
Research and Applications

Assessing perceived effectiveness of career development efforts led by the women in American Medical Informatics Association Initiative

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ABSTRACT

Objective: We sought to ascertain perceived factors affecting women's career development efforts in the American Medical Informatics Association (AMIA) and to provide recommendations for improvements.

Materials and Methods: Data were collected using a 27-item survey administered via the AMIA newsletter and other social channels. Survey questions comprised 3 demographics, 15 Likert-scale, and 9 open-ended items. Likert-scale responses were summarized across respondent ages, career stages, and career domains, and open-ended responses were thematically analyzed.

Results: We received survey responses from 109 AMIA women members. Our findings demonstrate that AMIA had made strides in promoting career development, and the most effective AMIA efforts included social events (83%), panel discussions (80%), and scientific sessions (79%). However, despite these efforts, women members perceived that gender-specific challenges persisted within AMIA, and recognized the need for increased networking opportunities (96%), raising awareness of gender-specific challenges (95%), and encouraging gender proportional representation in leadership (92%).

Discussion: International and national biomedical informatics professional communities have put forth efforts to address gender-specific issues in career development. Yet, our study identified that some of these, including the deep-rooted gender power hierarchy and bias, are still perceived as profound in AMIA.

Conclusion: Even though existing career development efforts for women are highly effective, important perceived gender-specific career development issues require further attention and investigation to improve existing AMIA activities.

Key words: AMIA, gender, career development, equity, biomedical informatics, professional organization, women

INTRODUCTION

Gender issues have an impact on career development for women in science, technology, engineering, mathematics, and medicine (STEM). According to the U.S. Bureau of Labor Statistics, although women comprise 57.4% of the workforce,¹ they hold less than 5% of the top jobs in the nation's 1000 largest companies.² In biomedical informatics, women are more likely to hold lower-ranking positions and be paid less, and women of color are significantly underrepresented.³⁻⁵ Furthermore, leadership and award-based recognition remain lower for women.^{6,7} Gender bias, stereotyping, family responsibilities (including childbearing and childrearing), fewer opportunities for career development, and exclusion of women from networking impede women's career advancement.^{8,9}

Multiple nationwide initiatives have propelled professional growth and advancement of women in STEM by supporting their professional and personal needs.¹⁰⁻¹² For example, the National Science Foundation's (NSF) ADVANCE program aims to increase participation from women in science and engineering by providing grants to address various aspects of STEM that may affect women faculty and academic administrators. Likewise, the NIH Working Group on Women in Biomedical Careers formed in 2007, solicited broad, innovative actions to overcome institutional and environmental barriers to help advance women's careers at all career stages through career development awards and research project grants.^{10,13}

Similarly, AMIA has undertaken efforts to enhance career development for women in biomedical informatics. AMIA is a community of practice committed to leveraging informatics to improve health and healthcare decisions with over 5600 members. To identify and address barriers faced by women professionals in biomedical informatics, the Women in AMIA (WIA) committee was established in 2015. WIA committee strives to engage and empower women in biomedical informatics to reach their career goals and promote equal opportunity. To support these quality improvement efforts, WIA is organized into 4 subcommittees: Awards and Leadership; Career Advancement; Networking, Mentoring and Lifecycle; and Pathways.¹⁴ In addition to holding regular meetings throughout the year, these subcommittees host several programs and activities during the annual AMIA symposium for women members. These include but not limited to (a) *WIA-sponsored panel discussions* on several topics such as identifying resources for career development, and impact of COVID on work-life balance, etc.; (b) *Women In Informatics Event (WINE)*, a networking event aimed at connecting women from different backgrounds, career stages, and career domains; (c) *Career Development Events* provide a platform for women members to seek career-related help and build mentor-mentee relationships; (d) *WIA Podcast* showcases women at all career stages, their unique experiences and personal challenges; (e) WIA "First Look" program encourages participation of undergraduate women with an interest in informatics and/or STEM at AMIA's annual symposium; and (f) *WIA Leadership Program*, the first nationwide biomedical informatics leadership training program for women in the United States, designed to unleash hidden and overlooked leadership potential and talent of women. These WIA-sponsored programs have successfully attracted over 2000 women members and numbers continue to grow every year.

Nevertheless, we are yet to assess whether these programs and efforts by WIA are addressing its original mission, and to what ex-

tent. Towards this end, WIA Networking, Mentoring, and Lifecycle subcommittee administered a survey from November to December 2020 to ascertain the perceptions of AMIA women members as it relates to WIA concerted efforts, as well as to identify any unmet career needs and obstacles that must be addressed, including those brought forth by the COVID-19 pandemic.

The objectives of this quality improvement (QI) study were 3-fold: (1) evaluate the effectiveness of programs currently offered by WIA; (2) assess and recognize any unmet needs and resource barriers impeding career goals of WIA; and lastly, (3) garner suggestions for improving career development opportunities for WIA.

METHODS

The WIA Networking, Mentoring, and Lifecycle subcommittee administered a survey to all AMIA members to gather their perspectives on the effectiveness of the WIA programs. The institutional review board at Washington University in St. Louis (IRB No. 202205044) determined this study as nonhuman-subjects research. We followed the SQUIRE (Standards for Quality Improvement Reporting Excellence) guidelines for reporting this QI study.¹⁵

Study population

Active AMIA members of all genders were invited to participate in the study survey. However, only 2 respondents self-identified as male and their responses were excluded from this analysis due to insufficient sample size. No respondents self-reported as transgender or gender variant. Therefore, in this paper, we focused on the analysis of responses from individuals who self-identified as women.

Data collection

We iteratively developed and pilot-tested a 27-item survey with 3 demographics items, 15 Likert-scale items (scale of 1 to 5), and 9 open-ended items to: (1) assess perceptions on WIA's efforts to support women informaticians; (2) rate the effectiveness of AMIA-sponsored events; (3) identify factors impacting women's careers and representation in leadership; and (4) assess perceptions on career development obstacles. The survey topics were mainly related to WIA career development events and actions, unmet needs, and career obstacles (Table 1, see [Supplementary File](#) for the complete survey).

The survey was designed using Survey Monkey tools and was advertised in the AMIA e-Newsletter, and other social channels such as AMIA Connect in November and December 2020. At the time of survey distribution, AMIA had 2084 (38%) self-identified female members, 3016 (55%) self-identified male members, and 2% prefer not to answer and 0.22% nonbinary, 262 (4.78%) not specified/unknown with a total of 5484 active members. A convenience sampling approach was used, and all responses were anonymous.

Data analysis

All responses were exported into an Excel spreadsheet for processing and clean-up.

