (2013), Wallace et al (2021), and Zu et al (2006).[11,12,19]

These findings also highlight the important role of the ED in addressing social risks that are identified during ED screening. If screened risks are not addressed (and instead referred to outpatient physicians), follow-up may not occur for up to one month. One conceptual question that remains unanswered is what services (eg, primary care, social work, case management, nutrition/dietetics, community agencies, or multidisciplinary teams either in person or virtually) are most appropriate to refer patients to after they screen positive for a social need, such as food insecurity, in the ED. The study protocol opted to refer participants back to their primary care physician because food insecurity would likely require a more comprehensive social needs assessment, but researchers in future studies may wish to consider alternative strategies to address this question.

LIMITATIONS

The study design was at risk of selection bias, participation bias, and contamination bias. Selection bias occurred during inclusion/exclusion wherein individuals arriving outside the study hours, individuals with psychiatric illness, patients presenting in extremis, minors, and individuals who could not provide written consent in English were excluded. Although subsequent quality improvement projects have addressed these populations, the research results presented here are not generalizable to patients outside the study population. Participation bias may have occurred due to the ethics requirement to disclose the risks and benefits of study participation, including a food voucher with monetary value; this may also explain the higher-than-expected proportion of participants screening positive for food insecurity among the study population. Additionally, participation bias may have occurred using a written screening tool that may have made individuals with low literacy less likely to participate, even though the RA protocol included offering that the screening questions be read aloud.

The single-center study design without longitudinal contact with study participants limits our ability to comment on contamination bias; it is possible that patients obtained connection to care from external resources rather than the study's voucher program and printed resources and did not use the provided voucher for this reason. The low redemption rate of food vouchers was unexpected, and the study design and informed consent did not allow further investigation into the reasons for the low proportion of voucher redemption; thus, conclusions about the causes of this finding are limited. Finally, the unique aspects of project funding and market location limit this study's generalizability to similar health systems with similar available resources.

CONCLUSION

A high proportion of study participants screened positive for food insecurity and accepted a food voucher for a co-located resource addressing this social risk; however, voucher redemption rates were low and occurred greater than one week following distribution. These results imply that food insecurity screening and voucher distribution are feasible, but that co-location of resources alone may not completely address the social risk and should prompt consideration of resource accessibility (both location and hours), customizability, and patient preferences in treating social needs identified in the emergency department.

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The California Managed Care Organization Tax and Medi-Cal Patients in the Emergency Department

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Last week, Timothy[*], a 60-year-old unhoused gentleman, presented to the ED requesting medical clearance. When asked why, he explained that he was staying at a warming center and had been separated from his wife and quarantined in a separate sleeping space due to concerns that he was infectious. He then doffed his beanie cap to reveal a 10 × 10-centimeter fungating squamous cell carcinoma that had been thriving on his scalp for the past two years. He had moved counties a few years back and since then had had difficulty reestablishing and understanding his coverage within a geographically managed care system. He was on the waiting list to see a dermatologist who accepted Medi-Cal (California's version of US Medicaid health insurance for the poor). Further chart review revealed that, following at least three ED visits, he had been referred to health navigators to try to secure a dermatologist appointment; but he had been waiting over a year and now was simply requesting medical clearance to be reunited with his wife. This case was a stark example of the arduous barriers some patients in California must overcome to receive care and the hurdles that emergency physicians (EP) must surmount to help these covered patients access the follow-up care they require.

HISTORY OF THE MANAGED CARE ORGANIZATION (MCO) TAX

Medi-Cal is funded through state and federal dollars. The federal government uses the Federal Medicaid Matching Rate to calculate how to match state spending on Medicaid programs. For every dollar spent on Medicaid, a state can receive at least $1 in Medicaid federal financial participation (FFP) funding. Because many states struggled to generate enough revenue to cover their share of Medicaid costs, in 1985 the Health Care Financing Administration allowed states to accept donations from private medical care providers and deemed these donations eligible for FFP matching.[1] In 2006, Congress gave states the authority to tax providers, including managed care organizations (MCO), to meet their share of Medicaid spending.[2] According to the Medicaid and Children's Health Insurance Program Payment and Access Commission, 49 states used some form of provider tax to fund their Medicaid programs in 2019.[3]

California has used an MCO tax for over 20 years to receive federal FFP matching funds. The tax must be authorized by the legislature and is subject to federal approval. The authorizing legislation includes an end date for the tax, requiring it to be reauthorized periodically. Historically, California has used the monies generated by FFP dollars to backfill the General Fund deficit or to fund an array of public services and systems outside the Medi-Cal program.[4]

2023 MANAGED CARE TAX AGREEMENT

When the authorizing legislation for the previous MCO tax was nearing its sunset date, a coalition of providers and healthcare facilities came together to negotiate a new MCO tax agreement. The proposal by the coalition was to dedicate the additional funds to provide a Medi-Cal rate increase for a variety of healthcare providers. The increase was proposed to roll out over a series of years. In the first fiscal year 2023–24, a subset of primary care clinicians, reproductive health services, and some outpatient mental health services would receive increases effective January 1, 2024. It also proposed to appropriate $1.28 billion for primary care rate increases and $1.15 billion in specialty rate increases effective January 1, 2025.[5] There were additional funds allocated for facilities and transport, reproductive health, and mental health that would also take effect in 2025. The coalition argued that California's Medi-Cal reimbursement rates were objectionably low, forcing clinicians to limit the number of Medi-Cal patients they see, thereby limiting patient access to care.

As the Legislature was considering the coalition proposal, the California Chapter of the American College of

Emergency Physician (CalACEP) advocacy team lobbied for a specific pool of funding exclusively for EPs, arguing that the funding was necessary due to their exclusion from previous Medi-Cal physician increases and their disproportionate care for the Medi-Cal population relative to other clinicians. As a result of its advocacy, a $200 million state budget line item was included to bring EM Medi-Cal rates to 87.5% of Medicare.[6]

MAY REVISION AND FINAL BUDGET

The agreement between the coalition, CalACEP, and the California Legislature was codified in legislation in 2023 and was scheduled to take effect January 1, 2025. However, because the state budget is only a one-year document and the Legislature does not have the sole power to create the state's budget, the MCO tax agreement for the 2024–25 fiscal year was subject to negotiation once again between the Legislature and the governor. Governor Newsom included the agreed rate increases in his proposed budget released in January 2024, but his revised budget released in May removed the rate increase entirely and used the MCO tax surplus to backfill California's General Fund deficit.[7]

The CalACEP advocacy team used a variety of strategies to lobby legislators to restore the $200 million for EP rate increases. Staff lobbied members of the Budget Subcommittees in person for each house of the Legislature to explain the impact of low reimbursement on emergency medicine practice and how it effects access to care for patients. Staff also coordinated a targeted social media campaign that focused on the Sacramento area to keep the issue in the minds of stakeholders. Members of the CalACEP Executive Committee wrote letters to the editors of major news organizations throughout the state. Finally, CalACEP coordinated a grassroots campaign to encourage EPs to contact legislators directly and tell personal stories about their patients and Medi-Cal access. Ultimately, the $200 million for EP rate increases ***were*** included in the budget that Governor Newsom signed on June 29, 2024. However, none of the other previously promised rate increases for other specialties, which had been scheduled to take effect January 1, 2025, were included.

PROPOSITION 35

While EPs were able to get their increase restored, other physicians were not so fortunate. The California Medical Association, with the support of organizations that were a part of the 2023 MCO coalition, qualified an initiative for the 2024 California State Ballot that, if passed by California voters, would permanently enshrine the agreement reached by the Coalition and the Legislature in 2023 into law. Proposition 35 would require the state to use the MCO tax revenues to fund increases for the Medi-Cal program for the duration of the current MCO tax authorization. This would restore the revoked Medi-Cal rate increases for other clinicians and protect the EP increase for years to come, without having to renegotiate with the Legislature and governor every year, as is typically required by the annual budget process. As of August 2024, the proposition seems to have broad bipartisan support. Numerous healthcare organizations including the California Medical Association, Planned Parenthood, the California Hospital Association, and CalACEP formally support the proposition. Other supporters include the California Hawaii State Conference National Association for the Advancement of Colored People, the Insure the Uninsured Project, the California Democratic Party, and the California Republican Party.[8]

The proposition has no registered opposition, but Governor Newsom has expressed serious concerns in the press about the impact the proposition will have on the ability of the Legislature and governor to deliver a balanced budget in the future.[9]

IMPACT ON PATIENTS AND CLINICIANS

Emergency departments (ED) are uniquely poised to suffer the strain of insufficient Medi-Cal funding, as patients covered by Medi-Cal seek care in the ED at higher rates than patients with other types of insurance. Since 2019, one of three Californians are covered by Medi-Cal,[10] but 42% of visits to the ED are by Medi-Cal patients.[11] This discrepancy is largely driven by low physician participation in Medi-Cal. California's low Medi-Cal reimbursement rates for physicians result in very few primary care physicians and specialists who accept patients with Medi-Cal and long wait times.[12] This often leaves the sickest and most vulnerable patients with nowhere to go except the ED. Emergency physicians operate under the Emergency Medical Treatment and Labor Act, enacted in 1986, which ensures that all patients arriving in the ED will receive treatment regardless of insurance status or ability to pay. Given the current state of Medi-Cal funding, EPs are forced to navigate not only direly sick and urgent cases, but to fill gaps for preventive and specialty care. This leaves them scrambling to find and coordinate follow-up care. It also leaves them with the moral injury of showing up to shifts day in and day out without being able to get their patients the transfer and follow-up care they need. This is taking a toll on patients and EPs alike.

While EPs are proud to help patients when they need it most, the current funding conditions are unsustainable. Despite the number of ED patients increasing, underfunded departments are decreasing the number of EPs working, and in some cases are employing more physician assistants and nurse practitioners.[13] In turn, California faces difficulty in hiring and retaining well-qualified and experienced EPs, particularly in historically under-resourced areas.[14] These changes impact all ED patients in the form of longer wait times and, in the worst cases, poor patient outcomes.

The impact of Medi-Cal underfunding reverberates far beyond emergency services, especially as Medi-Cal eligibility criteria expands. Under the current funding scheme, an

increasing number of patients covered by Medi-Cal in California's healthcare system will result in deeper inequity, as more Medi-Cal patients are competing for the same few spots from a limited number of physicians. A proportional increase in access to physicians is needed, and this must come in the form of increased funding, such as the Medi-Cal rate increases outlined in Proposition 35.

