



Original Article

National Trends of Gender Disparity in Canadian Cardiovascular Society Guideline Authors, 2001-2020

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ABSTRACT

Background: The level of representation of women in cardiology remains low compared to that of men, particularly in leadership positions. We evaluated gender disparity in the authorship of Canadian Cardiovascular Society (CCS) guidelines.

Methods: All CCS guidelines from 2001-2020 were identified. Gender was assessed based on pronoun use in the biographies and social media of the authors. Only primary panel authors were included in our analysis. Stratified analyses were performed based on subspecialties.

Results: A total of 76 guidelines were identified, with 1172 authors (26% women, 74% men, $P < 0.0001$), with no significant change in percentage of women authors over 2 decades, (37.1% in 2001, 36.3% in 2020, $P = 0.34$). Inclusion of women as authors occurred less frequently than inclusion of men in general cardiology guidelines (20.1% vs 79.9%, $P < 0.0001$) and all subspecialties—heart failure (36.4% vs 63.6%, $P < 0.0001$), interventional cardiology (12.6% vs 87.4%, $P < 0.0001$), electrophysiology (20.2% vs 79.8%, $P <$

RÉSUMÉ

Introduction : La représentation des femmes en cardiologie demeure faible par rapport à celle des hommes, particulièrement dans les positions de leadership. Nous avons évalué la disparité entre les sexes de la paternité des lignes directrices de la Société canadienne de cardiologie (SCC).

Méthodes : Nous avons relevé toutes les lignes directrices de la SCC de 2001 à 2020. Nous avons déterminé le sexe en fonction de l'utilisation du pronom dans les biographies et les médias sociaux des auteurs. Seuls les auteurs du panel principal ont été ajoutés à notre analyse. Nous avons réalisé les analyses stratifiées en fonction des sous-spécialités.

Résultats : Nous avons relevé un total de 76 lignes directrices, qui regroupaient 1 172 auteurs (26 % de femmes, 74 % d'hommes, $P < 0,0001$). Par conséquent, il n'y avait eu aucun changement significatif dans le pourcentage des autrices au cours de deux décennies (37,1 % en 2001, 36,3 % en 2020, $P = 0,34$). L'intégration d'autrices

Women remain a minority of practicing cardiologists in Canada, even though more than 50% of medical student graduates from Canadian medical schools have been women since 1995.¹ The proportion of women internal medicine residents has diminished slightly over the past decade and has been persistently below 50% (46.1% in 2009 to 43.9% in 2019).^{2,3}

Nevertheless, there has been an increase in women in cardiology (WIC) in Canada in recent years, from 12.9% in 2001 to 22.2% in 2019.^{4,5} Despite this increase, there remains a disparity between the number of women vs men in research leadership roles within cardiology, which is not unique to Canada but rather is seen throughout the global cardiology community.⁶⁻⁸

The Canadian Cardiovascular Society (CCS) has begun to take action to bridge this gap and promote the inclusion of WIC and the appointment of women to leadership positions.⁹ A recent environmental scan study of the Canadian cardiovascular landscape reported persistent gender disparities and underrepresentation of women in the Canadian Cardiovascular Congress (CCC) scientific program committee, CCS

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Ethics Statement: Our research adhered to the ethical guidelines and did not include any personal health information.

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0.0001), and pediatric cardiology (41.7% vs 58.3%, $P = 0.02$). It was less likely for women to be a chair or cochair of a guideline writing committee, compared with men (20.1% vs 79.8%, $P < 0.0001$). There were 609 unique authors (25.6% women, 74.4% men, $P < 0.0001$), 542 unique medical doctorate (MD) authors (20.7% women, 79.3% men, $P < 0.0001$), and 67 unique non-MD authors (65.7% women, 34.3% men, $P = 0.0003$).

Conclusions: There is a persistent shortfall in the inclusion of women authors for CCS guidelines, which has not changed over time. Further efforts are required to promote women's inclusion in leadership roles, which may lead to authorship of the guidelines.

major symposia, and the Canadian Institute of Health Research (CIHR) grant committee.¹⁰ The study also reported a persistent gender disparity and a lower level of inclusion of women in CCS guideline authorship.¹⁰ We assessed the inclusion of women in CCS guideline writing committees as a metric to assess the impact of the overall CCS efforts to include more women. We analyzed the gender difference in the CCS guideline authorship across 2 decades (2001-2020) and examined this difference in relation to gender representation in general cardiology and its subspecialties. We hypothesize that despite current efforts, an underrepresentation of WIC among CCS guideline authors likely exists.