Quantitative analysis

Descriptive statistics were calculated for demographic variables and Likert-scale (1 to 5) responses about respondent priorities and effectiveness ratings for events and programs. Missing age was imputed

Table 1. Survey topics on WIA effectiveness

Survey topics	Survey topic definition and scope
WIA career development events	Career development events refer to activities that foster professional growth (eg, mentorship career development events, women in informatics networking events (WINE), panel discussions, scientific sessions, and workshops in AMIA meetings, mentor-mentee meetings)
Leadership development actions	Leadership development actions refers to activities to expand the capacity of women to perform in leadership roles within organizations (eg, nominating women for AMIA leadership, providing leadership training opportunities, and sending an email reminder to encourage women to nominate peers or self-nominate)
Unmet needs	Unmet needs refer to women needs that could improve their careers in the future (eg, increasing networking opportunities, raising awareness of gender-specific challenges in career development, encouraging gender-proportional representation in AMIA leadership, highlighting gender in AMIA's workforce-related mission/vision/values statements, and improving the "family friendliness" of AMIA)
Career obstacles	Career obstacles refers to barriers that hinder career progress (eg, barriers related to work-life balance, difficulty building connections, and gender bias)

as 41–50 years ($n = 1$). Responses of 4 and 5 on Likert scale were considered as "effective" for career development efforts or as "significant" for unmet needs/career obstacles and were summarized across age, career stage, and career domain. All questions were optional. If a respondent skipped a question, their response was excluded from the denominator for percentage calculation.

Qualitative analysis

A thematic analysis approach was used to code the open-ended responses.¹⁶ Two researchers (JA and research assistant) read responses multiple times for familiarization with the content, and independently conducted open coding using initial data-driven codes. Both researchers independently compared open codes across responses to identify any repeated and interrelated codes and categories which formed subthemes. Similar subthemes were grouped over multiple rounds of review to generate overarching topics and themes across the data to align them with the main topics covered in the survey questions. Final themes and subthemes were discussed and refined between researchers until 100% consensus was reached.

RESULTS

We received 111 survey responses 109 of which were from self-identified women members. Respondent demographic characteristics are summarized in Table 2.

Responses were grouped into 3 categories: (1) effectiveness of WIA career development events and actions; (2) obstacles and unmet needs of WIA; and (3) recommendations for AMIA to address WIA needs and career goals. Eighty-one respondents provided free-text responses about factors impacting a career in health informatics and AMIA contributions to professional quality and skill improvement. Fifty-one respondents provided free-text responses about suggestions for AMIA to help members overcome obstacles.

Effectiveness of WIA career development efforts

WIA career development efforts included *career development events* and *leadership development actions* (Table 1). The respondent attendance and effectiveness of WIA career development events are summarized in Figure 1. Seventy-six (69%) of all respondents reported that they attended WIA social events. Among 21- to 30-year-old respondents, only 2 (33%) were aware of WIA social events. Contrarily, among respondents over 60 years old, 8 (80%) were aware of WIA social events. Similar levels of awareness were reported for WIA panel discussions, scientific sessions, and scientific

Table 2. Characteristics of survey respondents

Respondent characteristics	N (%)
Age (years)	
21–30	6 (5.4)
31–40	35 (31.5)
41–50	41 (36.9)
51–60	19 (17.1)
Over 60	10 (9)
Career stage	
Full time student (including interns and residents)	9 (8.1)
Early career (entry into workforce/career establishment)	25 (22.5)
Midcareer (career advancement/stability)	64 (57.7)
Advanced-career (transition/encore careers/semiretired)	13 (11.7)
Career domains	
Academia or research institution	72 (64.9)
Informatics-related industry	19 (17.1)
Clinical practice	15 (13.5)
Government or regulatory organization	5 (4.5)

workshops. Those who participated in the WIA career development events rated them positively (Figure 1).

The effectiveness of WIA leadership development actions is summarized in Figure 2. Overall, respondents supported nominating women for AMIA leadership (98%), providing leadership training opportunities (83%), and sending email reminders to encourage nomination (74%) as effective actions that AMIA could take as a community to encourage gender proportional representation in AMIA leadership.

The qualitative findings revealed several subthemes related to respondents' perceptions on factors contributing to the effectiveness of career development events and leadership development actions.

Social (formal and informal) events

Most respondents agreed that social events in AMIA meetings on gender-specific challenges in career development were somewhat or very effective, and only very few members indicated they had limited awareness of social events being organized. Some respondents listed building social networks and collaborations as important priorities in professional development and felt that "diversity and inclusion seminars [were] hot topics (Respondent #108, R108)." Other respondents stated that formal and informal networking opportunities were helpful and extensive, such as the AMIA 10×10 class projects. For more casual social events, others suggested it might even be helpful to "have periodic virtual café/meetup times—not necessarily on Zoom,