Emergency physicians need a sufficient network of primary care and specialty physicians willing to accept Medi-Cal to provide comprehensive and timely care to patients. Adequate networks would enable patients like Timothy to receive the care they need, when they need it, as opposed to the current system of backlog and waiting. Increasing reimbursement to more closely match the cost of care, and protecting dedicated funds, will improve efficiency and equity in the healthcare system, ultimately improving the quality of care for all Californians.

*Patient name has been changed to protect confidentiality.

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A Review of the Clinical Presentation, Causes, and Diagnostic Evaluation of Increased Intracranial Pressure in the Emergency Department

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Increased intracranial pressure (ICP) is encountered in numerous traumatic and non-traumatic medical situations, and it requires immediate recognition and attention. Clinically, ICP typically presents with a headache that is most severe in the morning, aggravated by Valsalva-like maneuvers, and associated with nausea or vomiting. Papilledema is a well-recognized sign of increased ICP; however, emergency physicians often find it difficult to visualize the optic disc using ophthalmoscopy or to accurately interpret digital fundus photographs when using a non-mydriatic retinal camera.

Emergency ultrasound can evaluate the optic nerve sheath diameter (ONSD) and optic disc elevation to determine whether increased ICP is present, however, the studies have been small with different definitions and measurements of the ONSD. The ONSD threshold values for increased ICP have been reported anywhere from 4.8 to 6.3 millimeters.

Neuroimaging is the next step in the evaluation of patients with papilledema or high clinical suspicion of increased ICP, as it can identify most structural causes or typical radiological patterns of increased ICP. Neuroradiographic signs of increased ICP can be helpful in suggesting idiopathic intracranial hypertension (IIH), especially when papilledema is absent.

Patients with papilledema and normal neuroimaging may undergo lumbar puncture as part of their clinical workup. The cerebrospinal fluid (CSF) opening pressure remains one of the most important investigations to establish the diagnosis of IIH. A CSF evaluation is also required to exclude other etiologies of elevated ICP such as infectious, inflammatory, and neoplastic meningitis. Invasive ICP measurement remains the standard to measure and monitor this condition. [West J Emerg Med. 2024;25(6)1003–1010.]

INTRODUCTION

Increased intracranial pressure (ICP), regardless of etiology, is a life-threatening condition that requires prompt diagnosis and treatment. It can lead to decreased cerebral perfusion pressure with subsequent cerebral ischemia and herniation, and thus potential disability and increased mortality.[1] Recognition of elevated ICP is of utmost importance in the emergency department (ED). Knowledge of the clinical presentation (which can help differentiate not only between multiple causes of headache and altered mental status but also between causes of elevated ICP) and diagnostic options and their accuracy is paramount for correct diagnosis and rapid treatment.

The Monro-Kellie hypothesis states that the sum of the intracranial volume of blood, brain, cerebrospinal fluid (CSF), and other components (eg, tumor, hematoma) is constant. The skull is a rigid container; hence, an increase in one of the intracranial components will cause a decrease in the volume of one or more of the other components. Intracranial blood (especially in the venous compartment) and CSF are the two components whose volume can adapt most easily to accommodate an increase in the volume of intracranial contents. When the compensatory capacity is exhausted, the ICP begins to rise, compromising cerebral perfusion and causing cerebral ischemia or herniation. Normal ICP is 7–15 millimeters of mercury

(mmHg) or 10–20 centimeters of water (cmH_2O) in adults.[1,2]

$$\begin{aligned} &Cerebral\ perfusion\ pressure\ (CPP) \\ &= Mean\ arterial\ pressure\ (MAP) \\ &- intracranial\ pressure\ (ICP). \end{aligned}$$

CAUSES AND CLINICAL PRESENTATION

Increased ICP is caused by a variety of disease processes such as space-occupying lesions (eg, mass, hemorrhage); obstructive hydrocephalus; communicating hydrocephalus (eg, inadequate reabsorption of CSF such as seen in subarachnoid hemorrhage secondary to hypersecretion of CSF and fibrosis of arachnoid granulations); venous outflow obstruction (eg, cerebral venous sinus thrombosis); diffuse cerebral edema (eg, vasogenic, as seen in tumors; cytotoxic, as seen in traumatic brain injury or stroke; interstitial, as seen in hydrocephalus or meningitis; or osmotic, such as seen in hyponatremia, diabetic ketoacidosis); increased CSF secretion (eg, choroid plexus tumor); and idiopathic causes (eg, idiopathic intracranial hypertension [IIH]).[3,4,5]

The combination of headache, papilledema, and vomiting is considered indicative of increased ICP, although there is no consistent relation between severity of symptoms and the degree of elevated ICP.[2] Headache is a common complaint in the ED, representing 2.6% of ED visits, and the sixth most common reason for presentation to the ED.[6] The headache related to increased ICP is typically a global headache commonly described as throbbing or bursting, is most severe in the morning, often aggravated by maneuvers that increase ICP (eg, Valsalva-like maneuvers, coughing, sneezing, recumbency), and is associated with nausea or vomiting.[3] Other signs and symptoms of increased ICP include changes in behavior such as irritability and restlessness, visual changes (eg, diplopia, visual field deficits), pupillary changes (dilated unreactive, mid-position fixed, pinpoint pupils), bilateral ptosis, impaired upward gaze, focal neurologic deficits, depressed consciousness, seizures, and the ominous findings of decorticate or decerebrate posturing and Cushing triad (bradycardia, hypertension, and respiratory depression).

A progressive deterioration in level of consciousness can be seen with worsening increased ICP (except for IIH, which is characterized by normal mental status).[2] Brain herniation leads to further brain injury and ischemia, compression of vessels and cranial nerves, and obstruction of the normal circulation of CSF producing hydrocephalus. (See Figure 1 for types of brain herniation.) Owing to its location, each type of herniation is associated with specific neurologic findings.[7]

Subfalcine herniation, also known as midline shift or cingulate herniation, is the most common type of herniation. It is usually caused by mass effect that pushes the ipsilateral cingulate gyrus down and under the falx cerebri. The quantification of the midline shift is made by measuring the deviation of the septum pellucidum compared to midline at the level of the foramen of Monro. This measurement is used for prognosis with less than 5 millimeters (mm) of deviation associated with good prognosis and greater than 15 mm associated with poor prognosis. It can present with hypobulia, apathy, and indifference. If the anterior cerebral artery is compressed, it will manifest with contralateral or bilateral leg weakness and acute urinary retention.[7]

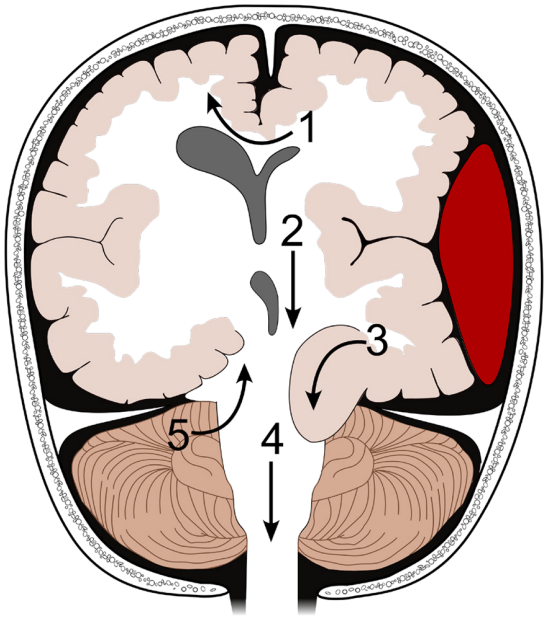


Figure 1. Types of brain herniation[11]: 1) subfalcine herniation; 2) central descending transtentorial herniation; 3) lateral descending transtentorial herniation; 4) tonsillar herniation; and 5) ascending cerebellar transtentorial herniation. Adapted from User: Delldot, CC BY-SA 3.0 <http://creativecommons.org/licenses/by-sa/3.0/>, version 21:08, 5 March 2008 via Wikimedia Commons.

Descending transtentorial herniation is the second most common type of cerebral herniation. It occurs when brain tissue is displaced downward through the tentorial notch and may be lateral (anterior and posterior) or central. Lateral hernias involve the medial temporal lobe; anterior hernias involve the uncus (also called uncal herniation); and posterior hernias involve the parahippocampal gyrus. In the central hernia, there is descent of the diencephalon, midbrain, and pons.[7]

Anterior descending transtentorial (uncal) herniation leads to compression of the parasympathetic fibers running with the third cranial nerve, causing an ipsilateral fixed and dilated pupil. Compression of the ipsilateral cerebral peduncle will cause contralateral motor paralysis since the motor tract fibers cross below this level; however, the contralateral cerebral peduncle can be compressed against the edge of the tentorium causing a false localizing sign with ipsilateral hemiparesis.[8] Posterior descending transtentorial

herniation is due to herniation of the parahipoccampal gyrus, presenting with symptoms of Parinaud syndrome (vertical gaze palsy, loss of pupillary reflex to light with preservation of pupillary constriction with convergence, upper eyelid retraction, convergence-retraction nystagmus).[9,10] Central descending transtentorial herniation is due to herniation of the thalamus and midbrain through the tentorial notch and the medulla though the foramen magnum. It causes acute obstructive hydrocephalus and posterior cerebral artery injury, clinically presenting with agitation followed by obtundation, bilaterally poorly reactive or potentially midpoint fixed pupils, and then decorticate followed by decerebrate posturing, Cushing triad, coma, and death.[9]

Ascending cerebellar transtentorial herniation is due to cerebellar herniation superiorly through the tentorial notch. It presents with symptoms of pontomedullary compression: obtundation; cardiorespiratory instability; severe bradycardia; arrhythmia; abd pinpoint pupils.[9] Tonsillar herniation involves herniation of the tonsils of the cerebellum through the foramen magnum into the upper spinal canal, compressing the medulla. This may result in cardiorespiratory impairment, hypertension, high pulse pressure, and Cheyne-Stoke respiration. The combination of bradycardia, hypertension, and irregular respirations is known as Cushing's reflex and occurs in approximately one third of cases of tonsillar herniation.[2] It may also cause pinpoint pupils, flaccid paralysis, and sudden death.

