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Medical Emergency Data and Networks: A German-Canadian Comparison

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Abstract. A significant number of problems in emergency care are caused by a lack of provider access to pre-existing patient information at the point of care. Medical Emergency Datasets (MEDs) are brief summarizations of an individual's medical history, providing vital patient information to emergency medical providers. The German MED was validated by German physicians and – based on an international research project – also by Canadian physicians. Physicians in both countries considered the content very useful. The MED is currently being introduced in Germany as part of the Telematic Infrastructure. At the same time, the COVID pandemic forced healthcare professionals around the work to optimize the digital information exchange among different healthcare providers. While the exchange of data is important, additional personal expert advice is sometimes vital. Real time virtual support systems (RTVS) were introduced in Germany and Canada to support team-based healthcare delivery, independent of the actual location. Such systems have been implemented for intensive care, emergency medicine, primary care and several other medical specialties. These systems serve as a safety net, a funnel (appropriate utilization; linking patients back to primary care networks – thus reducing fragmented or disrupted services) and a medical network by building interprofessional relationships.

Keywords. medical emergency, dataset, telemedicine, virtual care

1. Introduction

The first network for medical emergencies – strokes - in Germany (TEMPiS) was founded in 2003 in Bavaria. Since then, this network has treated over 7000 patients annually. The rate of stroke-related permanent disabilities and the mortality rate of stroke patients could be drastically reduced [1]. This network is an excellent example of how emergency medicine is implemented in Germany and how it can be optimized with modern technology. A stroke is a time-critical emergency, where important decisions regarding treatment must be made quickly. The diagnosis of a stroke is made using medical imaging such as computerized tomography (CT) and possibly magnetic resonance imaging (MRI) and patient examination. There are a number of treatment options available, some of which can only be carried out at specialized treatment facilities. However, there are also treatments options available at less specialized clinics.

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If a patient suffers a stroke in the area covered by the TEMPiS network, an emergency physician will admit them to the nearest in-network clinic. Then, all necessary diagnostics are carried out there, and the nearest specialized treatment centre is contacted, if that clinic is not part of the TEMPiS network. The images are transmitted electronically, so with the help of a video teleconferencing solution, not only the doctor at that clinic, but also a specialist in the stroke centre can examine the patient. The experts can then decide together whether the patient needs to be brought to the specialized stroke centre. This is even enhanced by offering a CT-diagnostic in the ambulance car, transmitting the images to a specialized treatment center and the option for the emergency physician on scene to communicate with other specialists.

Another example of successful hospital networking is the German Society for Trauma Surgery's nationwide Trauma Network initiative. Similar to a stroke, some injuries, such as serious road traffic injuries, require effective treatment [2]. As of February 2021, 700 hospitals have joined to form 53 certified trauma networks. In order to ensure the same standard of care at each clinic, they exchange patient data amongst each-other. X-ray and CT images of critically ill and injured patients are sent to a superordinate hospital. Decisions can be made together on how to proceed and the patient transferred if necessary.

The increasing integration of systems in all sectors, across all boundaries, means change is coming to the medical profession. Increasing specialization means no physician today is capable on their own of offering each patient optimal care for every illness. In emergency medicine, fast decisions are also essential. The Ministry of Health in Northrhine-Westphalia (NRW) has decided that in the near future a network of tele-emergency physicians must be introduced in NRW, so that medical emergency professionals have the opportunity to consult with experts already on scene, thus avoiding unnecessary hospital admissions or inter-hospital transports.

Another special aspect of emergency medicine is the lack of information concerning the patient. Often the patient who presents with an acute medical emergency is not known to the admitting physician and often not able to present important information–such as current medications, allergies, diagnoses, etc. To optimize this, the German Federal Ministry of Health started an initiative to introduce a medical emergency patient summary, which includes all important information about the patient. However, this Medical Emergency Dataset has not yet been implemented completely in Germany as of February 2021.

In Canada, telehealth activities have been initiated for over 50 years [3, 4]. These early exemplars included, but are not limited to telepsychiatry in Alberta [5] and the Tele-health and Educational Technology Resource Agency (TETRA) in Newfoundland (Memorial University of Newfoundland) [6]. Federal policy changes introduced in early 2000's stimulated the development and implementation of provincial and national health information highways and opened up a new level of telehealth adoption. This supported the establishment of large-scale telehealth provincial programs such as the Ontario Telehealth Network [7], and electronic prescribing such as the MOXXI program in Montreal [8]. The establishment of a national agency, Canada Health Infoway, an independent, not-for-profit organization funded by the Canadian government, in 2001 was another important milestone in Canada [9]. Canada Health Infoway's role is to advance national electronic health record (EHR) and telehealth infrastructures [10]. These are important milestones for the advancement of telehealth across Canada that have led to the development and implementation of many additional telehealth and virtual care initiatives across Canada. However, there were and continue to be a number