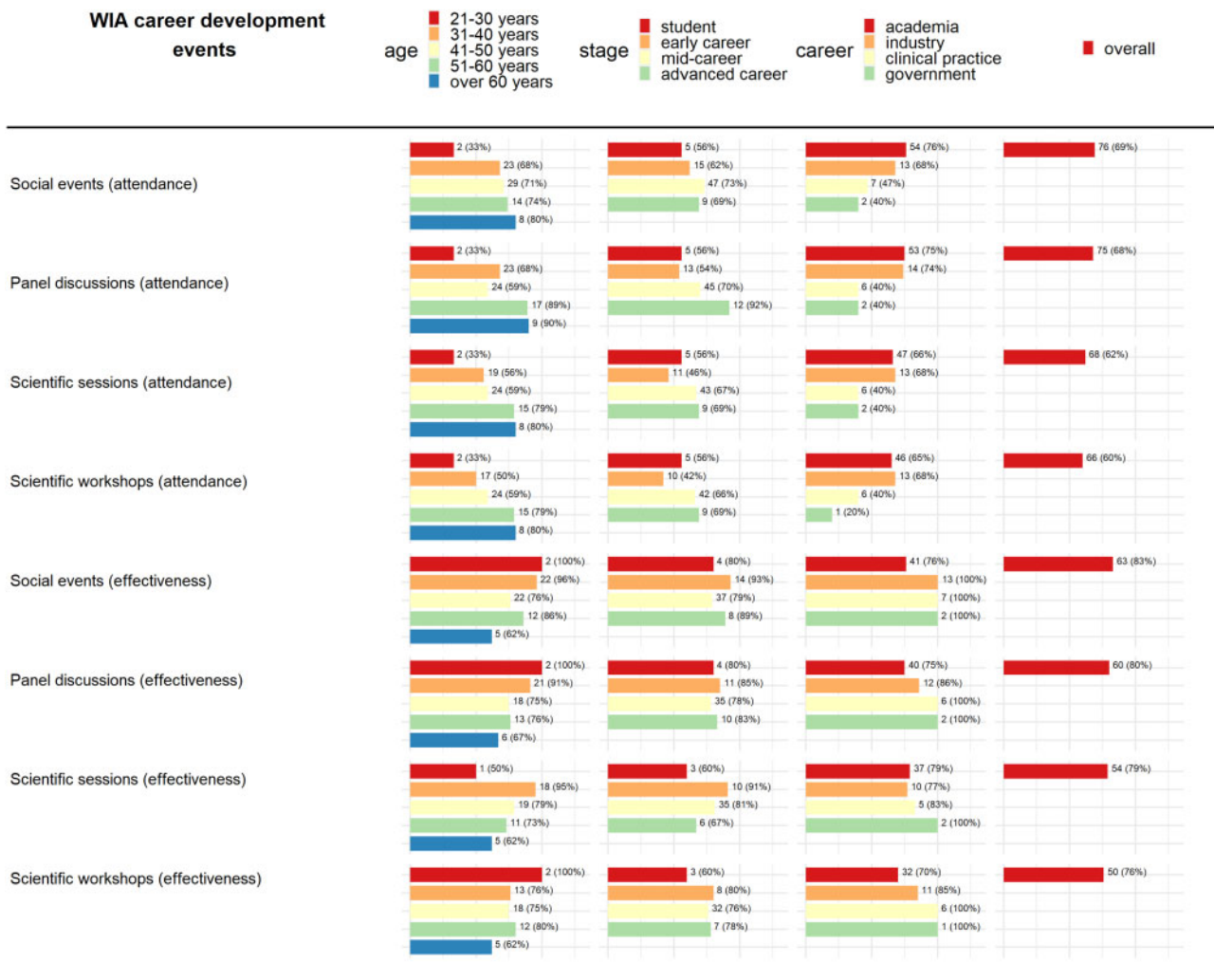


Figure 1. Effectiveness of WIA career development events. *Note:* Responses of 4 and 5 on Likert scale were considered as “effective” for the career development efforts.

but on a platform that could simulate a virtual mingling and social time (R14)” to encourage communication and networking.

However, a few respondents strongly suggested male participation in these events, arguing that female empowerment did not exist in a vacuum, and there was a “need [for] more awareness amongst male colleagues about how they can be active allies (R5).” A few other respondents agreed that AMIA should expand program inclusiveness and encourage even gender distribution across events for fruitful sessions.

Panel discussions

Of those who felt that panel discussions on gender-specific challenges in career development were somewhat or very effective, many spoke highly of the Women in AMIA-sponsored panels, describing them as “useful for informatics in the #metoo world (R17).” Most respondents who responded called for more diversity in the form of women-led panels, research-related panels, and conferences incorporating male allies.

Identified barriers to panel effectiveness included timing and lack of buy-in on content. As one respondent stated: “the trouble

with panels is that they mean you can’t go to something else, and the sessions are usually not helpful (R75).” Another respondent lamented that “some of these (events), I was just unable to attend due to scheduling conflicts. Others (events) I skipped, I couldn’t relate to the speakers, or I was honestly skeptical about their ability to address work-life balance, for example (R32).”

Scientific sessions

Only one respondent commented on the effectiveness of scientific sessions, requesting that AMIA “provide scientific and networking sessions recommending ways/providing opportunities for women to participate in leadership (R48).” Examples included how to apply for a board position and how to apply to become a Fellow of AMIA (FAMIA).

Workshops and workgroups

Workgroups such as the Nursing Informatics Workgroup were touted as engaging and inclusive by 8 respondents. One respondent stated that these workgroups provided opportunities to “build skills (R71).”

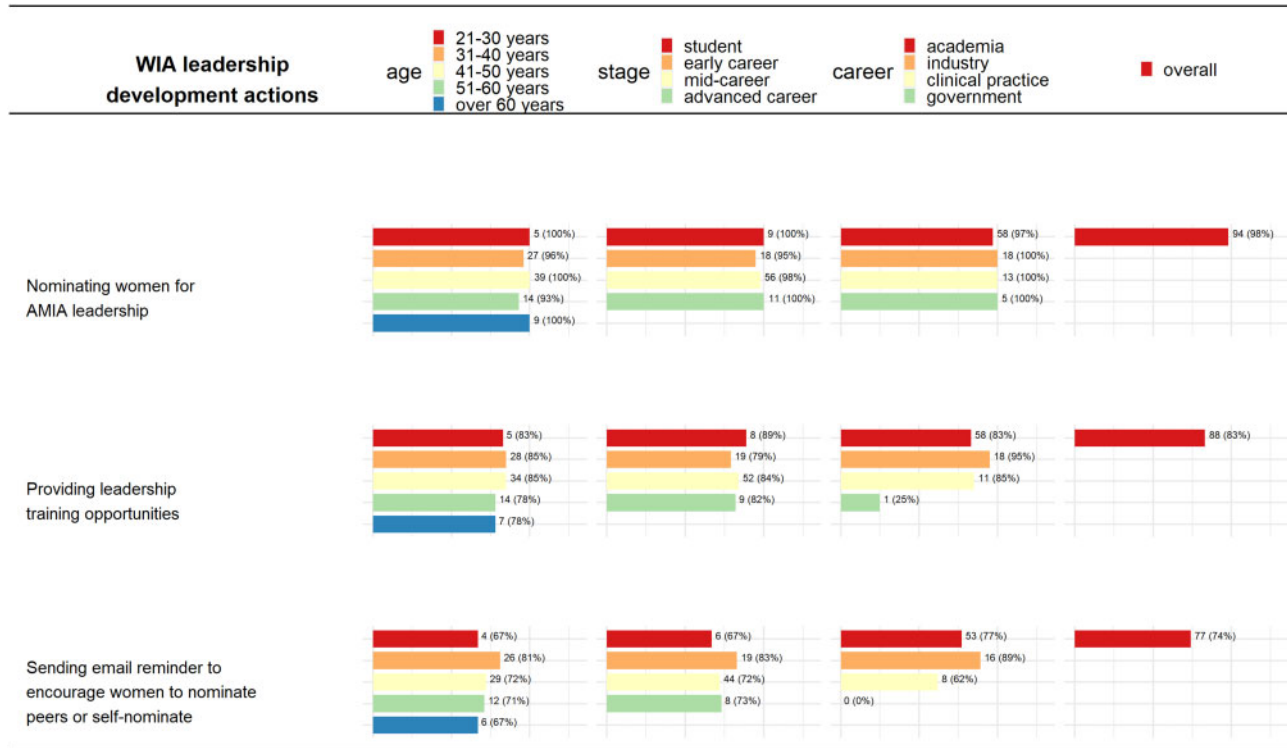


Figure 2. Effectiveness of WIA leadership development actions. *Note:* Responses of 4 and 5 on Likert scale were considered as “effective” for the career development efforts.