Idiopathic intracranial hypertension, formally known as pseudotumor cerebri or benign intracranial hypertension, deserves special attention as it has a unique presentation. It is a syndrome of increased ICP of unclear etiology that occurs most often in obese women of childbearing age (average age 28 years). It occurs less often in men (approximately 9%) who are usually obese and average 37 years of age at diagnosis.[12] It is usually a diagnosis of exclusion that is characterized by signs and symptoms of increased ICP, normal mental status, and absence of focal neurologic signs (although it can be associated with sixth and seventh nerve palsies). Neuroimaging might show signs of elevated CSF pressure but without obstruction or deformity of the ventricles and without identifiable cause of the increased ICP. The CSF evaluation will have opening pressure greater than 25 cmH2O but with normal CSF composition.[3]

Common symptoms of IIH are headache, visual disturbances, and pulsatile tinnitus. The most common presenting symptom of IIH is headache, which is found in 84% of the patients. The headache is constant, non-pulsating, exacerbated by coughing or Valsalva maneuver, and it has a progressive course. The second most frequent symptom of IIH is visual disturbance such as variable, visual field defects that commonly go unnoticed by the patient until severe; transient visual obscurations (transient unilateral or bilateral visual loss lasting less than one minute and often precipitated by postural changes, with full rapid visual recovery to baseline); enlarging blind spots; diminished visual acuity in patients with advanced disease; diplopia, especially in the horizontal plane generally due to sixth cranial nerve palsy; or blurry vision due to shortening of the globe secondary to increased ICP. Tinnitus, another common symptom in IIH, is more often bilateral, pulsatile, synchronous with heart rate, and can occur with variable frequency from daily to monthly.[3,12] Idiopathic intracranial hypertension is characterized by normal mental status; however, it can cause disabling headaches and blindness.

DIAGNOSTIC EVALUATION

Papilledema

The presence of optic nerve head edema (ONHE) in patients with headache signifies a secondary cause for the headache and the need for further urgent evaluation.[13] This condition is commonly encountered in papilledema (optic disc swelling due to increased ICP); optic neuropathy (optic neuritis, ischemic optic neuropathy); and pseudopapilledema (disc elevation without nerve fiber layer edema). The distinction between the three major causes of disc swelling is based on history, eye examination including fundoscopy, and ancillary testing. Other causes of optic disc swelling are central retinal vein occlusion, diabetic papillopathy, uveitis, optic disc tumors, malignant hypertension, and optic nerve infiltration (such as seen in sarcoidosis, lymphoma, and leukemia).[14] Optic neuropathies lead to a more severe visual loss and are usually sudden, unilateral, and associated with afferent pupillary defect and impaired color vision.[14]

Pseudopapilledema is associated with optic nerve variants that mimic papilledema ophthalmoscopically, such as congenital abnormalities; crowded hyperopic disc; optic disc hamartomas; or optic nerve head drusen. Visual loss may occur, but it is more indolent, painless, and frequently unnoticed by the patient. Pseudopapilledema is stable over time compared to untreated papilledema, which will change and progress in time. There are also ophthalmoscopic findings that will help differentiate papilledema from pseudopapilledema.[14] Optic disc drusen are acellular deposits located in the optic nerve head. In children, the optic disc drusen are not calcified; they resemble papilledema with optic nerve head swelling and can be difficult to diagnose on opthalmoscopy.[15] With age, the optic disc drusen become calcified and easier to diagnose on ophthalmoscopy and ultrasound, as optic disc drusen are hyperechoic with posterior acoustic shadowing.[15]

The Frisén classification is the most frequently used papilledema grading system and describes stages of optic disc swelling (grades 0–5); however, it has poor inter-rater reliability. Therefore, more descriptive terminology is often used to describe papilledema (eg, mild vs high grade).[14,16,17] Papilledema is usually bilateral and symmetrical; however, it can be asymmetrical and, rarely, it can be unilateral or even absent.[12,18] Papilledema is thought to be secondary to either

axoplasmic stasis that causes axonal swelling or due to enlargement of the subarachnoid space. Usually, the development of papilledema requires at least 1–5 days of persistently elevated ICP; however, it has also been found to develop rapidly, in hours, in subarachnoid and intraparenchymal hemorrhages. If the elevated ICP is treated, papilledema usually resolves over weeks to months.[14]

Non-expert clinicians often find it difficult to properly view the optic disc using ophthalmoscopy.[19] Phase I of the FOTO-ED study found that direct ophthalmoscopy was rarely and inadequately performed by emergency physicians (EP) in a large academic medical center where EPs failed to diagnose any cases of optic-nerve head edema using direct ophthalmoscopy.[20] Phase II of the FOTO-ED study found that non-mydriatic retinal photography in the ED was superior to direct ophthalmoscopy performed by EPs; however, EPs do not commonly perform this and identified only 16 of 35 relevant findings (sensitivity 46%).[21] Sachdeva et al[13] performed a cross-sectional analysis of patients with ONHE in the prospective FOTO-ED study and found that 2.6% of patients presenting to the ED with a chief complaint of headache, acute vision loss, focal neurologic deficit, or a diastolic blood pressure ≥120 mmHg had ONHE. The most common final diagnoses were IIH (19/37), CSF shunt malfunction/infection (3/37), and optic neuritis (3/37), thus reiterating the importance of ocular fundus examination in these patients.[13]

Emergency Ultrasound Evaluation for Increased Intracranial Pressure

Emergency ultrasound is an easy-to-use, noninvasive method of increased ICP assessment by evaluating the optic nerve sheath diameter (ONSD) and the optic disc elevation (ODE). The optic nerve can be thought of as an outpouching of intact brain tissue with the intraorbital component CSF and fluctuates in size based on changes in ICP. Increased ICP causes enlargement of the subarachnoid space and increase of the ONSD. The bulbous portion of the optic nerve, approximately 3 mm posterior to the globe, appears to be the most distensible and sensitive to changes in ICP.[22] On ultrasound, the globe appears as a round, anechoic structure. The optic nerve presents as a hypoechoic structure posterior to the globe (see Figure 2).

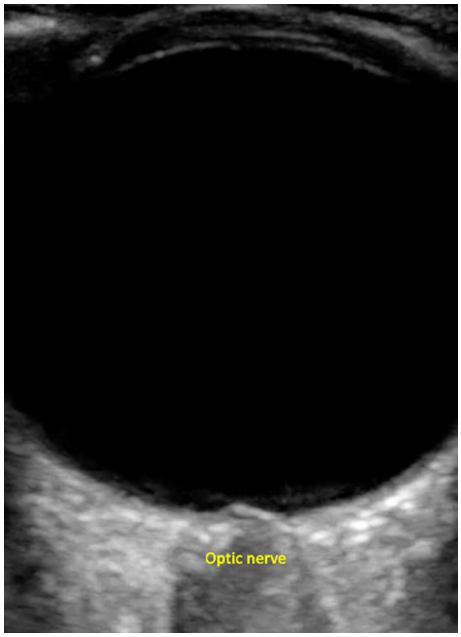


Figure 2. Optic nerve appearance on ultrasound.

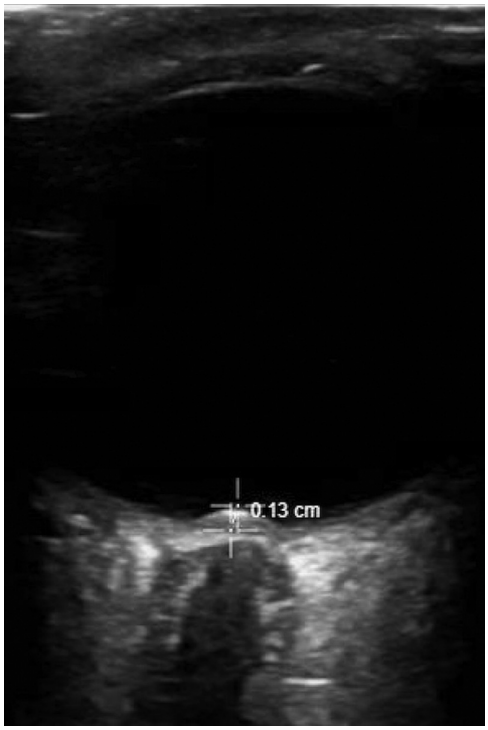


Figure 3. Optic disc elevation (ODE) measurement between the top of the swollen optic disc and the lamina cribrosa. In this figure, ODE of 0.13 cm suggests optic disc edema.

Optic disc elevation

Optic disc elevation refers to the height of elevation of the optic disc from the lamina cribrosa (the area through the sclera where the optic nerve axons pass).[23] The measurement is performed with the optic nerve in the horizontal plane, and the view with the maximum disc elevation is selected. Disc elevation is measured from the uppermost part of the swollen disc to the strongly reflecting line representing the lamina cribrosa (see Figure 3).[24] Teismann et al[25] determined that a cutoff value of 0.6 mm for optic disc elevation, as measured by ultrasound, predicted the presence of optic disc edema noted on fundoscopic exam with a sensitivity of 82% (95% confidence interval [CI] 48–98%) and a specificity of 76% (95% CI 50–93%). A cutoff value of 1.0 mm yielded a sensitivity of

73% (95% CI 39–94%) and specificity of 100% (95% CI 81–100%). In this study, most patients had IIH causing disc swelling due to elevated ICP; however, disc swelling can also be found in patients with multiple sclerosis, infiltrative processes such as sarcoidosis or lymphoma, infections directly affecting the optic nerve, and microvascular infarction caused by malignant systemic hypertension.

Optic nerve sheath diameter

The ONSD is measured 3 mm deep to the globe where it appears to be the most distensible and sensitive to changes in ICP.[22] Three possible positions for depth markers have been described in studies: 1) location where imaginary nerve midline intersects the contour of the retina; 2) hyperechoic reflection corresponding to the lamina cribrosa; and 3) top of the hypoechoic structure corresponding to the optic nerve (see Figure 4). However, these discrepancies did not affect ONSD values, most likely because the distance between the different anatomical landmarks used is less than 1 mm resulting in comparable ONSD values. Stevens et al[26] recommends using the papilla as reference for the 3-mm depth assessment.