of challenges in implement critical technology. This includes addressing challenges such as health professionals' and patients' digital literacy, comfort with technology, privacy and confidentiality considerations, change and sustainability of technology and new policy focused on health professional remuneration models as well as a lack of motivation for change overall [11, 12]. In 2020, a Canadian Virtual Care Task Force, formed through a tripartite partnership between the Canadian Medical Association, the Royal College of Physicians and Surgeons of Canada, the Canadian Family Physicians of Canada, and the Associations of Faculties of Medicine of Canada, undertook the opportunity to chronicle the fundamental building blocks of virtual care in Canada, and identify the path forward to leverage virtual care to change our health system to improve equity in access and quality of care in Canada (Canadian Medical Association 2020) [10].

The current COVID-pandemic has led to a tremendous increase in the uptake of telemedicine in Germany, Canada, and worldwide. Many patients were not able to safely go to a hospital as a result there was a need to develop other means for connecting patients and physicians. Safe and easy to use online video-conferencing applications, which were developed especially for the healthcare sector, enabled physicians to see and talk to the patient, saving them a personal visit. However, online video consultation cannot be used for all patients, especially not for those who need a physical examination or any other procedure that requires physical attendance.

A study in United States chronicled the rapid increase in adoption of virtual care from 11% in 2019 to 76% in May 2020 [13]. A contemporary Canadian study also found that, by the end of May 2020 since the onset of COVID, almost half of all Canadians accessed virtual care to interact with health professionals and the satisfaction rate reached 91% (Canadian Medical Association 2020)

This chapter will describe the various activities as examples of using modern digital technology in Germany and British Columbia, Canada in emergency medicine. We will also emphasize the importance of usability aspects of these technologies. Finally, when international travel will pick up again with an increase in the vaccination the world's population, the international exchange of medical information will become even more important.

In order improve and support patient-health professional communication and positive health outcomes, the usability of virtual care systems needs to be considered [14]. Usability can be defined as the capacity of a system to allow users to carry out tasks effectively, efficiently, safely, and enjoyably [15]. Many researchers have identified that the usability and usefulness of a system is important to the adoption of a technology, its continued and ongoing use, its correct use, and its effects on health interventions being delivered via the technology [16]. Usability of systems has become a critical attribute of many health technologies. Usability is of particular importance in emergency medicine, where there are time and urgency constraints at play for accessing information in a useful and timely way to support critical decision making.

2. Real Time Virtual Support Systems in Emergency Medicine

In March 2020, in response to the COVID pandemic, in Canada the BC Ministry of Health, Rural Coordination Centre of BC [17], First Nations Health Authority [18], Provincial Health Services Authority, Providence Health Authority, BC Emergency Medicine Network [19] and UBC Digital Emergency Medicine worked together to establish the Real Time Virtual Support Network (RTVS) in BC [17]. It has two key

components: (i) the provision of peer-to-peer support between health professionals, and (ii) patients-and-providers support for patients to seek care from health professionals through virtual care. These pathways were formed to ensure that equity of access of care services were made available across the province through the rural collaborative framework (BC framework). The peer-to-peer just-in-time support was exemplified by the Rural Urgent Doctors in-aid (RUDi) that focuses on emergency practices, ROSe on intensive care, CHARLiE on pediatrics, and MaBAL for maternal and newborn care. The patients-to-physicians services included the First Nations Virtual Doctors of the Day [18] to serve the indigenous populations and community members. Besides, HealthlinkBC Emergency iDoctors in-assistance (HEiDi) established for the general population through calling 811 province-wide [17]. As of March 2021, there were over 160 physicians serving in these different virtual services, and over 30,000 cases of patients being served by this provincial network of just-in-time services, connected through Zoom, text messaging, and connected electronic health records.

At the same time, in Germany the Ministry of Health in Northrhine-Westphalia rolled out a tele-emergency physician system in NRW. NRW covers a population of 17.9M people, living in one of 31 communities and 22 cities, each of these offering its own emergency services. 345 hospitals are located in NRW including six university hospitals. Altogether, over 4.6M patients are treated in hospitals in NRW each year. Emergency services were called over 1.4M times in 2020 in NRW, including emergencies which required an emergency physician on-scene. Currently, tele-emergency services have been implemented in only a few regions in NRW. The first tele-emergency service was implemented in Aachen in 2014. In 2021, 75 tele-emergency physicians served over 28,000 emergency calls in Aachen and the neighboring regions [20].