Most workshop feedback centered on leadership sessions, with many respondents requesting more leadership-building activities. Other workshops that respondents wanted to see included workshops on preparing documents for academic career searches and writing techniques. Regarding other workshop subjects, one respondent suggested that AMIA conduct “polls for workshops on informatics hot topics (R50).”

The primary barrier to workshop effectiveness again involved timing. A few respondents felt that existing workshops were effective but suggested that, in addition, AMIA should conduct “focused workshops outside of meetings that provided affordable training in focused areas (R5)” to avoid long multisession training. This was seen as more feasible and helpful to others.

Leadership nominations

Almost all respondents felt that nominating women for AMIA leadership was an effective step towards gender-proportional representation. When questioned about leadership nomination, one respondent stated that “[they] like the informal calls and the offers of senior people [mentors] to nominate others (R110),” but noted that it was usually from other women as well. A few others agreed and suggested that AMIA provide “sponsorship and personal invitations from those who are already leaders (R3),” emphasizing that men should reach out, not just women. Some respondents noted that based on website instructions, the nomination process for AMIA leadership positions was not always clear. As a solution, they suggested that email reminders would help encourage the nomination of women into AMIA leadership. Along with email reminders, one respondent also requested that within nomination emails, AMIA could provide direct links to information on AMIA’s website about “what positions are elected (and why), opportunities to access lead-

ership training (and how to do it), and easy instructions and processes to self-nominate (R5).” These, along with examples of completed and effective nomination materials, could help respondents understand how to go through the process. Example respondent comments related to the effectiveness of WIA career development efforts are provided in Table 3.

Leadership training

Most respondents agreed that leadership training opportunities within AMIA were effective steps towards gender-proportional representation in AMIA leadership. One respondent highly praised AMIA’s approach, noting the substantial number of women in leadership and commenting that she would also love to “have a chance to meet and talk with this group of high-achieving women during a special event (R30).” A few other respondents also felt that the leadership training was very effective but also recommended designing a virtual leadership program at less cost to increase participation and to benefit those unable to attend in person. Additionally, respondents stated that seeing women in leadership and having female mentors throughout the program was empowering and provided support and connections with other women in the field. One respondent suggested asking women in leadership roles to share their experiences and become even more visible, to further encourage other women to take on similar leadership roles (R67).

Career obstacles and unmet needs

The perceived importance of career obstacles is summarized in Figure 3. Lack of work–life balance (80%), difficulty building connections (77%), and gender bias (74%) were recognized as significant barriers faced by women. Among 21- to 30-year-old respondents, 6 (100%) agreed that gender bias was a major obstacle for them. Con-

Table 3. Effectiveness of WIA career development events and actions

Theme	Subtheme	Respondent responses	No. of responses
Social events	Regular social events like WINE were helpful, but could benefit from inclusivity to allow networking with nonfemale leaders	<p>“Loved WINE but did not like it restricted to women and put in small hotel rooms that are stifling. Stupid to not include most of the people who are hiring or leading in the field (most are men).”—R9</p> <p>“The best sessions have been those that include all genders as I am particularly irritated when I go to something with all women or with all men or with nothing in between!”—R28</p> <p>“Regular network meetings [were helpful].”—R46</p> <p>“More events like WINE [would be great].”—R72</p>	24
	Informal and formal mentoring were significant facilitators to career development	<p>“Being informally mentored by my female working group chair when I was a vice-chair [was an advantage].”—R3</p> <p>“Mentoring early-career women for leadership [was effective].”—R69</p>	5
	Making events, memberships, and training programs more affordable would increase membership and accessibility	<p>“Affordable and accessible training/memberships [are necessary for most].”—R4</p> <p>“Engage learners at institutions without training grants or provide more affordable memberships for nonclinician members.”—R3</p> <p>“Membership needs to be affordable [so as not] to exclude women who may not be in higher-paying male roles/afford membership, be on maternity leave, work part-time, and take care of children/parents, etc.”—R90</p>	4
	Providing opportunities to find sponsorships is important to career development	<p>“Mentors and sponsors, building these relationships [is important]. Help women connect with sponsors, not just mentors.”—R82</p> <p>“Active support and sponsorship from male allies and leaders in the industry would be helpful to women seeking to fill leadership roles.”—R3</p>	4
Panel discussion	Providing opportunities to showcase expertise from women in panels and events would assist career development	<p>“Use social media to showcase expertise from women in AMIA.”—R55</p> <p>“Showcase expertise from women.”—R94</p> <p>“Other WIA-sponsored panels and leadership programs.”—R26</p>	5
Scientific sessions	Diversifying conference topics would increase interest and participation	“Diversify the conference topics to include more applied informatics.”—R54	2
	Providing current updates in the field improve buy-in and participation	“[These sessions] can help me to be updated in the subject.”—R4	3
	Increasing the variety of information resources offered increases membership and accessibility	“Do like the women’s forum, newsletters, podcasts, etc. More is needed and needs to be accessible to ALL women, not just members behind firewalls. It may help AMIA attract more women to membership.”—R90	2
Workshops and workgroups	Offering more skill workshops for a variety of career-building skills would assist career development	<p>“[We want] more skill workshops at conferences.”—R9</p> <p>“Offer more skill-based and leadership workshops or facilitate access to these.”—R20</p> <p>“Workshops with active participation of skills [is useful].”—R71</p>	18

(continued)

Table 3. continued

Theme	Subtheme	Respondent responses	No. of responses
Nominating women for AMIA leadership	Raising awareness and expanding inclusivity to workshops would increase membership and accessibility	“Workshop on preparing documents for academic career search.”—R88 “Workshops to support manuscript, grant, and other kinds of professional development.”—R96	9
	Outreach to women for leadership positions is strong	“Workgroups are good, but if limited participation, or recognition, may exclude some.”—R90 “I think we are doing fine with AMIA leadership.”—R28 “Outreach to women in the field, especially leadership for conversations and training.”—R68	
	Providing leadership training opportunities	Leadership-building activities, and workshops assist women in developing careers in leadership	“There is a lack of awareness of the current resources and opportunities for women to participate in leadership roles.”—R14 “Virtual women leadership program [is helpful].”—R29 “[We would like to see an] informatics leadership workshop for women leaders—or other leadership-building activities.”—R51

trarily, among respondents over 60 years old, only 3 (30%) agreed with that statement.

Descriptive analysis of respondents' needs is shown in Figure 4. Most respondents reported that increasing networking opportunities (96%), raising awareness of gender-specific challenges (95%), and encouraging gender-proportional representation in leadership (92%) were important to them.