The optic nerve itself has a diameter of 3 mm, and the optic nerve sheath has a thickness of approximately 1 mm. From the inside out, the sheath consists of pia mater, the subarachnoid space, the arachnoid mater, and the dura mater. When studies were reviewed, two types of images with different echoic characteristics of the optic nerve sheath were described. One group of images showed two hyperechoic, striped bands between the hyperechoic retrobulbar fat (see Figure 5a), while the other group showed a single dark linear structure surrounded by hyperechoic retrobulbar fat (see Figure 5b).[26]

The striped bands have been interpreted to represent either the pia, both pia and dura mater, or the subarachnoid space. Stevens et al[26] found that C caliper position was the least sensitive to changes in the ICP and corresponds to the outline of the optic nerve itself. B caliper measurement increases in patients with elevated ICP; hence, it incorporates the arachnoid space, and it likely corresponds to the outer edge of the subarachnoid space. B caliper position and calipers measuring a single dark linear structure (D calipers) were found to be equally sensitive to changes in ICP and were recommended as reliable ONSD measurements.[26]

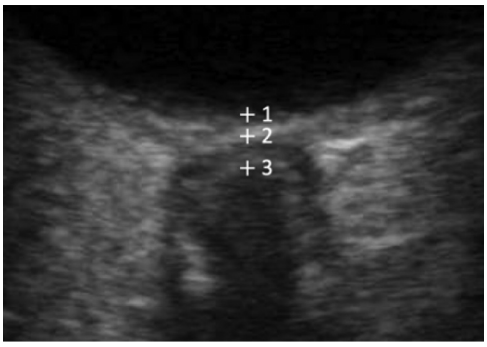
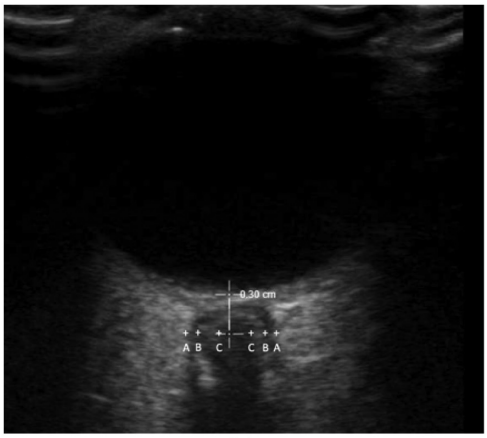
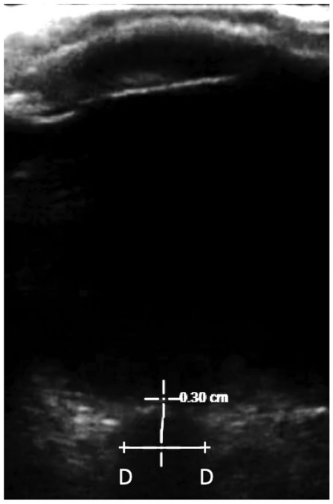


Figure 4. Optic nerve sheath diameter superficial caliper placement: 1) retina level; 2) lamina cribrosa level; and 3) top of the hypoechoic optic nerve level.



(a)



(b)

Figure 5. (a) Optic nerve (between C calipers) as one anechoic band surrounded by two hyperechoic striped bands (between C and B calipers on each side of the optic nerve) between the hyperechoic retrobulbar fat (A calipers). (b) Optic nerve with one single anechoic band representing the optic nerve and its sheath, D calipers at the border between the optic nerve sheath and the retrobulbar fat.

The ONSD threshold values that optimized sensitivity and specificity for elevated ICP varied in studies from 4.8 mm (Rajajee et al[27]) to 6.3 mm (del Saz-Saucedo et al[28]). The studies on ONSD have been small and heterogeneous, and these studies have done the following:

- used different definitions and measurements of ONSD[26]
- used different planes to measure ONSD: only transverse planes[27–32]; transverse and sagittal planes[33–35]; transverse and coronal[36]

- predominantly used mean values of the ONSD measurements obtained from both eyes, with Agrawal et al[36] identifying the highest transverse measurement and Rajajee et al[27] studying each individual transverse measurement
- enrolled different patient populations, with multiple studies enrolling neurocritical care patients with traumatic and non-traumatic brain injury, and some studies enrolling clinic patients with IIH[28,32]
- used different confirmations of elevated ICP including computed tomography (CT),[37,38] lumbar puncture (LP),[28,32] or external ventricular drain (EVD) and intraparenchymal catheter[33,36]
- defined elevated ICP as either 20 mmHg or 25 cmH_2O (20 mmHg = 27 cmH_2O[39]).

In a meta-analysis including 18 prospective studies that had ICP measured by EVD or intraparenchymal catheter (LP measurements excluded), Aletreby et al[40] demonstrated that ONSD showed reasonable accuracy in diagnosing raised ICP. The highest sensitivity was achieved using an ONSD cutoff of more than 6 mm.[40] While ONSD of <5 mm correlates with normal ICP, the cutoff ONSD for elevated ICP varies from study to study with >6 mm demonstrating a high sensitivity for elevated ICP. An ODE >0.6 mm can also be helpful in determining papilledema; however, ODE can be seen in multiple other medical conditions. While ONSD and ODE can be helpful in screening for papilledema, larger studies with standardized ONSD measurements and a consistent ICP cutoff are still needed. It is also known that papilledema can be asymmetrical; hence, each eye ONSD measurements should be studied independently.

Neuroimaging

In the evaluation of a patient with increased ICP, neuroimaging has two main purposes: to exclude structural causes; and to identify typical radiographic patterns of elevated ICP. Non-enhanced CT is commonly used as the first test for evaluation of secondary headaches and altered mental status in the emergency setting, and it is the standard imaging modality in acute head trauma. Computed tomography is widely available, has shorter acquisition time, and is less expensive than brain magnetic resonance imaging (MRI). In the emergency setting, CT is regularly performed to readily identify conditions that require surgical intervention.[7] A CT can identify brain edema, tumors, hydrocephalus, intracranial hemorrhage, and signs of cerebral herniation. A CT may also detect signs of increased ICP, such as ventricular or sulcal effacement, compression of the basal CSF cisterns, herniation, or midline shift. However, ICP can be elevated even in the setting of a normal CT.

Compared to CT, MRI provides better tissue characterization, especially for posterior fossa disease, and is required for evaluation of underlying brain lesions. Brain MRI with contrast can identify most structural causes of increased ICP, and magnetic resonance venography (MRV) with contrast will exclude cerebral venous sinus thrombosis.[3] In IIH, brain MRI and MRV are important to exclude secondary causes of elevated ICP. Additionally, empty sella turcica, posterior flattening of the globe, enlargement of the perioptic subarachnoid space, optic nerve midportion tortuosity, hyperintensity of the optic nerve and optic disc, and bilateral transverse sinus stenosis have been found to be associated with IIH; and the sensitivity and specificity improve with a combination of these neuroimaging signs.[12,41] Slit-like ventricles, tight subarachnoid space, and inferior position of the cerebellar tonsils shows low sensitivity but good specificity of 90–97% for IIH.[12]

Intracranial Pressure Measurement

Patients with papilledema and normal neuroimaging could undergo LP as part of their clinical workup to measure the ICP in search for etiologies such as IIH. The CSF opening pressure remains one of the most important findings to establish a diagnosis of IIH. The CSF pressure may vary considerably with time; thus, the possibility to repeat LP or perform a more invasive ICP monitoring should be considered if clinical suspicion is high.[12] A CSF evaluation is also required to exclude other etiologies of elevated ICP such as infectious, inflammatory, or neoplastic meningitis.[3] The LP is obtained in lateral recumbent position, while the CSF opening pressure should be measured with the legs extended, head in neutral position, and the patient breathing normally. The normal CSF opening pressure in adults is 10–20 cmH_2O and is considered high if greater than 25 cmH_2O. A CSF opening pressure of 20–25 cmH_2O is considered borderline, and it is interpreted in the clinical context.[3]

Idiopathic intracranial hemorrhage without papilledema is well recognized. These patients tend to have lower opening pressure levels than those who present with papilledema. In the absence of papilledema, the other criteria should be met, with the additional symptom of unilateral or bilateral abducens nerve palsies. If there is no abducens nerve palsy, three of the following neuroimaging criteria should be met: 1) empty sella; 2) flattening of the posterior aspect of the globe; 3) distention of the subarachnoid space with or without a tortuous optic nerve; and 4) transverse sinus stenosis. A normal opening pressure level does not exclude the diagnosis of IIH when the patient has other typical symptoms. Conversely, an increased opening pressure level without appropriate symptoms should not be interpreted as IIH.[42]

A LP carries no risk of herniation if there is no brain shift, whether CSF pressure is raised or not and whether papilledema is present or not. A CT is used to diagnose brain shift seen in space-occupying lesions and diffuse brain swelling. Findings of brain shift on CT may demonstrate the following: displacement of brain structures; loss of differentiation between gray and white matter; flattened gyri;

effacement of CSF spaces (such as sulci, Sylvian fissures, ventricles and basal cisterns); dilated ventricles (in obstructive pathology); and in advanced stages herniation (displacement of brain from one intracranial compartment to another).[43]

An invasive ICP measurement device such as external ventricular drain or intraparenchymal device remains the standard to determine the pressure in the cranial vault. The necessity for ICP measurement is either deduced by a pathological CT or a consciousness impairment score of ≤8 on the Glasgow Coma Scale.[44]

CONCLUSION

Increased intracranial pressure represents a life-threatening diagnosis. Idiopathic intracranial hemorrhage, while not life-threatening, can cause irreversible visual loss and disabling headaches. Clinical presentation requires immediate recognition and investigation. While papilledema is important to diagnose in the ED, emergency physicians have found it difficult to diagnose by direct ophthalmoscopy.[20] Ocular ultrasound (optic nerve sheath diameter and optic disc elevation) is commonly used to screen for increased ICP; however, there is need for further research using standardized ONSD measurements. Neuroimaging remains the first step in investigating elevated ICP as it excludes structural causes and identifies typical radiological patterns of elevated ICP. Invasive ICP measurement remains the standard to measure and monitor ICP.

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Barriers to Adoption of a Child-Abuse Clinical Decision Support System in Emergency Departments

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Introduction: Child abuse is a leading cause of morbidity and mortality in children. The rate of missed child abuse in general emergency departments (ED), where 85% of children are evaluated, is higher than in pediatric EDs. We sought to evaluate the impact of an electronic health record (EHR)-embedded child-abuse clinical decision support system (CA-CDSS) in the identification and evaluation of child maltreatment in a network of EDs three years after implementation.