In order to improve the effectiveness of tele-emergency services, not every community or city is required to offer these services. Instead, each of the five so called community regions ("Regierungsbezirk") may offer a tele-emergency physician service until the end of 2022. Each of these community regions covers a population between 2.6 and 5.2 million. The tele-emergency physician is called whenever the paramedic on scene needs urgent medical advice. The tele-emergency physician can see the patient's data, including the ECG. Additionally, a video-call is possible so that physicians can also see the patient and, if necessary, talk to the patient. Typically, there are three scenarios in which a tele-emergency is called:

- Affirmation of medication, e.g. pain medication, that is administered by the paramedic
- Support in either choosing the appropriate hospital or affirmation that the patient does not need to be admitted to a hospital
- Support of the paramedic in complex emergency cases until the emergency physician arrives on scene

While there are formal requirements that each physician must fulfill before being eligible as an emergency physician, these requirements are not yet formalized for tele-emergency physicians. Ideally, these physicians must be experienced emergency physicians and have additional expertise in tele-emergency care. Since this type of care has recently been implemented, tele-emergency physicians will be those physicians who have worked for several years as emergency physicians on scene [20]. It is important to identify and train the special skills, which are needed for tele-emergency physicians. The tele-emergency physician does not have the complete set of information the emergency

physician on scene would have. The physician needs to communicate with the paramedic on scene and make the right decisions based on the available information. In addition, the physician can only advise the paramedic, but cannot treat the patient directly. Thus, the physician must also be able to take the paramedic through certain procedures, if necessary. This requires not only a deep knowledge of the procedure itself, but also the ability to instruct other people via tele-communication.

Another typical aspect of emergency care is limited access to patient information. Ideally, the emergency patient is already known to the hospital or emergency physician, so that the medication and pre-existing conditions of the patients are also already known. Unfortunately, this is not always the case. Patients presenting with acute medical emergencies are often not known to the paramedics, nurses and physicians and are sometimes also not able to communicate. While some countries, such as Sweden or Denmark, offer electronic patient records which allow for access to all relevant medical information online, Germany currently has no such system implemented. In order to improve the access to emergency medical information, the Federal Ministry of Health of Germany has introduced the so-called Medical Emergency Dataset (MED), which can be stored on the electronic health card. The MED is supposed to be introduced in Germany in 2021 (it was originally intended to be rolled out earlier, but the underlying technical telematics infrastructure was not in place). If implementing the MED is successful, it is a great opportunity to improve timely access to emergency medical information and improving emergency medical care [2].

3. Usability Aspects in Linking Emergency Medicine

In emergency medicine, patients often arrive to a hospital emergency department with varying levels of criticality in their health condition(s). Some patients can describe the events that have led to their emergency department visit (e.g. a car accident) while others cannot because of being unconscious, having varying levels of alertness or some disabling event that many have impaired their ability to communicate (e.g. a stroke) [5]. Even the most knowledgeable and health literate patient may forget to disclose or bring information that is important to a physician's diagnostic reasoning and decision-making processes. This places a great deal of burden on the physician to diagnose and treat a patient given a lack of information. Technologies that address physician-patient information needs and support information gathering are important tools to aid in physician decision-making. However, these tools are only effective if they provide useful information. There are significant time and urgency constraints in emergency medicine. Thus, the systems designed for emergency physicians must be effective and timely.

To address this issue, researchers have examined varying aspects of patient information and usability of systems in the context of emergency department visits. Researchers have studied: (i) the type of information that emergency physicians would like to review during emergency visits, (ii) how the information is structured and (iii) the platforms that best suit a physician's ability to access such information. In emergency medicine this has included work by Shapiro and colleagues [21] that described analytical approaches to eliciting the information requirements of emergency physicians by applying online surveys and designing health information exchange (HIE) based on that requirements gathering [21, 22]. Further work in human factors engineering has resulted in designing systems that support critical health information interchange across disparate healthcare systems. These systems are used in emergency situations and support critical decision-

making under time restrictions [22]. We point out the essential need for integration, flagging urgent information from different systems, removal of duplicate information, and improvement in the information structure and display relevant to decisions made in emergency contexts, as the human factors barriers.

From a patient perspective, many researchers have advocated that patient information should be accessible via a mobile device in an emergency (i.e. with health care app containing important information about the patient) or via a patient portal that is accessible over the WWW. With a mobile app, a patient could provide access to the information stored on a mobile device during an emergency room visit and this information could be downloaded to the local emergency department's EHR [23, 24]. Patient portals have also been identified as a key source of information for emergency department physicians. Patients could support physicians by providing access to personal health record portals, and information such as medication lists. Using portals to support emergency physician decision-making has been pioneered since the late 1990s [25]. They have since proven their effectiveness in areas such as accessing information about the patient's current diagnoses and medications. Researchers in Taiwan have also used chipped health identification cards that are read by a card reader in a hospital or physician's office. Such an approach focused on sharing patient information with physicians has also been shown to be effective. However, usability concerns regarding use of such devices by patients and their caregivers exist around system accessibility to a wide range of patients and caregivers. Along these lines consideration of digital and eHealth literacy as well as work towards designing systems, applications and user interfaces that are intuitive and understandable by a wider range of users is critical [11, 26].