Career obstacle: work–life balance

In addition to childcare concerns, most respondents also felt stressed by the work–life balance upended by COVID-19. According to one respondent, “there is no boundary between work and family, and there is much more work required to bring groups together and create a feeling of community (R5).” Furthermore, others were frustrated with the approach to productivity across workplaces, complaining that “colleagues with few or no responsibilities at home are very productive and setting the standard of productivity during [COVID-19], which is unrealistic for everyone else (R83).” These challenges led to mental health issues, as reported by several respondents.

Career obstacle: difficulty in building connections

Several respondents highlighted barriers around building new connections within the AMIA community. The majority of the respondents voiced their perspectives on how to address this career obstacle and their contributors—by incorporating more formal and purposeful efforts towards mentorship classes, building grant skills and industry-researcher partnerships, increasing awareness of WIA strengths and research areas, and lastly, more recognition of nontraditional and nonclinical informaticists, as stated: “Support and value all areas of clinical informatics expertise, not just M.D. and R.N. informatics. Many non-MD/R.N. with PhDs in informatics exist, yet they are unable to be grandfathered in if newer and not qualified for clinical informatics boards. AMIA is excluding these

professionals which often have skills/expertise lacking in MD/RN training (R90).”

Career obstacle: gender bias

Respondents shared their sentiments around diversity, equity, and inclusion, specifically around combating existing disparities among genders and also towards developing negotiation skills for equal pay across the board. This is best exemplified by: “Offering sessions, webinars, on how women, new grads, diverse individuals and skills/experiences, etc. can attain better fitting informatics positions, equal pay as men/across all diversifications, etc. and are valued equally across profession. Disparities need to be overcome (R15).”

Unmet needs: increasing networking opportunities and connections

Across most respondents, a significant challenge due to COVID-19 was lack of mentoring and networking opportunities. One respondent agreed that providing “community interactions, connections, networking, facilitating interactions across diverse groups” was important, but also giving opportunities to “those with common connections to cross pollinate and support each other in the informatics community (R15)” was equally invaluable to success for a woman in informatics. However, a couple of respondents worried that networking events might feel inaccessible to women who were early in their careers. Thus, many strongly encouraged carving out innovative approaches for mentors and mentees to seek each other out and sustain their relationships.

To combat the limits of current socializing events, some suggested holding informal Zoom sessions to build connections. One respondent mentioned that “a number of clinical professional organizations have had great virtual meetings, including networking, and virtual beach party mixer with [drinks and party favors]. They also had networking trivia night/online games, and other ways to engage in a fun manner (R15).” Others agreed that interactions through other events were important as well, and a few noted that *JAMIA*

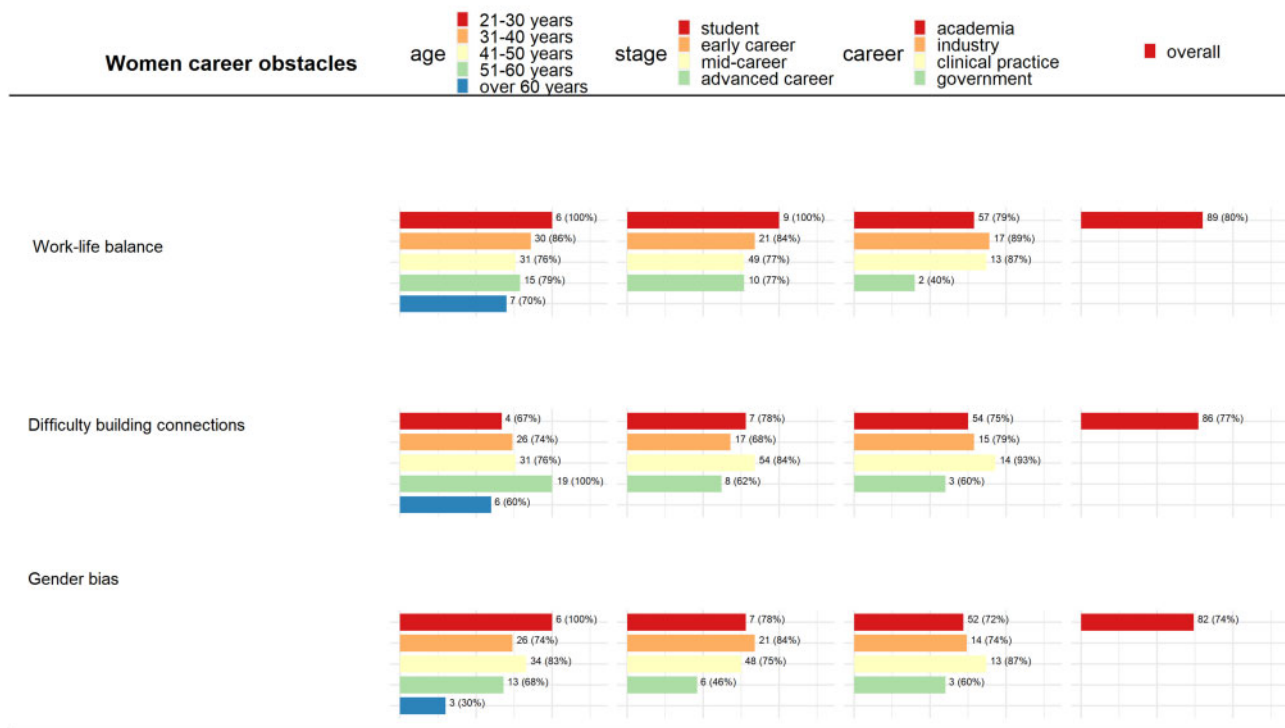


Figure 3. Career obstacles for women in AMIA.

journal club and working group meetings were great examples of networking opportunities.

Unmet needs: raising awareness of gender-specific challenges and biases

Many respondents spoke about the need for awareness of intersectional sexism and racism. A few noted that AMIA members needed to be mindful of bias particularly when selecting leaders, and several other members strongly encouraged speaking up against systemic issues of discrimination. A popular suggestion was to train leaders to speak on and address gender gap issues.

Unmet needs: encouraging gender-proportional representation

To support gender-proportional representation when nominating women in AMIA leadership positions, one respondent suggested that “selection committees for elections could make the decision to have proportional numbers of male and female candidates on the election slate (R5).” A few others agreed that it was necessary to “identify the ideal proportion (of women in AMIA leadership) and then [make] plans to reach this goal (R76).”

Unmet needs: improving “family-friendliness” of AMIA conferences

Another gender-related obstacle to career growth for women in AMIA was lack of family support during work. Childcare on site was highly praised by many respondents, who requested more flexibility in addition to the family support. One respondent also suggested that in addition to caring for children on site, AMIA should “allow those with kids at the conference to choose times for presenting that works with their childcare (R24).”

Due to COVID-19, many women struggled with at-home childcare demands as well, stating that they did not have energy or time

for anything outside of immediate work and family needs. Thus, several respondents requested more flexibility and understanding from their workplaces to accommodate for family stressors. Examples of respondent comments related to unmet needs and obstacles are provided in [Table 4](#).