Methods

We extracted all the CCS guidelines for the period 2001-2020 documented on the CCS website (<https://www.ccs.ca/en/guidelines/guidelines-library>). The website provides an archive of all consensus conferences, position statements, commentaries, clinical practice updates, Canadian perspective pieces, training, maintenance of certification, clinical practice updates, and guidelines from the past 20 years. We excluded all commentaries, Canadian perspective pieces, training, and maintenance of certification for our study. Typically, each CCS guideline is produced with contributions from primary panel members who comprise the writing committee.¹¹ The primary panel comprises a chair or multiple cochairs, along with primary panel members and external reviewers and coauthors. The primary panel is the leading writing committee selected from a geographically diverse representation of CCS members.¹¹ There are also secondary panel members who provide feedback and guidance on drafts and provide a wider perspective on the topic.¹¹ We also extracted the percentage of WIC from the Canadian Medical Association website, for the period 2001-2019, and evaluated the change in trend over time.^{4,5}

For the purposes of this analysis, we included the primary panel members of the guidelines and/or authors of consensus conferences, position statements, and clinical practice updates. The names of the chair, cochair, and primary panel members or authors were extracted into an Excel file.

est en général apparue moins fréquemment que l'intégration d'auteurs dans les lignes directrices de cardiologie (20,1 % vs 79,9 %, $P < 0,0001$) et de toutes les sous-spécialités (insuffisance cardiaque [36,4 % vs 63,6 %, $P < 0,0001$], cardiologie interventionnelle [12,6 % vs 87,4 %, $P < 0,0001$], électrophysiologie [20,2 % vs 79,8 %, $P < 0,0001$] et cardiologie pédiatrique [41,7 % vs 58,3 %, $P = 0,02$]). Il était moins probable que les femmes président ou co-président le comité de rédaction des lignes directrices que les hommes (20,1 % vs 79,8 %, $P < 0,0001$). Il y avait 609 auteurs individuels (25,6 % de femmes, 74,4 % d'hommes, $P < 0,0001$), 542 auteurs médecins (M.D.) individuels (20,7 % de femmes, 79,3 % d'hommes, $P < 0,0001$) et 67 auteurs non médecins individuels (65,7 % de femmes, 34,3 % d'hommes, $P = 0,0003$).

Conclusions : Des lacunes dans l'intégration des autrices aux lignes directrices de la SCC persistent et demeurent inchangées depuis des années. D'autres efforts sont nécessaires pour encourager l'intégration des femmes dans des rôles de leadership, qui pourront mener à la paternité des lignes directrices.

Although the terms sex and gender are frequently used interchangeably, sex refers to biological constructs, including hormones, genes, anatomy, and physiology, whereas gender is a socially constructed and culturally specific amalgamation of dimensions, including gender roles, identity, relationships, and institutionalized gender. Given the data constraints, the gender of the authors was determined independently by 2 authors (M. Guerriero—a woman—and S.H. Waheed—a man) by assessing the pronouns used in biography pages, publications, and/or Twitter as referring to a man or woman. All primary panel members who were authors of guidelines, including the chair or cochairs, were included in this analysis. The chair and cochairs were considered equivalent for our analysis. The number of unique authors was counted, and the frequencies of repetition of men and women authors were extracted. The identification of unique authors according to whether or not they held a medical doctorate (MD) was examined. All authors who were foreign medical school graduates (MBCh, MBBS degrees) were considered equivalent to MD authors.

The extracted guidelines were divided into general cardiology, interventional cardiology, electrophysiology, heart failure, and pediatric cardiology. The detailed categorization of the guidelines is provided in the [Supplemental Appendix S1](#). The categorization of the guidelines was done per the guidance of both senior authors (E.D. Michos and M. Gulati). Descriptive analysis included percentages. Data were stratified by subspecialty (general cardiology vs all subspecialties pooled) and years, grouped into 5-year buckets (2001-2005, 2006-2010, 2011-2015, and 2016-2020). A χ^2 test was used to compare nominal variables (gender and subspecialties). A linear-by-linear association test was used for trend analysis to examine the linear association of gender over time. The alpha used for all tests was 0.05. All tests were performed using IBM SPSS version 25.0 and Microsoft Excel 2016.