Methods: We anonymously surveyed all 196 ED attending physicians and advanced practice practitioners (APP) in the University of Pittsburgh Medical Center network. The survey evaluated practitioner awareness of, attitudes toward, and changes in clinical practice prompted by the CA-CDSS. We also assessed practitioner recognition and evaluation of sentinel injuries.

Results: Of the 71 practitioners (36%) who responded to the survey, 75% felt the tool raised child abuse awareness, and 72% had a face-to-face discussion with the child's nurse after receiving a CA-CDSS alert. Among APPs, 72% consulted with the attending physician after receiving an alert. Many practitioners were unaware of at least one function of the CA-CDSS; 38% did not know who completed the child abuse screen (CAS); 54% were unaware that they could view the results of the CAS in the EHR, and 69% did not recognize the clinical decision support dashboard icon. Slightly over 20% of respondents felt that the CA-CDSS limited autonomy; and 4.5% disagreed with the recommendations in the physical abuse order set, which reflects American Academy of Pediatrics (AAP) guidelines. Greater than 90% of respondents correctly identified an intraoral injury and torso bruise in an infant as sentinel injuries requiring an evaluation for abuse.

Conclusion: A child-abuse clinical decision support system embedded in the electronic health record was associated with communication among practitioners and was overall perceived as improving child abuse awareness in our system. Practitioners correctly recognized injuries concerning for abuse. Barriers to improving identification and evaluation of abuse include gaps in knowledge about the CA-CDSS and the presence of practitioners who disagree with the AAP recommendations for physical abuse evaluation and/or felt that clinical decision support in general limited their clinical autonomy. [West J Emerg Med. 2024;25(6)1011–1019.]

INTRODUCTION

Child maltreatment causes significant morbidity and mortality in the United States, especially for children under four years of age. Over three million children each year are reported to child protective services (CPS), and 1,600 children die at the hands of caregivers due to maltreatment,[1] a number greater than children who died from COVID-19 during the first 2½ years of the pandemic.[2] The number of children dying from maltreatment has been increasing; there was a 10% increase in fatalities from 2016–2021.[1,3] Between 20–25% of children who are ultimately diagnosed with physical child abuse have been previously seen by a medical practitioner who failed to identify the abuse.[4–7] Appropriate recognition and evaluation of physical child abuse in general emergency departments (ED), where most children receive emergency care, is crucial.

To improve the quality of identification, evaluation, and reporting of child maltreatment in the University of Pittsburgh Medical Center (UPMC) general EDs, we developed and deployed a child-abuse clinical decision support system (CA-CDSS) in our electronic health record (EHR) starting in 2016.[8–10] At that time there were 13 general EDs with the hospital management software Cerner (Cerner Corp, Kansas City, MO) in the UPMC system; they went live with the CA-CDSS system between January–March 2016. As the hospital system acquired additional EDs (one each in June 2017 and April 2019, and four in September 2019), they were added to the CA-CDSS.

Prior to the go-live at each site, training occurred for both ED nurses and practitioners. Nurses completed an interactive online learning module, which remains part of the onboarding process for ED nurses and has become an education requirement every two years. Practitioner education was done through the ED medical directors. Prior to the go-live at each hospital, each ED medical director received an onboarding packet that included general child abuse education, screen shots of all parts of the CA-CDSS, case examples, and a way for practitioners to reach out with questions. Each ED medical director also met with one of the authors (RB) who reviewed the onboarding packet and answered questions. The medical directors were, and continue to be, responsible for disseminating education to their practitioners. In addition to the initial training, ongoing training includes feedback to practitioners about cases from the medical director of each ED site-specific trainings at standing practitioner meetings in individual EDs and bi-monthly systemwide conference calls, which use case examples as a springboard for discussing specific child abuse-related topics. These calls provide continuing medical education credit for practitioners.

The features of this tool include a set of triggers including a child abuse screen (CAS) completed by the primary nurse, an alert that practitioners receive when a patient has triggered the CA-CDSS, and a physical abuse order set to assist practitioners in ordering the correct testing based on patient age and injury.[8,9] In addition, triggering the CA-CDSS results in an icon appearing on the main ED dashboard next to the patient's name. When providing feedback to practitioners about cases in which the physical abuse order set wasn't used when it was indicated, one of the co-authors (AP), who is also the director of one of the general EDs, noted that some practitioners reported that they did not agree with the recommendations in the order set and preferred to use clinical judgment.

We sought to understand the barriers to compliance with the order set recommendations, assess the impact of the CA-CDSS, and identify opportunities to improve the CA-CDSS with the goal of increasing engagement with the CA-CDSS overall.

Population Health Research Capsule

What do we already know about this issue?
Early diagnosis of child abuse is critical to decrease morbidity and mortality. Abuse identification in general EDs may be assisted by clinical decision support.

What was the research question?
What are the benefits of and challenges to sustainability of a child abuse clinical decision support system (CA-CDSS) embedded in the electronic health record (EHR)?

What was the major finding of the study?
Three-quarters of practitioners reported the CA-CDSS increased child abuse awareness and prompted interdisciplinary interactions.

How does this improve population health?
Using an EHR-embedded CA-CDSS may be one approach to improving child abuse awareness in general EDs, thereby decreasing abuse-related morbidity and mortality.

METHODS

Setting

The 19 general EDs in the UPMC hospital system operate in urban and rural settings and include community hospitals and academic centers. The primary academic centers are in the city of Pittsburgh, PA. The remainder are EDs affiliated with community hospitals across much of Pennsylvania and with individual sites in New York. Annual practitioner turnover at these 19 general EDs for full-time employees averages 6.8% for APPs and 3.6% for physicians. There is a

total of ~30,000 ED visits for children <13 years of age (the age included in the CA-CDSS) at the 19 EDs annually; the proportion of all ED visits involving children ranges from 1–3% at the academic sites and up to 12% in the community sites.

Survey

In February 2020, our team (a general emergency physician who is the director of one of the hospital system's EDs [AP] and a child abuse pediatrician [RB] from the affiliated children's hospital that was not one of the 19 included hospitals) emailed a survey to all 196 attending physicians and advanced practice practitioners (APP) at the 19 UPMC EDs. The email provided an anonymous link to a 25-question, web-based survey (Qualtrics LLC, Seattle, WA) that used skip logic, meaning clinicians received only questions that were relevant based on previous responses (Appendix A). Self-reported demographic data included years in practice, hospital affiliation(s), and practitioner type (physician or APP). The survey aimed to assess the practitioner's 1) knowledge about the CA-CDSS and its associated functionality; 2) engagement with and attitudes toward the CA-CDSS; 3) recognition of sentinel injuries—minor injuries that necessitate an evaluation for physical abuse; and 4) reasons for not using the physical abuse order set even when it was indicated. The survey was designed so that practitioners would learn about the CA-CDSS as they completed the questions.

Statistical Analysis/Measures

We used descriptive analyses to measure the proportion of surveys completed, knowledge of practitioners about the CA-CDSS, attitudes toward the CA-CDSS, recognition of injuries that should raise concern for physical abuse, and barriers to evaluating and reporting suspected abuse.

Ethical Consideration/Approval

The UPMC Quality Improvement Committee approved this project. There was no formal ethics review, and no potential conflicts of interest were identified.

RESULTS

Response Rate and Practitioner Characteristics

There was a 43% (84/196) initial response rate, with 13 surveys excluded for lack of completeness, leaving 71 surveys (36%) for analysis. Of the 13 incomplete surveys, one practitioner wasn't eligible and 10 of the remaining 12 incomplete surveys had fewer than 35% of the questions answered. As a result, we chose to exclude them entirely. Most respondents were physicians who worked in community EDs and had more than 15 years of experience (Table 1).

Practitioner Knowledge About the CA-CDSS and Its Associated Functionality

The child abuse screen (CAS)

Of the 71 respondents, 27 (38%) did not know who completes the CAS, and 54% (38/71) were unaware that they could see the completed CAS (vs simply being alerted when it was positive).

The alert

The same proportion of practitioners (27/71) did not recall ever seeing an alert, and 69% (49/71) of practitioners did not know that the lightbulb icon on the ED dashboard meant that the patient had triggered the CA-CDSS.

Table 1. Demographic characteristics of survey respondents.

Demographic characteristics of survey respondents	# (%) of respondents with completed surveys (N = 71)	Characteristics of surveyed population (n = 196)
Practitioner type		
Attending physician	57 (80%)	147 (75%)
APP	14 (20%)	49 (25%)
Primary practice type*		
Academic	26 (37%)	74 (38%)
Community	38 (54%)	122 (62%)
Split between academic community	5 (7%)	
Years of experience		
>15 years in practice	30 (42.3%)	Not available^
6–15 years in practice	27 (38.0%)	Not available
0–5 years in practice	14 (19.7%)	Not available

*Two declined to state.
^Years of experience was collected as part of the survey and, therefore, was not available for practitioners who did not complete the survey.
APP, advanced practice practitioner.

Practitioner Engagement with and Attitudes Toward the CA-CDSS

The alert

Of the practitioners who remembered seeing the alert, 68% (30/44) reported that they always approached the child's nurse for further details, and 86% (12/14) of the remaining practitioners reported that they sometimes approached the nurse; two could not recall whether they had done so. Of the 11 practitioners who were APPs and recalled seeing the alert, 78% (8/11) reported that they always approached the attending physician to discuss the case, and the other three reported they sometimes did.

The emergency department child physical abuse order set

Forty-two percent (30/71) of respondents reported having used the physical abuse order set. Of the 58% who did not report using it, 34% (14/41) indicated they were unaware of it, 54% (22/41) believed the order set was not relevant for the patient(s) they were treating, and 5% (2/41) were unable to find it. One practitioner made a broad comment about not using any order sets because he wanted to "use my brain" and not follow recommendations. Half (33/66) of respondents indicated they agreed with the recommendations contained in the order set, 45% (30/66) were neutral, and 4.5% (3/66) disagreed with the recommendations.

Attitudes

Overall attitudes about the CA-CDSS were positive, with 79% of practitioners agreeing or strongly agreeing with the statement, "The CA-CDSS increases my awareness of the potential risk for child abuse" (Figure 1a). Twenty-two percent of respondents felt that the CA-CDSS alert and physical abuse order set limited their ability to make independent decisions (Figure 1b). More than 75% of respondents felt that the alert was clear (Figure 2a), that the alert and order set fit well into practitioner workflow (Figure 2b), and that it saved time (Figure 2c).