Suggestions for improvement of WIA efforts

The respondents provided several suggestions for addressing unmet career needs and obstacles to career development: promoting women for awards and leadership positions; training of specific skills; supporting lifecycle, networking, and mentoring; and lastly building a pipeline for early career professionals ([Table 5](#)).

DISCUSSION

Results from WIA Networking, Mentoring, and Lifecycle subcommittee 2020 QI survey study demonstrated that women members have a positive perception of current AMIA efforts: 83% of women respondents perceived that the social events offered by WIA were effective and 80% of women respondents thought panel discussions as effective.

Despite these positive findings, several respondents pinpointed unmet needs and obstacles in meeting their career goals: respondents recognized the need for increasing networking opportunities (96%); raising awareness of gender-specific challenges (95%); and encouraging gender-proportional representation in leadership (92%). Although AMIA has created a pipeline with a variety of programs to support women in biomedical informatics, the lack of work–life balance, gender bias, and difficulties in building connections remain as somewhat significant barriers for women. We continue to witness and experience gaps between women’s needs and efforts to promote gender equity undertaken by professional organizations. Such gaps

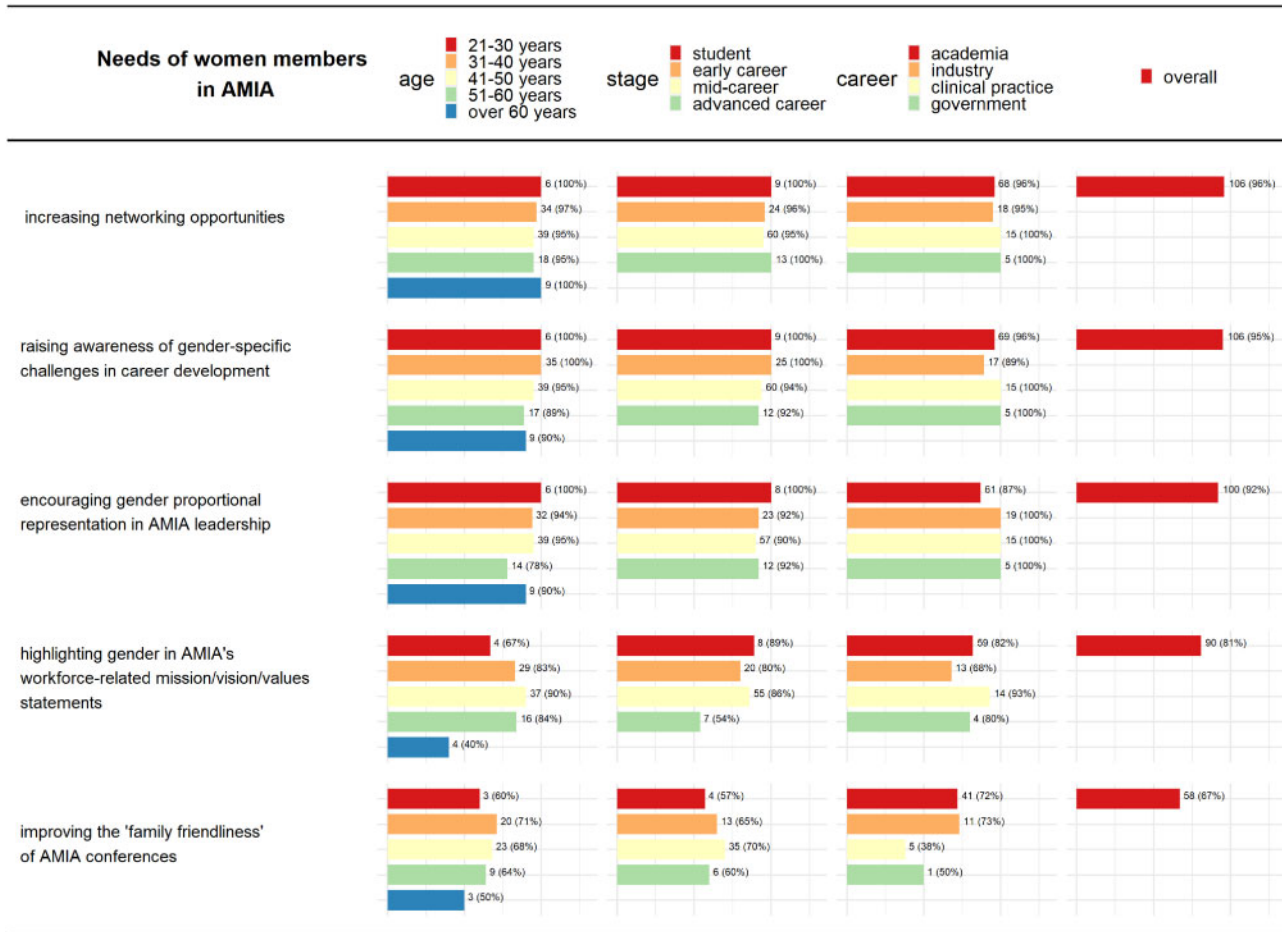


Figure 4. Unmet needs for women in AMIA.

are reflected in inequalities in salaries,¹⁷⁻²¹ underrepresentation of women in multiple areas including scientific publications,^{22,23} academic scientific careers,²⁴ leadership positions,^{6,25,26} leading to limited opportunities for career advancement, promotion and/or tenure in wide-ranging career domains and across different career stages.²⁷

Informed by these findings, we urge AMIA and WIA to focus their efforts on the following 3 areas: (1) mentorship, networking, and connection building, (2) high-quality communication and publicity, (3) promoting women’s leadership and recognition.

Mentorship, networking, and connection building

According to the 2020 survey, social events such as Mentorship Career Development Events and WINE had the highest attendance and effectiveness. In addition to mentorship and networking, some responders called out the need for sponsorship, not just mentorship, which could have been a result of previous WIA efforts. Engaging in networking behavior is considered an important career management strategy.²⁸ However, women’s networks are less powerful than men’s, and women are less able to utilize the networks they have built due to various reasons.²⁸ For women in informatics, it is crucial to discuss how to build and strategically maintain and grow a network in medical informatics. Conferences provide a stimulating venue to enhance professional networks and advance research. However, research reveals that women bear the “baby penalty”²⁹ more than men when it comes to attending conferences. The child-

bearing and childrearing all coincide with the peak of career development with the need to travel for conferences. Along with providing childcare (AMIA annual conference has often provided), AMIA can benefit by making conferences more family friendly. Suggestions include increasing networking opportunities for those seeking collaborations and social connections, providing more opportunities for mentors and mentees to connect and collaborate, choosing a family friendly venue for the conference, social events where families are welcome, and a conference-specific social networking group for parents.²⁹

High-quality communication and publicity

Panel discussions, scientific sessions, and workshops reached over half of the respondents and were considered effective by most. However, over 30% of respondents have never heard or participated in events organized by WIA subcommittees. This is a dilemma faced by many nonprofit organizations, and thus a strategy to consistently incorporate members’ feedback and increase their involvement is compelling to the success of publicity efforts in any professional organization. Suggestions include distributing WIA flyers at all the AMIA working groups, more aggressively promoting the WIA events through social networking channels with event hashtags, and posting inclusive leadership messages by WIA leaders that others will be happy to share.