In order to establish virtual care that ensures quality and accessibility, future work needs to be anchored on core principles in 4 domains [27]:

- Clinical to ensure quality optimization, communication facilitation, and continuity of care.
- Medicolegal to ensure informed consent, confidentiality and privacy, consistency with the legal and regulatory frameworks, and transparency of virtual care involvement.
- Andragogic to ensure competency based training of health professionals, harmonization with curricular priorities, and life-long learning commitment
- Social to ensure contextual sensitivity, return on investment, social reform and continuous quality improvement.

Furthermore, in order to choose and implement digital technologies, we should consider six dimensions to DECIDE [9]:

- **D**igital mirror to reflect data to provide information and insights for change;
- **E**thics to ensure appropriate use of technologies for service delivery that do not violate ethical principles;
- **C**ompetition between industry vendors and how this can positively or negatively affect quality and access;
- **I**nteroperability of all technologies to facilitate data and semantic information flow;
- **D**iscovery to ensure that research and innovation will always be needed to advance future practice of digital health;

- **E**merging future of digital health that will certainly look different from today through advancement and evolution.

4. Cross-Border Emergency Care

The COVID-pandemic has shown dramatically that medical care is not a question each nation can handle separately. In a connected world, healthcare is an international issue. The first COVID-case in Germany appeared by the end of January 2020, only weeks after the first case was discovered in China. Two months later, public life in Germany was shut down. One reason for the rapid spread of the virus and the difficulties of confining it, is the interdependent nature of the different states. Germany has nine different neighboring countries, with a number of people living, working and shopping cross-border. In 1958, the EUREGIO was founded, an organization that links 129 different German and Dutch cities and communities in order to improve cross border life in all its aspects. Other similar organizations can be found across the country.

One of these aspects is healthcare. A lot of different projects and activities have taken place since the foundation of EUREGIO. A German ambulance helicopter, for example, also operates in regions of the Netherlands. When an emergency occurs near the border, the next ambulance is dispatched regardless of its nationality. Dutch and German Level-1 trauma centres take care of trauma patients from both countries. There is also an App available which helps the paramedic translating typical phrases between German and Dutch.

Unfortunately, the information exchange between different countries in Europe is still very limited, despite of some activities by the EU to implement a European EHR in the future. Some countries already offer EHRs to their citizens, however, these records can only be accessed nationally. When the COVID-pandemic will be over, travel activities will resume quickly. Medical Emergency Information needs to be available to physicians outside of the home country of the patient, should he or she face a medical emergency elsewhere. This implies certain challenges, which need to be addressed:

- Different languages: this refers not only to the different languages spoken by the patients and the emergency physicians, but also to different medication names (e.g. paracetamol vs. acetaminophen) and different terms for medical conditions. This challenge emphasizes the need for an internationally approved standardized medical terminology that is used by all countries.
- Privacy and data protection: emergency data needs to be easily and quickly accessible. However, only medical personal should have access to these data. The identification as a medical professional can be assured in the home country of the patient (eg. national electronic medical profession IDs [16]), but there is no standardized international certificate of medical profession that could be used to limit access to medical information. This challenge emphasizes the need for a standardized international process of certification of medical professionals which allows them to access medical information in case of emergency safe and fast.
- Knowledge and education: even if a national medical emergency dataset exists, the medical personal in a foreign country needs to know where to look for it and how to access the information. This challenge emphasizes the need for an

internationally standardized and established process of storing and accessing medical emergency information.

Most smartphones already offer the possibility to store such information (eg. iOS Health or Android ICE – In Case of Emergency). While this information is entered by the patient and may thus not always be complete and valid, smartphones are common worldwide and can be used in different languages. However, this option does not solve the above mentioned challenges concerning medical language, privacy and data protection.

5. Conclusion

In case of emergency, fast and easily accessible expertise is vital. Several projects in Canada and Germany aim to provide specialized medical expertise for medical emergency professionals, regardless of time and place using modern communication technology. In order to provide such expertise, the access to medical information such as medication and pre-existing conditions is important. A standardized medical emergency dataset is to be introduced in Germany in 2021, providing the emergency professionals the information they need. While such a dataset is beneficial inside one's own country, it is desirable to implement a medical emergency dataset that can be read everywhere in the world.

Implementing tele-emergency services is not only a technical challenge, but also needs education and training. Handling an emergency as a tele-emergency physician differs from handling it on scene. Communication becomes even more important. Besides the mere technical training, communication training must be emphasized, so that tele-emergency physicians will have all the skills they need. Since tele-emergency is a new developing field in healthcare, further research will be necessary to identify the essential skills and knowledge to provide tele-emergency care successfully.

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