Results

We identified 76 CCS guidelines published in the period from 2001-2020, including 33 position statements, 27 guidelines, 15 consensus conferences, and one clinical practice



Figure 1. Trends of inclusion of women among authors of the Canadian Cardiovascular Society guidelines (red) and trends of women in cardiology in Canada from 2001-2020. WIC, women in cardiology.

update. A copy of the extracted data for the guidelines with the gender of the authors is provided in [Supplemental Table S1](#). A total of 1172 authors were extracted from these guidelines; 26% were women, vs 74% who were men, $P < 0.0001$. Overall, women's level of inclusion has remained similar over time—37.1% in 2001 and 36.3% in 2020 ($P = 0.34$), with a maximum of 37.1% in 2001 and a minimum of 9.8% in 2003 ([Fig. 1](#)). There were no guidelines released in 2015. There was a notable increase in WIC from 12.9% in 2001 to 22.2% in 2019. The percentage of women's inclusion in guideline authorship remains higher than the percentage of WIC for each year ([Fig. 1](#)).

A pooled subgroup analysis of the authors based on specialty- or subspecialty-specific guidelines demonstrated a low level of inclusion of women authors in CCS guidelines by category: general cardiology (20.4% women, 79.6% men, $P < 0.0001$), heart failure (36.4% women, 63.6% men, $P < 0.0001$), interventional cardiology (11.7% women, 88.3% men, $P < 0.0001$), and electrophysiology (20.2% women, 79.8% men, $P < 0.0001$) and pediatric cardiology guidelines (41.7% women, 58.3% men, $P = 0.021$; [Fig. 2](#)).

A secondary analysis was performed comparing the percentage of women among authors for nonspecialty or general cardiology vs pooled subspecialties (electrophysiology, heart failure, interventional cardiology, and pediatric cardiology) over 20 years (5-year data grouped), as shown in [Figure 3](#). The inclusion of women as authors in the general cardiology

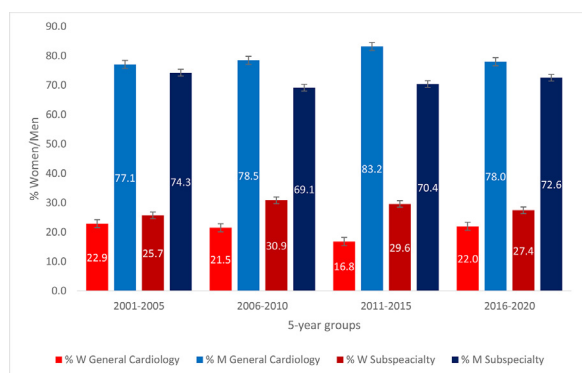


Figure 2. Involvement of women vs men in authorship of the Canadian Cardiovascular Society guidelines under general cardiology and subspecialties in 5-year groups. M, men; W, women.

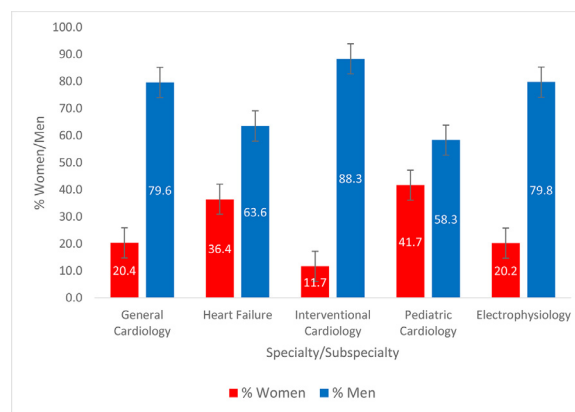


Figure 3. Involvement of women vs men in authorship of the Canadian Cardiovascular Society guidelines under general cardiology and subspecialties.