Table 4. Obstacles, needs, and areas for improvement

Theme	Subtheme	Respondent responses	No. of responses
Unmet needs: increasing networking opportunities for women in AMIA	Networking needs to be more inclusive and personal—one-on-one meeting opportunities and events are necessary	<ul style="list-style-type: none"> • “Restrictive in networking opportunities.”—R9 • “The networking events can feel pretty unwelcoming if you do not already know people. Women at different career stages have different needs, and also different contributions they can make.”—R105 • “Networking across diverse AMIA workgroups beyond primary affiliation [would be helpful]”—R69 • “More networking is needed in this virtual world.”—R94 • “Network events.”—R19 • “Domain focused networking with field leaders with option for one-on-one meetings as well as group.”—R96 	17
	Improving the mentoring experience is necessary to improving the mentee experience	<ul style="list-style-type: none"> • “Mentoring classes [would be useful]—how to be a better mentor or mentee.”—R95 • “Membership database [could provide] more information about career stage, degrees, in a searchable way to find mentors.”—R3 	16
	Building connections and finding grant funding for niche projects are necessary	<ul style="list-style-type: none"> • “Help match up folks with skills and folks with ideas/problems to solve.”—R73 • “[Offer] more skills/ideas for projects for folks with limited local support.”—R75 • “Connecting to industry grant funding.”—R98 	8
	Providing domain-specific training in the field is necessary to fully utilize member skillsets and expertise	<ul style="list-style-type: none"> • “A multidisciplinary informatics certification that covers a wide range of informatics domains [would be helpful]”—R59 • “Opportunities geared towards fully utilizing education, skills, and/or experience. Many have great “niche/specialized” expertise that fail to be fully realized.”—R90 • “[I’d like] opportunities to contribute to future direction of the field (don’t want the “Health Informatics” to be lost from the definition of “Bio-Medical Informatics.”—R64 	6
	Providing more opportunities to showcase expertise from women is necessary	“Create channels to increase awareness of expertise possessed by women in AMIA.”—R55	5
	Encouraging mentorship through awards and recognition would improve the mentor experience and increase motivation	“Perhaps an award for a successful mentor of women and/or minorities in the informatics field?”—R42	2
	AMIA needs to search for sponsorships in informatics-specific areas of leadership	“Sponsorship for national and international leadership roles that would benefit from informaticists [would help in overcoming career obstacles].”—R3	2
Unmet needs: diversifying training opportunities along career	Currently, there are no workshops or sessions to assist with grant-writing and other skills necessary in research	<ul style="list-style-type: none"> • “Sessions focused on effective grant and manuscript development for informatics [would be helpful].”—R5 • “Confidence, strategic thinking, bringing groups together, grant writing.”—R112 	3

(continued)

Table 4. continued

Theme	Subtheme	Respondent responses	No. of responses
	Currently, there are no workshops or sessions to assist with negotiations or promotions	<ul style="list-style-type: none"> • “Development of negotiation skills [would be helpful].”—R12 • “Training on working within complex organizations and negotiating for assets [would be helpful].”—R105 	2
	Recruitment and assistance along different pipelines for informatics careers is necessary	<ul style="list-style-type: none"> • “Pipeline development of physician informatician women and medical students to pursue informatics as a career (lots of focus on PhD pipeline but not enough on M.D. pipeline and very few applicants nationally that are women for CI fellowship subspecialty fellowship programs that are ACGME accredited).”—R107 • “Provide more ways to help with <i>JAMIA</i> and <i>JAMIA Open</i>—why isn’t there more recruitment of reviewers?”—R28 	2
Unmet needs: raising awareness of gender-specific challenges in career development	Identifying and adapting organization policies to raise awareness of gender bias and expectations for professional behavior is necessary to build women-friendly spaces in the field	<ul style="list-style-type: none"> • “Consider adopting organization policy for professional behavior and codes of conduct at AMIA activities, whether virtual, in-person, asynchronous on discussion forums, etc.”—R14 • “As a woman, there are areas of the informatics field that seem to remain male dominated, and it would be great to call this out so we can collectively work to address it. AMIA could lead us in identifying these areas.”—R48 • “Increase awareness of implicit biases.”—R88 	12
	Incorporating bias training into organization policy is necessary	<ul style="list-style-type: none"> • “Gender bias awareness training for both men and women.”—R65 • “Work to address bias starting with education and training.”—R32 	5
Unmet needs: encouraging gender-proportional representation in AMIA leadership	Creating space in leadership for women and minorities is necessary	“Conscious inclusion of women and women of color in leadership roles [is necessary.]”—R27	3
	Creating a training program specifically for women in leadership is necessary	“Create training program sponsored by AMIA.”—R13	2
Unmet needs: highlighting minority needs in AMIA’s workforce-related mission/vision/values statements	Raising awareness of racism and other challenges for minority women is necessary	<ul style="list-style-type: none"> • “Integrating intersectionality into any gender work; as black female scholars Crenshaw and Roberta have said, you can’t look at sexism without also looking at racism too (and vice versa).”—R24 • “Take an intersectional approach that goes beyond gender.”—R82 • “Any gender work needs to take into account intersectionality—looking at gender alone is insufficient.”—R104 	10
Career obstacles: work–life balance	Providing resources to avoid burnout and encourage work–life balance is necessary	<ul style="list-style-type: none"> • “A number of the midcareer female informatics leaders in my organization have needed to go to part time or take a leave of absence as they address childcare and other needs. I do not have children and do not have this work/life balance stressor, but am now 1 person covering 3.5 FTEs, while COVID has introduced a lot of disruption to our work (for better or worse). I’m experiencing burnout.”—R48 • “Encourage a culture that embraces work–life balance.”—R94 	5

(continued)