Recognition of injuries that do and do not necessitate a physical abuse evaluation

Case 1 described a 13-day-old with a subconjunctival hemorrhage clearly documented at birth. This case was an example of an infant who did not need a child abuse evaluation. Almost 40% of respondents (26/71) incorrectly stated that this required a child abuse evaluation.

Cases 2 and 3 described a 4-month-old and 2-month-old with an intraoral laceration and torso bruise, respectively. These cases were used to demonstrate infants who require a child abuse evaluation. In these scenarios, 91% (56/61) of practitioners in case 2 and 97% (69/71) in case 3 correctly noted the need for a child abuse evaluation.

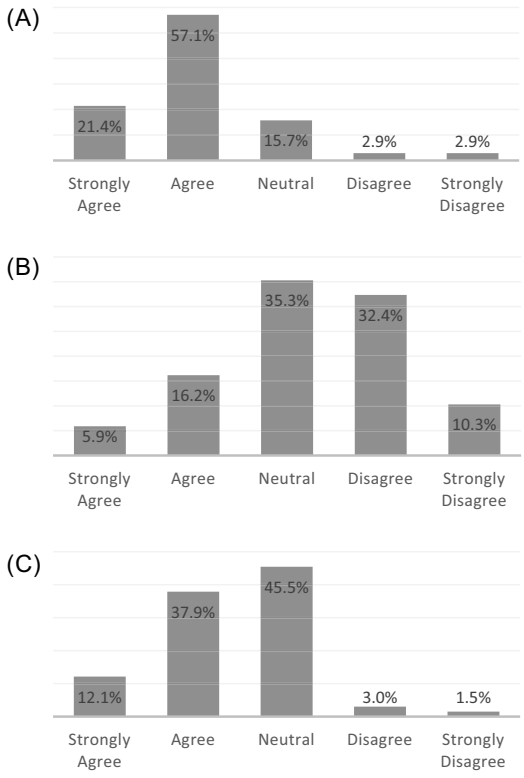

Figure 1. Practitioner attitudes about the alert's effect on clinical decision-making: a) Practitioner responses to the statement, "The CA-CDSS increases my awareness of the potential risk for child abuse," (n = 70); b) Practitioner responses to the statement, "The CA-CDSS pop-up alert and ED physical abuse order set limit my ability to make independent decisions," (n = 68) and c) Practitioner responses to the statement, "I agree with the suggested evaluations/workup in the ED physical abuse order set." (n = 66).
CA-CDSS, child-abuse clinical decision support system; *ED*, emergency department.

Barriers to evaluating and reporting suspected physical abuse

Of respondents, 89% (60/71) expressed uncertainty regarding their ability to recognize child abuse, with 52% reporting at least moderate amount of uncertainty in recognition (Figure 3a). When asked about pursuing the appropriate evaluation for child abuse, 65% (46/71) expressed uncertainty as to which tests were indicated (Figure 3b). Lack of a social worker or ancillary support in the ED was identified as a barrier by 54% (38/70) of respondents. Too much time needed for the workup was identified as a barrier for 16% (11/71) of respondents. Lastly, concern about being called to court to testify was identified as a barrier by 10% (7/71) of respondents.

Free-text responses regarding the child abuse-clinical decision support system

The final question allowed for respondents to provide free-text comments and/or suggestions about the CA-CDSS.

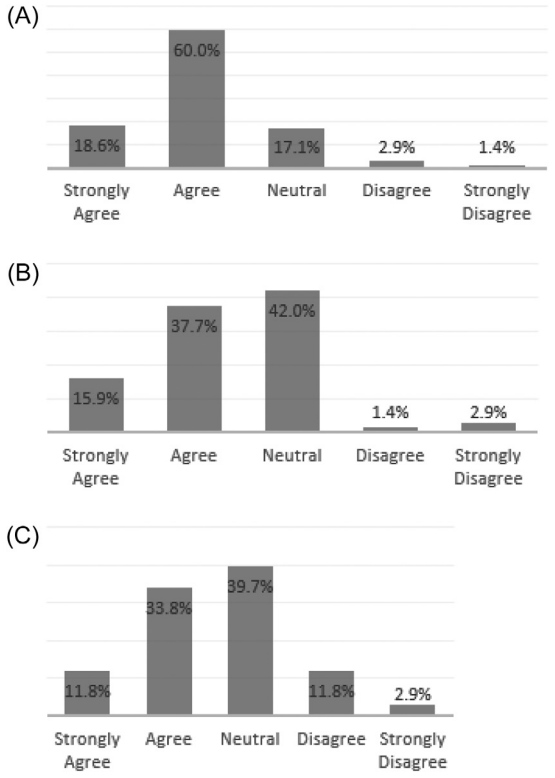

Figure 2. Practitioner attitudes about the alert and order set: a) Likert scale practitioner responses to the statement "The pop-up alert I receive from the CA-CDSS is clearly worded," reported as a percentage of 70 respondents (1 declined to state); b) Likert scale practitioner responses to the statement "Using the ED physical abuse order set fits well in my clinical workflow," Reported as a percentage of 69 respondents (two declined to state); and c) Likert scale practitioner responses to the statement "The ED physical abuse order set saves time when evaluating patients," reported as a percentage of 68 respondents. (Three declined to state.)
CA-CDSS, Child-abuse clinical decision support system; *ED*, emergency department.

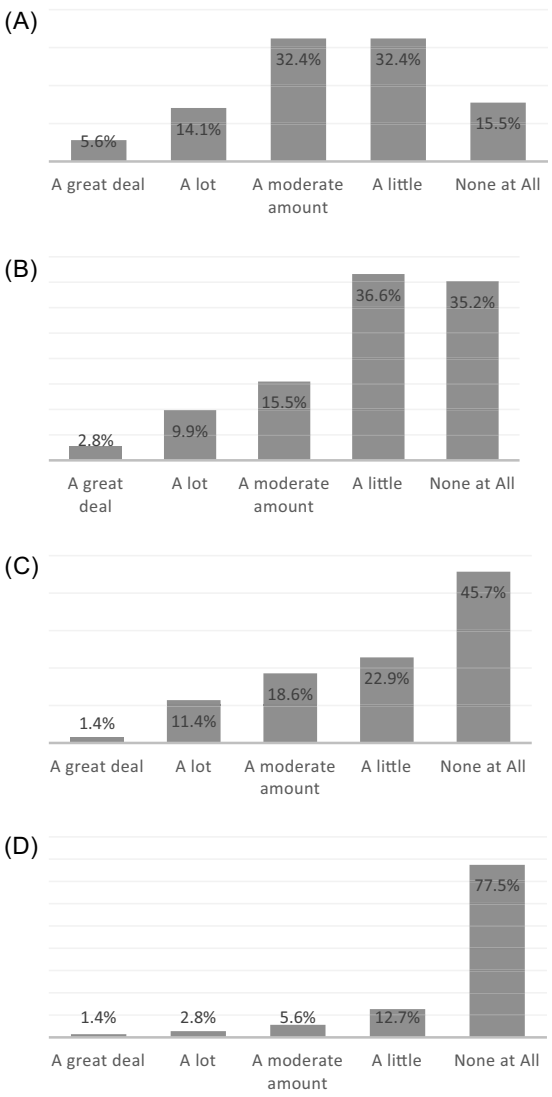

Figure 3. Practitioner self-reporting about barriers in child abuse recognition and evaluation: a) Lack of certainty about when to be concerned for abuse; b) Lack of certainty about what tests are indicated; c) Lack of social worker or ancillary support; and d) concern about being called to court.

A total of 18 (25%) respondents entered a free-text response. A common response related to the subtleties in these types of cases and the desire to have the ability to consult a pediatric and/or child abuse specialist while the patient is in the ED. As discussed below, practitioners do have this access but were unaware of it.

> Sometimes I have trouble choosing an order set because the situation does not fit in the list provided . . . .

> [Practitoner] uncertainty around the specifics/subtleties related to a specific case can be a big factor in choosing to fully utilize the order set and/or to file a report. I think [practitioners]/ patients/ families would greatly benefit by more direct involvement with the child advocacy team [while] the patient is in the emergency department.

> Raise awareness to [practitioners] so that they can consult pediatric specialists including peds [emergency] physicians for further assistance with suspected child abuse cases.

A second theme was not related specifically to the CA-CDSS but to the more general issues of pop-up fatigue" (ie, alert fatigue):

> More pop-ups cause click fatigue. This has destroyed medicine.

> We suffer from pop-up fatigue and this can just be one more.

A third set of comments were related to the desire to learn more about the CA-CDSS itself:

> I was not aware of this tool, so please send out an email describing it.
>
> Make clinicians aware of this tool.
>
> . . . more webinars or collaboration with . . . experts would be great.
>
> If there are routine free recorded lectures for us on classic regional cases . . . .I would be interested in taking them . . .

DISCUSSION

This is the first paper to evaluate the long-term effect of an EHR-embedded CA-CDSS on patient care in a network of general EDs. The most encouraging observation is that the CA-CDSS appears to facilitate interdisciplinary communication between nurses, physicians, and APPs. One of the concerns about transitioning the CAS from a paper form—the way in which it was originally studied and validated[11]—to an electronic format was that multidisciplinary communication would no longer be required and, therefore, would not occur.

The fact that 91% and 97% of practitioners, respectively, correctly identified an intraoral injury and a bruise as sentinel injuries and recognized the need for a child abuse evaluation is encouraging given the literature suggesting that practitioners often do not recognize these more subtle forms of abuse.[12–14] It is not possible to know whether this knowledge is related to the presence of the CA-CDSS or the practitioner education that has supplemented the CA-CDSS.

Over 90% of practitioners stated that concern about being called to court had little or no impact on their decision to report/evaluate for abuse. This is encouraging; in a landmark study by Flaherty and colleagues,[15] "Clinician spent many hours in court testifying" was one of the practitioner characteristics identified in a significant proportion of the practitioners who did not report to CPS despite having concern for maltreatment. Each of the authors of the current manuscript has personally spoken with practitioners who have said that they do not want to get involved in the legal system. Our data suggests that, overall, this concern is not driving decision-making about whether or not to make a report to CPS in our general EDs.

Our results also underscore the need for usability of the CA-CDSS; practitioners felt the alert and orders suggested were clear and useful, fit well into workflow, and saved time. The importance of usability cannot be overemphasized: if this is poor then it is unlikely that practitioners will use the tool.[16] However, as other responses to our survey seem to demonstrate, usability is necessary, but not sufficient, for practitioner engagement with the CA-CDSS. The number of practitioners unaware of different aspects of the CA-CDSS including the icon, the alert, and the order set demonstrates the challenges in education about a low-frequency event for any given practitioner in a large hospital system, even with a relatively low practitioner-turnover rate.