guidelines did not increase over the course of 2 decades (22.9% in 2001-2005, 21.5% in 2006-2010, 16.8% in 2011-2015, 22.0% in 2016-2020, $P = 0.39$). Although the level of inclusion of women in subspecialty guidelines was higher than that seen in general cardiology, the trend did not significantly increase over the course of 2 decades (25.7% in 2001-2005, 30.9% in 2006-2010, 29.6% in 2011-2015, 27.4% in 2016-2020, $P = 0.31$). There were 9 CCS guidelines for which women represented 50% or more of the authors (6 from heart failure, 2 from pediatric cardiology, and 1 from general cardiology).¹²⁻²⁰ Remarkably, there were 7 guidelines for which no women were included as authors on the committees ([Supplemental Table S2](#)).²¹⁻²⁷

We extracted 609 (25.6% women, 74.4% men, $P < 0.0001$) unique authors after accounting for repeat authorship, including both MD and non-MD authors ([Supplemental Table S3](#)). After substratification, there were 542 unique MD authors (20.7% women, 79.3% men, $P < 0.0001$) and 67 unique non-MD authors (65.7% women, 34.3% men, $P = 0.0003$). Interestingly, 1 specific female MD author and 3 specific male MD authors were included for 14 guidelines ([Table 1](#)). Men MD authors and women non-MD authors were more likely to be on more than 1 CCS guideline committees ([Supplemental Table S4](#)). The percentage of women serving as the chair or cochair of the CCS guideline committee was significantly less than that of men (20.1% women, 79.8% men, $P < 0.0001$). Women were appointed as the chair or cochair for only 15 guidelines ([Table 2](#)).^{15-17,19,20,28-36} Women were appointed to cochair with a man on 12 guideline committees.^{15-17,19,20,28-32,36} Finally, women served as solo chairs or with another woman as cochair on only 3 guideline committees.³³⁻³⁵

Discussion

Our analysis of 76 CCS guidelines from the period 2001-2020 reveals a significant gender disparity in inclusion of women vs men as authors for all guidelines. There has been no significant change in the percentage of women who are authors of CCS guidelines over the past 2 decades. Although, on the surface, the percentage of women authors of CCS guidelines seems to exceed the proportion of women cardiologists, the percentage of unique MD women authors was found

Table 1. Frequency of authorship of Canadian Cardiovascular Society guidelines 2010-2020, as distributed among medical doctorate (MD) and non-MD authors

Frequency of authorship on guidelines	Unique MD-women authors(n = 112)	Unique MD-men authors (n = 430)	Unique non-MD women authors (n = 44)	Unique non-MD men authors (n = 23)
1	75	271	28	18
2	14	80	8	2
3	11	27	4	—
4	2	14	2	2
5	1	13	—	1
6	2	10	2	—
7	1	6	—	—
8	1	2	—	—
9	3	2	—	—
11	1	2	—	—
14	1	3	—	—

to be 20.7%. Additionally, the level of inclusion of non-MD women among authors is higher than that of men who are non-MDs. Women authors were also less commonly included on multiple CCS guidelines, compared to men authors. The percentage of appointment of women as chair or cochair of the guideline committees is significantly lower than that seen for men, with few women ever appointed as a solo chair of any CCS guideline committee. Despite a visible trend toward increased inclusion of women on guideline committees, a significant gender disparity persists.

The results of our study are in concordance with those of a prior study showing a similar level of inclusion of women among authors of CCS guidelines.¹⁰ However, we further analyzed the authorship patterns by specialties vs subspecialties, gender of the chair, percentage of women on individual guidelines, and unique authorship by MD and non-MD authors, which builds upon this prior report of simple overall percentages of women among authors of CCS guidelines. The low rates of women as authors of CCS guidelines may be explained partly by reduced representation of WIC overall. Compared to men, the number of women decreases progressively as students move from medical school to internal medicine residency to cardiology residency and advanced fellowship, resulting in an even smaller number of WIC, with

an even smaller proportion of women in leadership roles in cardiology overall.⁷ The lack of flexible training, flexible work hours, research prospects, mentorship, and sponsorship have been proposed as possible reasons for the underrepresentation of WIC.⁷ The phenomenon referred as the “leaky pipeline” identifies a progressive reduction of involvement of WIC, from student to academia as a professor and research chair. The gender disparity in authorship of the CCS guidelines is present in general cardiology and all its subspecialties; these disparities closely mirror the underrepresentation of women in clinical cardiology subspecialties.² The underrepresentation of women in the authorship of CCS guidelines is representative of the end of the “leaky pipeline.” A survey of the Canadian R4 fellowship match of internal medicine residents reported exposure to rotation and role models as essential in selecting fellowship choice.³⁷

