Women in surgery: a systematic review of 25 years

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ABSTRACT
The number of women entering medicine significantly increased over the last decades. Currently, over half of the medical students are women but less than half are applying to surgery and even less go on to surgical specialties. Even fewer women are seen in leadership roles throughout the profession of surgery and surgical residency. Our purpose of the literature review is to identify any themes, which would provide insight to the current phenomenon. We used the Preferred Reporting Items for Systemic Reviews and Meta-Analyses method for a systematic review of the literature over a 20-year period (1998–2018). Five broad themes were identified: education and recruitment, career development, impact of/on life around the globe and surgical subspecialties as areas of barriers for women entering or considering surgery. The systematic review suggests there are opportunities to improve and encourage women entering the profession of surgery as well as the quality of life for surgeons. Creating systems for mentorship across programmes, having policies to support work–life balance and recognising surgical training overlaps with childbearing years are key opportunities for improvement. Improving the current status in surgery will require direction from leadership.

INTRODUCTION
The number of women in the workforce increased over the last century from 10% to over 50%, contributing significantly to the economy.1 Consistently, and steadily women enter and succeed at professions historically deemed for men.1 2 Despite the inherent barriers and biases women face, women excel in their chosen professions.1 3 4 Medicine has experienced tremendous growth in the number of women entering and excelling in the profession. In the USA, more than half of all medical residents are women.2 However, in sharp contrast is the number of women surgical residents.2 Less than half of all the residents in surgical residency and surgical specialties are women.4 5 6 It is unclear why general and specialty surgery do not see an increase in women.7 While the number of women in medicine significantly increased over the last decades, currently, over half of the medical students are women but less than half are applying to surgery and even less go on to surgical specialties. Even fewer women are seen in leadership roles throughout the profession of surgery and surgical residency. Our purpose of the literature review is to identify any themes, which would provide insight to the current phenomenon. We used the Preferred Reporting Items for Systemic Reviews and Meta-Analyses method for a systematic review of the literature over a 20-year period (1998–2018). Five broad themes were identified: education and recruitment, career development, impact of/on life around the globe and surgical subspecialties as areas of barriers for women entering or considering surgery. The systematic review suggests there are opportunities to improve and encourage women entering the profession of surgery as well as the quality of life for surgeons. Creating systems for mentorship across programmes, having policies to support work–life balance and recognising surgical training overlaps with childbearing years are key opportunities for improvement. Improving the current status in surgery will require direction from leadership.

RESULTS
After examining these articles, we identified five broad themes: education and recruitment, career development, impact of/on life around the globe and surgical subspecialties.

Education and recruitment
The rate of women entering surgical residency lags behind the number of women in medical school.10 Medical and surgical scholars identify the discrepancy between the number of women in medicine and the number of women in surgery as a threat to quality of care.10 11 With over half of the applicants to medical school being women but less than half applying to surgery; bright candidates are missed.11 A key challenge and opportunity is the poor exposure to surgery in undergrad or medical school. Women are not choosing surgery because they are unsure of how they fit in the profession and how professional practice will fit in their life goals.12 Further compounding

METHODOLOGY
This study systematically reviewed qualitative and quantitative studies relating to women in surgery. We conducted a systematic literature search using different electronic databases including Medline, PubMed, ScienceDirect, Wiley Online Library, Google Scholar and Cumulated Index to Nursing and Allied Health Literature (CINHAL). These databases were searched using various combinations of the key terms which included Boolean phrases (and, or) “Women surgeons”, “Work-life balance and female surgeons”, “Career development for women surgeons, education and women surgeons, recruitment and women surgeons, women and surgical specialty.”

We used the Preferred Reporting Items for Systemic Reviews and Meta-Analyses (PRISMA).9 The initial search using the terms female or women in surgery resulted in 244 094 citations over 25 years (1993–2018). We then further refined the search using the Boolean phrases (and, or) identified and limiting to humans and English resulting in 100 046 articles.

We reviewed the first 100 articles in full after screening for titles with and without abstracts and removing duplicate titles. From the review of the first 100 articles, studies which met the following six criteria: (1) journals published in English in the last 20 years; (2) women in surgery; (3) women in surgical specialties; (4) women’s experience in surgery; (5) women’s professional growth in surgery and (6) women’s experience in surgery around the globe was included in the systematic review. Exclusion criteria included: (1) editorials; (2) opinion pieces; (3) studies not focused on women in surgery; (4) studies not published in English; (5) studies published before 1995; (6) case reports; (7) personal experiences and (8) articles regarding women having surgery. Based on the above criteria 48 articles were included for review (figure 1).