Improving the knowledge of practitioners about the CA-CDSS itself is likely to be challenging. There are multiple studies evaluating the effectiveness of different training modalities, including hands-on training in a laboratory setting, required training, use of "super users" to assist others in learning, and use of "just-in-time" training.[17–20] But all these approaches are challenging when they aim to address a relatively rare event. While child abuse is a common cause of morbidity and mortality overall, it is not commonly seen or recognized by most individual practitioners. Multiple training approaches as well as individualized follow-up and ongoing training have all been shown to sustain engagement; these are approaches we have used and continue to use.[17]

Despite these approaches, many of the free-text responses noted an unawareness of the existing resources (eg, access to pediatric experts and ongoing available education). We hypothesize that some of this lack of awareness may be related to the increase in the use of locum tenens and temporarily or casually employed practitioners, which was rare prior to COVID-19 but increased significantly during the pandemic and has continued. These practitioners rarely if ever attend the education sessions and do not receive onboarding like other practitioners, both of which can limit the real utility of resources positioned to aid with knowledge and care.

It is concerning that one of the most common free-text responses related to the desire to have real-time access to a pediatric and/or child abuse specialist while the patient is in the ED. Emergency clinicians in all the general EDs in the hospital system already have this access. There is a phone number they can call 24/7, which provides consultation with a pediatrician at the tertiary-care pediatric hospital in the hospital system. If the pediatric practitioner is unable to answer a child abuse-specific question, the child abuse specialist on call is paged. The lack of knowledge about this phone number reflects a more general lack of knowledge about hospital resources. As a result of this survey, an email was widely distributed to make practitioners aware of this phone number, and it is now included on flow sheets in multiple EDs.

Many of the free-text responses targeted CDS tools in general rather than specifically the CA-CDSS. Alert fatigue was mentioned in the free-text responses regarding the CDS tool and are consistent with prior studies, which demonstrated that interruptive alerts (eg, pop-ups) adversely affect practitioner use of recommendations from CDS.[21–24] Both free-text comments related to the alert ("More pop-ups cause click fatigue. This has destroyed medicine," and "We

suffer from pop-up fatigue and this can just be one more") are consistent with the broader issue of alert fatigue. While the low trigger rate for the CA-CDSS is highly unlikely to be a major contributing factor to alert fatigue, it may exacerbate pre-existing frustration with the alerts/pop-ups in general.

Reported successful interventions to combat alert fatigue include the persistent presence of the pop-up on the chart until it is acknowledged, as opposed to having multiple alerts for the same clinical concern.[24] While a persistent alert wasn't a possibility in our EHR at the time the CA-CDSS was developed, we designed the system so that each practitioner only receives one alert in response to the specific concern of trying to alleviate alert fatigue. Interestingly, some of the early feedback about the system was that some practitioners wanted to be alerted repeatedly until they decided whether to evaluate for abuse, at which point they wanted to be able to silence the alert. It is not possible for the current EHR system to customize alerting rules for different practitioners; when designing any given CDS system, a decision must be made about the timing and frequency of alerts that applies to all practitioners. Addressing the issue of alert fatigue is challenging because it is the sum of all alerts rather than the alert from any single system that impacts adoption rates for all CDS. As a result, developing a solution requires a hospital/hospital system to holistically evaluate all the CDS systems in use.

Multiple conversations with practitioners displayed little agreement about when in the workflow and how often the alerts should be provided. Some practitioners wanted to know at first chart open that they should be concerned about abuse, so that they have this in mind when they examine the child and speak with the family, while other practitioners want the information later in the visit when they are formulating a differential diagnosis. Some practitioners wanted to be alerted only once, while others preferred to be alerted repeatedly until they decided whether to evaluate for abuse.

The finding that over 20% of practitioners perceive CDS as a threat to physician autonomy likely has a significant impact on engagement and acceptance of any CDS. The concern about CDS impacting practitioner autonomy is not specific to child abuse CDS; rather it is a major barrier to CDS in general.[21,25–27] Interestingly, and perhaps surprisingly, the characteristics of the 15 clinicians who felt that CDS was a threat to physician autonomy were not different from the clinicians who did not have this sentiment in terms of their response to the questions about how often lack of certainty about when to be concerned about abuse or lack of certainty about what tests to do influenced their decision about whether to do a physical child abuse workup. Neither did they differ from other practitioners in terms of the proportion who correctly answered the three scenarios related to sentinel injuries. While it is difficult to interpret this data given the small numbers, it suggests that there is a need to better understand how these practitioners would prefer to receive assistance making high-quality, evidence-based decisions since they recognize that they are uncertain and that this impacts their clinical decision-making, but they don't see CDS as a solution.

Behavioral economics (BE), an evolving field rooted in economic and psychology, may be one approach to enhance physician engagement with the CA-CDSS. Behavioral economics is based on recognition that humans are not rational decision makers and rarely behave as the conventional economics theory would predict. Interventions informed by BE attempt to change physician practice using a "nudge," an intervention that predictably changes human behavior without significantly limiting free choice or changing financial incentives. Changing default settings and providing social reference points (eg, peer comparison) are most consistently effective interventions in improving physician practice as it relates to following evidence-based practice.[28–30] As it relates to a CA-CDSS, BE may be able to be used to nudge practitioners to follow AAP recommendations for physical abuse, for example, by providing feedback about their performance compared to their peers.[28–30] Importantly, BE focuses on the subset of practitioners who are amenable to "nudging,"[31] which is generally only a subset of practitioners. One would not expect a practitioner who has a negative view of CDS (ie, feels that it limits autonomy and does not improve patient care) to be amenable to nudging, but it may still offer some ability to improve engagement.

Perhaps the most concerning and confusing finding was how many practitioners either have a neutral or negative opinion of the evidence-based AAP recommendations for child physical abuse evaluation. This observation occurred alongside 65% expressing uncertainty about how to evaluate for physical abuse and more than 90% recognizing that sentinel injuries require a physical abuse evaluation. Requiring a user to select a reason for not following recommendations provided within the alert (eg, to follow the recommendations in the physical abuse order set) can increase compliance with recommendations[32] and may provide insight into these seemingly inconsistent responses. Implementation of a required response needs to be weighed against the possibility of generating negative attitudes toward the tool and perceived impairment of workflow. Another way to potentially increase adherence to AAP recommendations is to ensure that practitioners understand how the CA-CDSS functions and ensure that practitioners understand the source for the electronic tool recommendation[27]; we currently do this during bi-monthly education sessions with practitioners.

LIMITATIONS

There are several limitations to the study. The response rate was relatively low, and those who chose to respond may

not be representative of all practitioners. The only demographic data available for all practitioners was whether they were a physician or APP and the type of hospital they practiced in; for these characteristics, respondents and non-respondents looked similar. We felt it was important for the survey to be anonymous so that respondents would be comfortable providing honest feedback; this approach means we could not target non-respondents to improve the response rate. It is also possible that the respondents having particularly strong feelings—positive or negative—about the CA-CDSS were most likely to respond to the survey. Because of the low number of practitioners who responded to the survey from any single hospital and because practitioners can work at more than one hospital within the 19-hospital network, it was not possible to determine whether there were site-specific variations in the opinions of practitioners about the CA-CDSS. Finally, the responses to the survey may not reflect actual practice and instead may reflect what practitioners know they should do. For example, practitioners may say they speak with the nurse when a child has a positive CAS, but it is not possible to know if this actually occurs.

CONCLUSION

In summary, our data suggests that a child-abuse clinical decision support system embedded in the electronic health record has yielded positive results in both interdisciplinary communication and practitioner attitudes toward the tool, including perceiving the tool as increasing child abuse awareness. However, there remain gaps in knowledge of the CA-CDSS functionality and in compliance with the recommendations. Comments suggest that practitioner dislike of CDS tools in general, and specifically alerts delivered in pop-up form, may contribute to poor adherence. While limitations of the EHR limit the type of alert, CA-CDSS educational efforts could be augmented to specifically address perceived barriers to autonomy and possibly to include behavioral economics techniques, such as peer comparison or testimonials,[33–35] to improve compliance with American Academy of Pediatrics recommendations. Further research should focus on the effectiveness of these interventions as we continue to improve care for a rare event that carries significant morbidity and mortality.

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Reframing Child Protection in Emergency Medicine

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Child maltreatment remains a concerning source of morbidity and mortality in the United States, where more than 600,000 children are victims of abuse each year, with well-described, long-term consequences for physical and mental health.

However, the US child welfare system is characterized by systemic racism and inequity. Black and Native American children are more likely to be evaluated and reported for suspected abuse despite evidence that race does not independently change their risk of being abused. Once reported to child protective services (CPS), these children are more likely to be removed from their homes and less likely to be reunited with their families than White children.

Much of the inequity in this system starts at the front door, where a growing body of research demonstrates that bias regularly infiltrates decision-making in the initial clinical evaluation and management of suspected abuse. Minority children presenting to emergency departments (ED) are more likely to receive diagnostic testing and are more likely to be referred to CPS.

In this editorial, we argue for the application of an equity lens to child protection in the ED. We discuss how emergency physicians can balance efforts to protect children from abuse with the imperative to protect children and families from the harms of an inequitable child welfare system. Our discussion concludes with concrete recommendations for emergency clinicians to participate in active bias mitigation and thoughtfully navigate their responsibilities as mandated reporters. [West J Emerg Med. 2024;25(6)1020–1024.]

Child maltreatment remains a concerning cause of morbidity and mortality in the United States, where greater than 600,000 children are victims of substantiated abuse each year with long-term consequences for physical and mental health.[1] The US child welfare system, however, is characterized by marked inequity.[2,3] Black and Native American children are more likely to be evaluated and reported for suspected abuse despite evidence that race does not independently change their risk of being abused.[4,5]

In years past, typical clinical decision-making might have dictated that even a small suspicion of child abuse meant an automatic report to child protective services (CPS). However, with the growing recognition of the racial inequity within the child welfare system and its adverse effects on communities of color, emergency physicians now must reconsider their approach.[6–8] As frontline care clinicians for injured children, emergency physicians should seek to strike a balance between safeguarding children from abuse and shielding families from unnecessary exposure to the child welfare system.