Although our results are representative of the end of the “leaky pipeline,” a concerted effort is required to motivate women to pursue cardiology from the nascent stage of medical school to the advanced training position. This goal can be achieved by improving women’s visibility in leadership positions and as other role models, fostering mentor–mentee relationships.³⁸ The CCS has focused on increasing the representation of WIC and launched a new Women in Cardiovascular Medicine/Science Mentorship Award in 2020 to close disparities between men and women in the receipt of awards and promote mentorship and sponsorship of future WIC.^{37,39} The American College of Cardiology (ACC) launched a WIC section in 2002 to strengthen professional development and networking for women.⁴⁰ A similar effort has been launched by the European Society of Cardiology (ESC) as “Women in ESC.”⁴¹ Similar active efforts by the CCS will help bridge the gender gap and increase parity.

Substratification of MD and non-MD authors overall showed that the percentage of MD authors of CCS guidelines is similar to the percentage of women cardiologists per the Canadian Medical Association.^{4,5} A higher percentage of non-MD women authors contributes to the increased level of inclusion of women over time, rather than a higher percentage of women cardiologists over the same time period. The non-MD guideline authors are inclusive of nurses, pharmacists, and nurse practitioners, and professionals in these roles are predominantly women. There is a higher level of inclusion of women in pediatric cardiology as authors than that in other subspecialties, likely due to a higher number of women in pediatrics. Nevertheless, gender disparity exists in pediatric

Table 2. Number of Canadian Cardiovascular Society Guideline Committee chairs and cochairs, by year and gender

Year	Total number in committee chair positions	Number of women in committee chair positions
2001	4	2
2002	1	0
2003	4	0
2004	5	1
2005	—	—
2006	2	0
2007	2	0
2008	4	1
2009	2	0
2010	4	1
2011	5	2
2012	8	1
2013	5	0
2014	6	0
2016	16	2
2017	2	1
2018	7	0
2019	7	2
2020	13	4

cardiology guideline authorship, reflecting the underlying underrepresentation of WIC in leadership positions. The percentage of women in pediatric cardiology has increased from 42.9% in 2001 to 62.2% in 2019.^{4,5} Women have made up more than 50.0% of professionals in pediatrics since 2010.^{4,5} The percentage of women in internal medicine has increased from 22.2% in 2001 to 39.1% in 2019, with a proportionate increase in WIC.^{2,3} However, there is still a gender disparity in internal medicine and cardiology.

Our group recently reported that the ACC/American Heart Association (AHA) have had a significant increase in women participating in guideline writing committees, from 3.6% in 2005 to 27.3% in 2019. There was no gender gap in the ACC/AHA heart failure and pediatric cardiology guidelines, in contrast to the persistent gap seen in general cardiology, electrophysiology, and interventional cardiology.⁴² There has been no significant trend in the inclusion of women among authors of CCS guidelines, but in contrast with the ACC/AHA guideline committees, those of the CCS have been more inclusive of women from the outset and have a stronger representation of women. The ACC has created a countrywide WIC section to encourage networking and leadership among women and advocate for parity and equity for WIC.⁴³ The ACC also provides mentoring to women in high school, college, and medical school to encourage interest in cardiology from early career stages. Similar efforts can help in encouraging WIC and thereby promoting leadership in the CCS. A system-wide quality initiative at Duke Cardiovascular Research Institute to promote representation of women and underrepresented racial and ethnic groups among those receiving cardiology fellowships resulted in improvement from a mean of 23.2% to 54.2% for women and 9.7% to 33.3% for underrepresented racial and ethnic groups within 3 years.⁴⁴ A similar quality initiative from other institutions also can help close the leaky pipeline, leading to more women cardiology trainees, which can ultimately lead to increased leadership and authorship among women, and increased numbers of WIC.