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the problem is the minimal representation by women surgeons or visibility of women surgeons. To facilitate women's decision to consider a surgical residency, structured surgical experiences during undergrad with 50% women surgeon faculty have a positive impact. Undergrads and medical students identified favourably with a career in surgery if they have a positive experience through exposure to women surgeon faculty and mentorship. Overwhelmingly, the literature points to positive mentorship experience facilitated by women surgeons as a vessel to overcome the low number of women applicant rates to surgery and gearing learning objectives to domains appreciated by women surgeons. Although surgical residents identified knowledge-based and skill-based learning goals in their final years of residency, the women surgical residents leaned towards attitudinal learning goals and knowledge base (table 1).

**Career development**

Women surgeons have increased in number and encouraged women colleagues to overcome barriers such as stereotyping. The harsh stereotyping of women surgeons has historically pigeon holed their career and imposed a glass ceiling. Talented surgeons felt held back and treated unfairly based on their sex. And this feeling among women surgeons is justified by the low number of women in tenured faculty, full professorship and programme directors positions across the country. The literature points to positive mentorship experience facilitated by women surgeons as a vessel to overcome the low number of women applicant rates to surgery and gearing learning objectives to domains appreciated by women surgeons. Although surgical residents identified knowledge-based and skill-based learning goals in their final years of residency, the women surgical residents leaned towards attitudinal learning goals and knowledge base (table 1).

Despite the increasing number of women in medicine and surgery, there are low numbers of women in senior faculty and clinical roles across all of medicine. The theme of women surgeons not equally represented in higher-ranking positions is consistent in the articles over the last three decades. Lack of mentorship, feelings of exclusion, demands of childrearing, poor accommodations during childbearing years and tenure all contribute to the barriers.

Some of the strategies emphasise women surgeons mentor young women surgeons new to the profession and as early as residency or medical school. Mentoring identifies with creating a positive environment, demystifying surgical practice and chisels away at the boy’s club mentality. Men surgeons are equally encouraged to mentor women surgeons and contribute to a thriving, collegial environment.

The overlap of surgical training and childbearing years is not a barrier to career development but one that requires accommodation. Women scholars suggest extending the time to reach tenure or stopping the clock during maternity leave as suggestions to foster women surgeons seeking full professorship. Some suggest affirmative action to help shift the balance between men and women surgeon in academia. Scholars suggest supporting women surgeons’ success in career development requires a commitment from organisations, professional societies and academia (table 2).

**Impact of/on life**

Increasingly authors are identifying the barriers felt by women surgeon practising in a model that assumes there is a full-time wife at home. A change in the model to accommodate the working mom, working-wife surgeon may open opportunities and improve career satisfaction. Women surgeons report career and home life satisfaction but worried that their careers lag behind their men colleagues and this was a source of dissatisfaction.

Older retrospective survey studies repeatedly identified women surgeon who wished they had started their families earlier or had flexible schedules to sustain a personal life. Recent studies identify medical students valuing quality of life with work–life balance as a priority and as women choose surgical residency, starting a family is equally a priority (table 3).
Around the globe, authors identify the lack of women in all levels of surgery, despite increase number of women entering medicine. The women who chose surgery as a profession report discrimination during pregnancy, lack of support and poorly structured residency. Women are choosing surgery at lower
rates in Japan, Central America and Ireland.26–31 Women in medical schools reported surgery as not a good career choice related to quality of life, salary and lack of mentorship.28–37 In Switzerland, women surgeons report career satisfaction despite the barriers.26 Canadian authors predict a wave of change across the surgical subspecialties, women report career satisfaction despite the sacrifices related to their personal lives. One of the barriers identified across the surgical subspecialties is the lack of mentorship.37–48 To a lesser scale, women report the demands of family life as a barrier, which is easily overcome with support.37–48 As seen in cardiothoracic surgery with steady growth of women sitting for board certification while other areas such as urology orthopaedic and vascular surgery lag behind.41,42 (table 5).

Women in surgical specialties

The surgical subspecialties identify several paradoxes facing women. Even though inherent barriers remain within surgical subspecialties, women report career satisfaction despite the sacrifices related to their personal lives. One of the barriers identified across the surgical subspecialties is the lack of mentorship.37–48

To a lesser scale, women report the demands of family life as a barrier, which is easily overcome with support.37–48 As seen in cardiothoracic surgery with steady growth of women sitting for board certification while other areas such as urology orthopaedic and vascular surgery lag behind.41,42 (table 5).