In a systematic review, Cenat et al compiled 36 studies of proportionality in child welfare systems and found that 27 of these studies show Black youth are over-represented in these systems.[2] This disproportionality is present at each phase of the child protection process beginning with reporting.

Nationally, Black children represent 15% of the general population but account for 25% of CPS investigations.[9] Separate state-level analyses of public records in Washington, Colorado, Missouri, Wisconsin, Texas, and North Carolina show that Black children are at least twice as likely as White children to be reported to CPS.[10–15]

Once an investigation is initiated, Black and Native American children are more likely to be removed from their homes and less likely to be reunited with their families than White children.[16] In a record review of 4,000 children referred to CPS in California, Lu et al found that in comparison to White children, Black children were 23.4% more likely to be placed in out-of-home care and 11.7% less likely to be reunified with their families if removed from the home.[17] A similar review by the Center for the Study of Social Policy found that Black victims of maltreatment were 36% more likely than White victims to be removed from their homes.[18]

The burden of child welfare involvement on Black families and communities is substantial. Research by Kim et al indicates that over 50% of Black children will undergo a CPS investigation within their family before turning 18.[19] Sociologist Dorothy Roberts and a coalition of academics and community advocates lead an intellectual movement that characterizes the child welfare system as a form of "family policing." Through a robust body of qualitative and narrative research they highlight how the system disrupts parental authority, hinders children's relationship development, fosters distrust among neighbors, and harms maternal mental health.[7,20–21] There is little evidence that contact with the child welfare system can improve outcomes for children or families.[22]

The role of emergency physicians as mandated reporters and providers of frontline care to injured children makes them de facto gatekeepers to this unequal system. Most CPS referrals in hospitals are for patients whose care starts in the emergency department (ED).[23] Both general emergency physicians and pediatric emergency physicians care for children who may have been the victims of physical or sexual abuse, or who may be experiencing one of multiple types of neglect (physical, supervisory, medical, educational, and emotional). A growing body of research demonstrates that bias regularly infiltrates decision-making in the initial clinical evaluation and management of suspected abuse. In a secondary analysis of CPS reports conducted at an academic tertiary hospital, Cort et al found Black and Hispanic pediatric patients were four times more likely than White pediatric patients to be reported to CPS by medical personnel.[24]

Lane et al demonstrated in a retrospective cohort study that Black and Latinx children seen for fractures were eight times more likely than White children to receive a skeletal survey and four times more likely to be reported to CPS, regardless of insurance status (poverty) or likelihood of an abusive injury.[5] In a study of pediatric patients admitted for traumatic brain injury at 39 hospitals, Wood et al observed that fewer skeletal surveys are performed among White infants (67.8%) than Black infants (84%).[25] In a cross-sectional analysis from 18 sites in the Pediatric Brain Injury Research Network, Hymel et al found that among acutely head-injured patients hospitalized for intensive care, minority patients were twice as likely to be evaluated and reported for abuse than White patients. This disparity was seen most in patients who had a low estimated risk of abusive head trauma at the outset of the encounter.[26] Most recently, Rebbe et al showed that among hospitalized patients, Asian and Native American children were more likely than White children to have their encounter coded with a maltreatment-related diagnostic code and to be reported to CPS.[27] It is in part because bias factors into child maltreatment reporting that emergency physicians have such a meaningful role to play.

It is not our intention to encourage physicians to shirk mandated reporting requirements. Physicians with a "reasonable suspicion" of child maltreatment should report their concerns to the appropriate authorities. This remains the legal standard in most jurisdictions across the United States. That said, it must be acknowledged that considerate, well-trained people disagree on what constitutes "reasonable suspicion." The term is plagued by indeterminacy in theory and practice.[28] Survey studies consistently show wide variation among physicians attempting to define reasonable suspicion and reach consensus on the threshold for reporting.[29] In one study, clinicians chose to report only 73% of children they considered "likely" or "very likely" to have been abused,[30] while in a separate study nearly half of respondents said they would report cases where abuse was fifth or lower on their list of potential differential diagnoses.[31] In many cases, it cannot be assumed that any two mandated reporters agree on the need for a CPS report.

In the setting of this indeterminacy, the burden falls to the individual clinician, and it is arguably an ethical one more than a legal one. Unnecessary reports to CPS stand in direct conflict with the principles of non-maleficence and justice. Reasonable people may disagree on the threshold for reporting potential abuse, but all clinicians should consider the full scope of harms and benefits any time they contemplate a filing.

Optimistically, this challenge is also an opportunity. There is a growing enthusiasm for remedying the child welfare system among pediatric healthcare clinicians in many settings.[4,6] Emergency and pediatric emergency physicians are perfectly positioned to join this movement and make positive changes in an unjust system. In the recommendations that follow, we draw on the work of experts in child protection and implicit bias to suggest interventions for emergency physicians at the intrapersonal and interpersonal levels.

1. Stay abreast of current evidence and recommendations. The evidence base for child abuse pediatrics is rapidly evolving. It is increasingly understood which mechanisms are feasible explanations for certain injuries, making it possible to accurately identify the findings most indicative of abuse. A good understanding of this evidence base allows clinicians to avoid unnecessary workups and referrals. The American Academy of Pediatrics provides clinical practice guidelines that summarize current recommendations for the evaluation of physical abuse.[32,33] Going a step further, physicians can use their knowledge of evidence-based practice to implement standardization within their departments. Limited studies show that clinical practice guidelines can improve disproportionality in child maltreatment evaluation.[34] This should be done carefully. Standard screening guidelines may improve proportionality, but standardized referral guidelines risk overexposing children and families of all races to the child welfare system.
2. Use a multidisciplinary approach to child protection. A thorough protective assessment by a skilled social worker is an invaluable tool for determining whether a CPS filing is necessary. In addition to the injury history typically obtained by the medical team, social workers often have the opportunity to learn more about family dynamics, housing status, caretaking responsibilities, protective factors, or prior CPS involvement. All this information can be used to make a holistic assessment of protective concerns and inform dialogue to mitigate bias.
3. Consult child abuse pediatricians whenever possible. Child abuse pediatricians are subspecialists with extensive training and expertise in all aspects of child protection. They can recommend diagnostic workups, comment on whether injuries are consistent with stated mechanisms, and help physicians navigate the reporting process. There is evidence that consultation with a child abuse pediatrician can reduce unnecessary referrals to CPS.[35]
4. Understand your local CPS and make referrals in accordance with their capabilities. A good emergency room physician does not order a test or treatment without knowledge of its limitations. The same should apply to a report to CPS. What types of concerns do investigators have the expertise to investigate? What supports can they offer to families? Can they help with childcare, housing, transportation, or employment? It is a common misconception among clinicians that a report to CPS benefits families by helping them to access additional resources.[36,37] In practice, it is uncommon for CPS to provide social supports that could not have been made available by a hospital social worker or primary pediatrician. It has been questioned whether CPS has an impact at all on modifiable risk factors for abuse. In a multicenter cohort study of 595 children between 4–8 years old judged to be at risk of abuse, Campbell et al found no association between CPS investigation and subsequent social support, family function, poverty, maternal education, or child behavioral problems.[38]
5. Be careful about language and information sharing. When communicating about a case with colleagues or CPS, avoid discussing unnecessary demographic details (race, employment status), or sharing subjective judgments ("lovely family"). The more communication is limited to essential information and neutral language, the more we can minimize the effect of bias.

Emergency clinicians can play an essential role in decreasing systemic inequity in child welfare by mitigating implicit and explicit bias and taking a thoughtful approach to mandated reporting.

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Comments on "Bicarbonate and Serum Lab Markers as Predictors of Mortality in the Trauma Patient"

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Dear Editor:

We read with great enthusiasm the article "Bicarbonate and Serum Lab Markers as Predictors of Mortality in the Trauma Patient" by Talbott et al,[1] which was recently published in the *Western Journal of Emergency Medicine*. Talbott et al utilized the TriNetX database to explore associations between serum laboratory markers (bicarbonate, lactate, and base excess) and 30-day mortality. Despite the novelty of their findings, we have a few comments about the methodology and results that may not support their conclusions.

Our first comment is with regard to the lack of stratification of anatomical location and trauma type. While it is commendable to employ large sample sizes to improve generalizability, it is less helpful for clinicians who manage various types of traumas. For instance, patients who sustain gunshot wounds to the thigh may suffer hemorrhagic shock and metabolic acidosis producing elevated lactate values,[2] yet they have a higher chance of survival if resuscitation is prompt.[3] Several studies have shown lactate levels from patients with blunt traumatic brain injury are indistinguishable from healthy controls, yet these patients' risk of mortality is increased due to the location of injury.[4] These patients activate different treatment algorithms, making conclusions about "trauma" patients too broad for clinical utility.

Moreover, the methodology for patient selection could be more narrowly defined. The authors used the International Classification of Diseases, 10th Revision, Clinical Modification (ICD) code ICD 10 CM: T14 Injury to any unspecified body region, which includes any injury from a superficial injury to traumatic amputation. This poses a wide spectrum of treatments and survivability, as injury location impacts the triage process and mobilization of staff and resources.

We replicated Talbott's analysis with a narrower anatomical location using ICD 10 CM: S06 Intracranial injury including subarachnoid and subdural hemorrhage, both of which raise suspicion for elevated lactate. We agree higher lactate values are associated with increased risk of mortality; however, specifying the location of injury (intracranial) strengthened this association beyond the Talbott et al analysis. After stratifying lactate by increments of 2 we found that the risk of mortality was 1.06%, 3.42%. 13.3%, 27.4%, 38.1%, and 57.0% for lactate ranges of <2, 2–4, 4–6, 6–8, 8–10, and 10–12 millimoles per liter, respectively. These results illustrate how specifying an injury type and anatomical location provides narrower, more useful associations between serum lab markers and 30-day mortality.

Finally, Talbott et al used "same day" lactate levels. Although lactate at arrival may have prognostic value, persistently elevated level after 20 hours of injury portends different prognoses.[5] When providing guidance to clinicians treating trauma patients, this granularity aids in understanding a patient's clinical condition, as outcomes for patients with elevated arrival lactate that is cleared after four hours vs those with persistently elevated lactate at 24 hours are vastly different.[6] Nonetheless, we commend the work of Talbott et al and are excited about the magnitude of this study. We recommend that clinicians be prudent in interpreting the study's result and in applying them to their clinical practice.

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and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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