The guidelines are written by content experts of specific cardiovascular topics, usually chosen from among those in the mid-career to senior faculty member stages. The authors are chosen to be part of a panel; typically, panel membership is for 2 years, which may explain the inclusion of authors on more than one guideline.¹¹ As women in cardiovascular medicine progress academically, they disproportionately lack opportunity, recognition, and promotion pathways. Also, as WIC progress further in their careers, the number of women colleagues decreases. The situation results in less support in the workplace, perpetuating a vicious cycle.⁴⁵ Burns et al.⁴⁶ assessed grant and personal award applications that were authored by women and submitted to the Canadian Institute of Health Research. The organization reported that fewer women submitted grant proposals (31.1%) and personal award (44.7%) applications, with women being 14% less likely to be funded when their research focused on circulatory and respiratory health.⁴⁴ More importantly, Witteman et al. investigated 23,918 Canadian Institute of Health Research grant applications and reported a significant gender gap in grant funding, attributable to a less favorable assessment of women as principal investigators, and not to the quality of the research proposal.⁴⁷ Encouraging women during the early

career stage through peer mentoring may increase participation in research, grant writing/review, and authoring publications, thereby validating content expertise and increasing opportunities for leadership. Women who are established investigators as demonstrated by successful tri-council funding and publications, are often recognized as being “senior” enough to be invited to participate in or lead guideline writing committees. Such experience may also serve to improve gender representation on grant review committees and reduce potential biases in the grant review process.⁴⁷

Guidelines are critical for evidence-based delivery of patient care, and guideline authors ideally should reflect the patient populations they serve. A prior study assessed the leadership committees of 2433 clinical trials published in the *New England Journal of Medicine*, the *Journal of the American Medical Association*, and the *Lancet* and reported that only 11% were women.⁴⁸ A cross-sectional study of the Canadian cardiology conferences (2017-2018) reported that only 26% of speakers were women, and 37% of panels were all men, in contrast with only 3% of panels being all women.⁴⁹ Only 14% of the trainee editorial board and 9% of the associate editors for the *Canadian Journal of Cardiology* are women.⁷ Promoting gender equality on trial steering committees, and among editorial authors and conference speakers/panels may help curb this gender gap. A conscious effort to help women physicians network and achieve gender equality in the medical community is the goal of Canadian Women in Medicine and the Federation of Medical Women of Canada.^{50,51}

Overall, there has been no significant increase in inclusion of women among authors of guidelines (including guidelines, position statements, and consensus conferences) over the past 20 years. Additionally, there is a persistent gender disparity in the appointment of women as chairs and cochairs. The CIHR reports that women and men have similar success rates in obtaining mainstream doctoral and fellowship training in Canada, but men are more successful than women in obtaining more prestigious awards and funding.⁷ Unconscious (implicit) bias and institutional structural inequities that favor men can perpetuate these gender differences in compensation, funding, promotion, and leadership positions.^{52,53} A similar bias could be the reason for the lack of appointment of women to the chair position. Another possible reason could be an unconscious bias that “men are more effective leaders than women.”⁸ A conscious attempt to encourage women to pursue cardiology, encourage and support academic promotions, advancement, and leadership, and the increase of the appointment of WIC on CCS guideline committees and to other national leadership positions may help curb the gender gap within cardiology. Objective criteria for inclusion on guideline committees also may help bridge the gender gap and better serve the population they serve. Although the number of WIC trainees is increasing, the gender gap in cardiology leadership positions remains. The CCS has applied its “3G principle” in efforts focusing on increasing geography (range), gender representation, and generations (inclusion) in both clinical trials committees and authorship. A concerted effort to ensure increased representation of women on guideline committees/conference panels/grant review panels may be the most expeditious approach toward inspiring more students and residents to pursue a career in cardiology, thereby increasing the WIC membership.

Our study's strengths include its novelty in assessing trends in women's inclusion, specialty vs subspecialty 5-year trends, and unique authorship in the national guideline leadership over 2 decades, showing how gender disparity has persisted over time. The inclusion of general cardiology and subspecialty guidelines provides a broader perspective. However, our study contains certain limitations. We focused only on CCS guidelines, which does not give us a global perspective. Second, the gender of the authors was determined by review of their university biography and social media; there is room for error in identifying gender, as authors were not approached directly. Additionally, gender is not binary, but for this study, we were limited to a binary determination.

Conclusion

There is a clear gender gap in the authorship of CCS guidelines, with women being underrepresented on all cardiology subspecialty guideline committees. This gender disparity is even more pervasive in chair and cochair positions. Further efforts are required to promote women's inclusion in leadership roles, which may lead to authorship of the guidelines.

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Disclosures

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Supplementary Material

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