Different barriers correlate with the different subspecialties. Women practising in orthopaedic surgery and residency reported the long hours and inflexibility in hours as challenging.31,45–48 Urology and vascular subspecialties report the lack of mentorship and women faculty as deterrents to attracting women surgical residents.31,42 Urology residents reported facing sexism in clinical practice.41 With less than 10% of women urologists, the specialty reports financial discrepancy, lack of mentorship, career advancement and a path for academic advancement as barriers.41

**DISCUSSION**

Our aim in systematically reviewing the literature was to identify themes, which could provide insight into the low number of women entering surgery. Five broad themes of barriers or opportunities were identified: education and recruitment, career development, impact of/on life around the globe and surgical subspecialties.36–30,37–41

Women surgeons from around the globe verbalise their concerns about: isolation, heavy burden managing a home and career despite feeling immensely satisfied with their career.41,42 The responsibilities inherent to women and nurturing children while working is a challenge faced by many professional women but easily overcome with support from within and outside the profession.6,16,49,50

Another major theme woven throughout the articles is the lack of mentorship or role models. However, a comprehensive mentorship programme for any one surgical training programme is a challenge given the low number of practicing surgeons. A national approach to mentorship programmes may help fill the void in mentorship.50,52

A redesign of the daily work, career advancement and scholarly demands could attract more women to surgery.11–14 Shifting the surgical profession to support a work–life balance may encourage women to enter the profession. It appears the greatest barrier is the current structure of surgical practice. Historically, the structure of surgical practice is developed by men for men.4,8 However, overwhelmingly both women and men wish for a flexible schedule to support a home life and quality of life.10,12 The surgical profession needs to consider the opinions of their young surgeons and residents to attract qualified applicants.21,25 With more than 57% of all medical residents being women but less than 50% applying to surgical residency, there is a real chance of missed candidates.

Coming full circle is the relationship between the demands of child rearing, nurturing a family and the rigid timeline for full professorships or opportunities to advance into programme director positions.4,8,17–19 Without a change or a restructuring in surgical career advancement, the profession will leave women behind. And perhaps more damning to the profession is the missed opportunities of brilliant women surgeons as leaders.4,8,18,19 However, utilisation of a national or global approach may help break the cycle of lack of mentorship and leadership opportunities.

The labour laws protecting maternity leave is too vague in relation to the needs of surgical residency. In many countries,
### Table 4  Around the globe