Table 4. continued

Theme	Subtheme	Respondent responses	No. of responses
Career obstacles: gender bias	Providing credits and flexibility to coursework is necessary to increase participation	<ul style="list-style-type: none"> • “[COVID-19 work–life balance] has been quite the mental-health hit.”—R32 “On-demand minicourses including questions and CME—a couple of credits time.”—R40	2
	Identifying and adapting organization policies to raise awareness of gender bias and expectations for professional behavior is necessary to build women-friendly spaces in the field	<ul style="list-style-type: none"> • “Consider adopting organization policy for professional behavior and codes of conduct at AMIA activities, whether virtual, in-person, asynchronous on discussion forums, etc.”—R14 • “As a woman, there are areas of the informatics field that seem to remain male dominated, and it would be great to call this out so we can collectively work to address it. AMIA could lead us in identifying these areas.”—R48 • “Increase awareness of implicit biases.”—R88 	12
	Incorporating bias training into organization policy is necessary	<ul style="list-style-type: none"> • “Gender bias awareness training for both men and women.”—R65 • “Work to address bias starting with education and training.”—R32 	5
	Recognizing and addressing the wage gap between men and women in informatics is necessary	“Promote equal pay for women in informatics.”—R34	2

Promoting women leadership and recognition

Women in AMIA Awards and Leadership subcommittee reported that similar to other STEM fields, leadership, and recognition in biomedical informatics is lower for women. Our study found that nominating women for leadership positions and recognitions can be an effective strategy to recognize and promote women leaders. These findings can further inform data-driven strategies and mechanisms to foster diversity and inclusion.⁷ The possibilities for various professional development mechanisms include continuing the WIA Leadership Program, skill-based workshops to train women across a variety of topics (eg, grant and manuscript writing, regular webinars on professional soft skills).

Our study comes with limitations. First, as the survey was not sent to members in the form of an email, we cannot track the specific number of members it reached. For future surveys, we may consider applying a proactive approach to reach out to more members by sending multiple email reminders to increase the response rate of the survey. Second, due to the nature of the survey, self-selection bias may limit the generalizability of the findings to the larger WIA members. Highly motivated individuals with strong opinions about the topic were probably more likely to respond, which could lead to a somewhat elevated estimate of the prevalence of some of these viewpoints. Additionally, due to the survey timing during the beginning of the COVID pandemic, those who were particularly stressed or burdened by COVID including family demands from COVID may not have had an opportunity, or awareness, to respond. Third, this was a quality improvement effort and hence our results are not generalizable to other similar professional biomedical organizations. Fourth, this quality improvement study was not hypothesis driven and due to our limited sample size, our results are based on a descriptive summary. As part of future work, we plan to test associations between respondent characteristics and

perceptions of gender issues. If such associations are confirmed, differential actions might be needed to address these differences. Fifth, the survey was neither validated nor tested for reliability prior to administration. However, the survey was developed and tested by the WIA Networking, Mentoring, and Lifecycle subcommittee members. Sixth, only about 5% of 2084 AMIA members self-identifying as women have responded, which has resulted in a small sample size, especially for 21- to 30-year-old respondents ($n=6$) and respondents working in government and regulatory organizations ($n=5$). Seventh, the survey did not collect data on how the respondents gather information about WIA events. Given especially younger members' lack of awareness about events, future surveys might include a question about how members gather such information (eg, Twitter, emails, AMIA connect). Finally, this analysis only focuses on respondents who self-identified as women. Future studies are necessary to investigate perceptions on gender-related issues of individuals identifying as males and other genders.

Despite these limitations, insights gained from this study are valuable for informing current WIA efforts and actions.

CONCLUSION

Our survey findings revealed that existing career development efforts for women are highly effective, and yet there are important gender-specific career development issues that need attention. Professional organizations must rise to the challenge to further improve and promote a culture of diversity and inclusivity by providing soft skills training, building networking and connections, improving communication between organizations and members, and across groups within professional organizations.

Table 5. Suggestions for improvement of WIA efforts

What could AMIA do to help improve professional quality or skills to succeed in informatics?		
Themes	Subthemes	No. of responses
Promoting women for awards and leadership	Train women who aspire to take leadership positions	11
	Raise awareness of intersectional sexism and racism, be mindful of bias when selecting leaders, and act against systemic issues of discrimination	8
Training to advance career	Make room for women across leadership roles	7
	Provide sponsorships to those seeking support from current leaders	4
	Offer skill-based workshops to train women across a variety of topics (eg, grant and manuscript writing)	18
	Provide opportunities for projects and collaboration with others in the field	8
	Support careers across a variety of areas (eg, nontraditional teaching, nonprofit organizations, policy, etc.)	6
	Better management of communication channels between members to discourage hierarchy and encourage connections	5
	Make training and memberships more affordable and accessible	4
	Keep members up to date with the field of informatics	3
	Diversify training and courses on informatics topics (eg, include more applied informatics)	2
	Provide training for job negotiation	2
Supporting networking, mentoring and lifecycle	Provide access to research resources	2
	Increase networking opportunities for those seeking collaborations and social connections	24
	Provide more opportunities for mentors and mentees to seek each other out	16
	Provide childcare and family support to allow flexibility for women with challenging work–life balances	2
	Develop a series of mini-courses that are flexibly scheduled for women with challenging work–life balances	2
Building pipeline for early career professionals	Provide career guidance for those in the early stages of career development	9
	Provide course credits across programs	2
	Make a stronger effort to recruit members	2
What could AMIA do to help members overcome obstacles?		
Subtheme	Respondent responses	No. of responses
Promoting women for awards and leadership	Raise awareness of intersectional sexism and racism, be mindful of bias when selecting leaders, and act against systemic issues of discrimination	12
	Provide equal opportunities for all minorities (not just women)	10
	Provide opportunities and support for women to showcase their expertise (eg, across panels)	5
	Train leaders to address gender gap issues	5
	Make room for women across leadership roles	3
	Train women who aspire to take leadership positions	2
Training to advance career	Provide sponsorships to those seeking support from current leaders	2
	Provide more opportunities for community interaction and collaboration (including those outside of AMIA)	8
	Offer skill-based workshops to train women across a variety of topics (eg, grant and manuscript writing)	3
	Encourage diversity in panels and workshops (including gender)	2
	Promote equal pay for women	2
Supporting networking, mentoring, and lifecycle	Increase networking opportunities for those seeking collaboration and social connections	17
	Provide more opportunities for mentors and mentees to seek each other out	5
	Promote a work–life and health balance	5
	Provide childcare and family support to allow flexibility for women with challenging work–life balances	2
	Reward successful mentors to motivate them and encourage successful mentoring	2

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AUTHOR CONTRIBUTIONS

DHW and DT led the conception and design of the study. IB, MS, DP, PD, and JA were involved in the design and testing of the survey instrument. DHW and DT performed the data collection; DHW, PVK, and JA conducted the data coding and analysis, and drafted the manuscript. All authors were involved in the critical review of its content and editing the manuscript. All authors have provided their final approval of the version to be submitted.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *Journal of the American Medical Informatics Association* online.

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CONFLICT OF INTEREST STATEMENT

Authors report no conflicts of interest related to this publication.

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author.

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