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Participants</th>
<th>Type of study</th>
<th>Study objective</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaderli et al.</td>
<td>2011</td>
<td>Board certified women surgeons and surgical residents in Switzerland</td>
<td>Survey</td>
<td>To analyse women surgeons current personal and professional lives</td>
<td>189 (59.4%) surveys returned, 70% reported career satisfaction however identified discrimination towards pregnancy, rigid work hours, poor structured residency</td>
</tr>
<tr>
<td>McHugh et al.</td>
<td>2011</td>
<td>Basic Surgical Training Residents and Royal College of Surgeons in Ireland</td>
<td>Quantitative</td>
<td>To identify modifiable factors to encourage surgical training recruitment</td>
<td>Women residents were less likely to choose a surgical career (p=0.049). Surgical role model, intellectual challenge and academic opportunities influence choosing surgical subspecialty</td>
</tr>
<tr>
<td>Kwong</td>
<td>2012</td>
<td>Surgeons in Hong Kong</td>
<td>Quantitative survey</td>
<td>To evaluate the attitudes of women and men towards work, personal life and work–life balance</td>
<td>Of all the surgeons women surgeons (13%) reported not enough time community (p=0.038) and rest (p=0.024). Both men and women surgeons reported satisfaction at work and life. Men surgeons reported wanting to work part-time during child rearing year (p=0.013).</td>
</tr>
<tr>
<td>Bonacci et al.</td>
<td>2013</td>
<td>Medical students at the Universidad de Buenos Aires and Surgeons</td>
<td>Observation case control analysis</td>
<td>To analyse the relationship between choosing or not choosing surgery</td>
<td>Women 74’100 students reported not choosing surgery because of limits in intellectual growth, jobs, not prestigious, poorly paid and it’s a male specialty</td>
</tr>
<tr>
<td>Okoshi et al.</td>
<td>2014</td>
<td>Kyoto University Hospital and School of Medicine</td>
<td>Descriptive study</td>
<td>To study gender inequality in Japanese academic surgery</td>
<td>There are no women professors/associates in surgical medicine and one lecturer (2.3%).</td>
</tr>
<tr>
<td>Kerr et al.</td>
<td>2015</td>
<td>Women Junior Doctors and Medical Students in the United Kingdom</td>
<td>Survey</td>
<td>To understand decision making process in choosing a surgical career</td>
<td>Ninety-six (96%) surveys returned and 12% of junior doctors and 30% medical students plan a surgical career with 56% citing work–life balance as the main reason for not choosing a surgical career. Thirty percent identified women surgeons dissuading a surgical career.</td>
</tr>
<tr>
<td>Yorozuya et al.</td>
<td>2015</td>
<td>Women surgeons in Japan</td>
<td>Quantitative</td>
<td>To clarify the role of mentors among Japanese women surgeons</td>
<td>Of the survey respondents (48.7%), 67% identified mentorship as crucial for staying in a clinical position, clinical advancement and moral support but not academic advancement or work–life balance.</td>
</tr>
<tr>
<td>Cruz et al.</td>
<td>2016</td>
<td>Graduates of the Department of Surgery University of Puerto Rico</td>
<td>Retrospective</td>
<td>To evaluate the gender distribution of General Surgery Residents between 1998 and 2014</td>
<td>Women represent 36% of surgical residents while 50% of all medical residents are women.</td>
</tr>
<tr>
<td>Steklacova et al.</td>
<td>2016</td>
<td>European National Neurosurgery Societies</td>
<td>Survey</td>
<td>To establish the rates of gender inequality across Europe within neurosurgery</td>
<td>There are 12,985 neurosurgeons across Europe and 12% are women with 26% in Denmark and 24% in Italy. Men neurosurgeons reported higher rates of marriage and children (p=0.001)</td>
</tr>
<tr>
<td>Dingemann</td>
<td>2017</td>
<td>Female Surgeons in Germany</td>
<td>Descriptive</td>
<td>To present the challenges, current climate, gender disparities facing women surgeons in Germany</td>
<td>With support for a balanced work–life and mentorship women have successful careers in surgery.</td>
</tr>
<tr>
<td>Retrouvey and Gdalevitch</td>
<td>2018</td>
<td>Women Plastic Surgeons of Canada</td>
<td>Survey</td>
<td>To explore the role of Women Plastic Surgeons of Canada</td>
<td>In Canada, women currently represent 22.6% of practicing plastic surgeons but 40.3% of all plastic surgery residents are women; thus, the need for mentorship, recognition of gender disparity is crucial and education of members regarding gender disparity</td>
</tr>
</tbody>
</table>
the labour laws protect women needing time off for pregnancy and childbearing; however, these labour laws fall short in a surgical practice or residency. Surgical residencies and surgical practices require structured policies around time-off, on-call coverage and modified return to work schedules. Tenure tracks and timelines need modification to create opportunities for prospective women surgeons taking time off to start a family or reducing commitments to nurture a young family. Changes in policy and practice would not only be supportive but could shift the culture away from the woman surgeon/resident as a burden.

There is no evidence in the literature that starting a family takes away from surgical training, the impact of pregnancy on surgical training relates to the lack of policy to support lighter call hours, time off and accommodations for breast feeding. However, the negative impact of pregnancy on surgical training relates to the lack of policy to support lighter call hours, time off and accommodations for breast feeding. Changing policies around childrearing may be the start to encourage more women to enter the field of surgery and may be what women surgeons need to advance in their career.

Throughout the articles reviewed regardless of locations and specialty, there is a fear of missed opportunities. The remedy echoed in each article is a push for increased visibility of women surgeons in higher academia and leadership in general. The dismal numbers of less than 10% of women surgeons in leadership positions across the board in academia and acute care is an area for tremendous growth. There needs to be a deliberate shift within the profession of surgery so that both men and women entering the profession do not feel they have to choose between living a life and training to save a life. With the increasing number of women entering medicine but stagnant numbers of women entering surgical practice, there is a clear signal for change. The current structure of surgical practice and residency is not desirable or conducive to a sustainable practice and quality of life for both women and men. The surgical profession continues to make people choose between living a fulfilled life and committing to saving lives, when there is an opportunity for the surgical profession to model how to live a life while saving lives.

### Table 5 Women in surgical specialty

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Participants</th>
<th>Type of study</th>
<th>Study objectives</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caniano et al</td>
<td>2004</td>
<td>Paediatric women surgeons</td>
<td>Survey</td>
<td>To maintain surgery and paediatric surgery as a premier career choice</td>
<td>Seventy-nine (83%) surveys returned insufficient protected time, clinical load, on-call, lack of mentorship and departmental support as barriers.</td>
</tr>
<tr>
<td>Benzil</td>
<td>2009</td>
<td>American Association of Neurological Surgeons</td>
<td>White Paper</td>
<td>To attract women to neurosurgery services</td>
<td>Mentors, role models and exposure can encourage women in medical school to consider the specialty</td>
</tr>
<tr>
<td>Hamilton et al</td>
<td>2012</td>
<td>Women surgeons</td>
<td>Survey</td>
<td>To identify aspects of pregnancy and childbearing factors that impact residency and clinical practice</td>
<td>Women orthopaedic surgeons/residents who work more than 60 hours a week are at higher risk for preterm deliveries compared with the general population</td>
</tr>
<tr>
<td>Dageforde et al</td>
<td>2012</td>
<td>Women medical residents</td>
<td>Survey</td>
<td>To find the elements which will encourage women to vascular surgery and leadership</td>
<td>Overall perceptions of women in surgery need to change</td>
</tr>
<tr>
<td>Grimsby and Wolter</td>
<td>2013</td>
<td>Urology resident</td>
<td>Commentary</td>
<td>To explore the experience of urology residency for a woman</td>
<td>Less than 10% of all urologist are urologist and there needs to be mentorship and exterminating sexual harassment</td>
</tr>
<tr>
<td>Hill et al</td>
<td>2013</td>
<td>Graduate Medical Students and American Academy of Orthopedic Surgical Residents</td>
<td>Survey</td>
<td>To understand what residents think of orthopaedic surgery and what hinders women from choosing the specialty</td>
<td>Women constitute 12.3% of all orthopaedic specialty and 15% of full-time faculty. Increased exposure to orthopaedic specialty and mentorship can encourage women to enter the specialty</td>
</tr>
<tr>
<td>Renfrow et al</td>
<td>2016</td>
<td>American Association of Neurological Surgeons</td>
<td>Retrospective survey</td>
<td>To characterise the enrollment, attrition, and post attrition</td>
<td>Women attrition rates in neurosurgery are similar to other specialties but greater than men. Twelve percent of the surgical residents from 2000 to 2009 were women.</td>
</tr>
<tr>
<td>Weiss and Teuscher</td>
<td>2016</td>
<td>Council of Orthopedic Residency Directors within orthopaedics</td>
<td>Survey</td>
<td>To understand the influence of maternity policy and choosing a surgical specialty</td>
<td>45 programme directors responded (31%) of those 80% have written maternity policies and 36% have formal and informal; 49% have maternity leave policy. There is a general lack of uniformity, which warrants transparency and discussion.</td>
</tr>
<tr>
<td>Garza et al</td>
<td>2017</td>
<td>Plastic Surgery Program Directors</td>
<td>Survey</td>
<td>To investigate issues related to pregnancy</td>
<td>A return rate of 61.36% (54/88) identified 36.54% programmes have formal maternity policy and 20% have a policy for breast feeding. The rest of the directors identified multiple barriers to maternity leave policy, which include clinical training, coverage, workload burden, administrative support.</td>
</tr>
<tr>
<td>Chambers et al</td>
<td>2018</td>
<td>Orthopaedic surgery</td>
<td>Quantitative survey</td>
<td>To quantify discrepancy across surgical specialties among residents and faculty</td>
<td>Orthopaedic surgery has the lowest rates of women in training (14%), less than 1% of women medical residents choose orthopaedics, 17.8% women orthopaedic surgeons are faculty, 8.7% professors of orthopaedics are women and 6.5% of the AAOS are women.</td>
</tr>
</tbody>
</table>
Limitations/bias
Limitations for this systematic review include the inherent biases within the studies related to the database. Most studies used survey results from national surveys and several studies used similar if not the same database. Although article review occurred until identification of no new themes, there may be overlooked themes. Another limitation was the articles were restricted to the English language.

CONCLUSION
Our systematic review of the literature identifies that women have forged their way through surgery and surgical specialties. Fearless women have overcome the challenges of not having mentors, being limited in roles, juggling home and work life to be pioneers in their field. All the while, there is a constant hum that women feel choosing a life of surgery means sacrificing a life that has space for self-interests. Woven throughout the themes is the need to acknowledge surgical residency coincides with prime childbearing years and asking women and men to sacrifice starting a family for the practice of surgery is no longer acceptable. There is a great opportunity for the profession of surgery to increase the number of women entering surgery while simultaneously improving overall career satisfaction by developing policies to accommodate a work–life balance. It may take healthcare leaders to foster the change process which supports a balance in the profession of surgery.

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All data relevant to the study are included in the article or uploaded as supplementary information. Data for this study were from published articles which are included in the systematic review.

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