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 Systematic 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 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.4 However, in sharp contrast is the number of women surgical residents.5 Less than half of all the residents in surgical residency and surgical specialties are women.4 6 It is unclear why general and specialty surgery do not see an increase in women entering surgery. Based on the above criteria 48 articles were included for review (figure 1).

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.10–15 With over half of the applicants to medical school being women but less than half applying to surgery; bright candidates are missed.16 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
the problem is the minimal representation by women surgeons or visibility of women surgeons.10

To facilitate women’s decision to consider a surgical residency, structured surgical experiences during undergrad with 50% women surgeon faculty have a positive impact.10 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.11–14 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.13 15 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.4–8 16–19 The harsh stereotyping of women surgeons has historically pigeon holed their career and imposed a glass ceiling.4–8 16–19 Talented surgeons felt held back and treated unfairly based on their sex.6 16 17 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.4–8 16–19

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.10 The theme of women surgeons not equally represented in higher-ranking positions is consistent in the articles over the last three decades.5 7 8 18 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.4 19 Mentoring identifies with creating a positive environment, demystifying surgical practice and chisels away at the boy’s club mentality.4 19 Men surgeons are equally encouraged to mentor women surgeons and contribute to a thriving, collegial environment.18

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.6 16 Some suggest affirmative action to help shift the balance between men and women surgeon in academia.5–7 17 Scholars suggest supporting women surgeons’ success in career development requires a commitment from organisations, professional societies and academia (table 1).

**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.20–25 A change in the model to accommodate the working mom, working-wife surgeon may open opportunities and improve career satisfaction.20–25 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.

Women in surgical residencies did not report pregnancy or marriage as a barrier during training but the perception of being a burden.22–24 In general, marriage is increasingly common in surgical residency.20–25 A recent study identified 38.9% of 5345 surgical residents were married and 23.3% of those married were women and 15% of those married women had at least one child.20–25

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.20 21 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.22–25 (table 3).
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.25–26 Women are choosing surgery at lower

| Table 1 | Education and recruitment |
|---------|---------------------------|
| Author  | Year | Participants | Type of study | Study objective | Findings |
| Ourian et al15 | 2011 | Undergraduate students considering a career in surgery | Survey | To examine the impact of outreach at the undergraduate level in the form of a course hosted by surgeons (50% women surgeons) influence on women’s interest in medicine and surgery | Thirteen (100%) of the participants, 11 (85%) women found the outreach programme reaffirmed their decision to attend medical school and interest in surgery |
| Gifford et al11 | 2014 | Surgical residents in 13 programmes | Survey | To determine how often surgical residents consider leaving the programme | Women residents are more likely to consider leaving (OR 1.2; 95%; p=0.003) |
| Vertrees et al22 | 2014 | Graduates from the Uniformed Services University of the Health Sciences | Survey | To determine if there are disparities among civilian and non-civilian women entering surgery and surgical subspecialties | Women in military medical programmes enter surgical training at the same rates as civilian programmes with an increase in rates (3.9% to 39% p=0.025) |
| Nebeker et al13 | 2017 | MSU Goal Consortium | Quantitative research | To identify gender differences in surgical residency | Greater impact is year of residency with first year residents leaning towards attitudinal learning objectives and later years choosing knowledge-based and skill-based learning objectives. Residents taught by women surgeons leaned towards knowledge based objectives over skill based. |
| Luc et al44 | 2017 | Medical and surgical residents | Quantitative survey | To identify the role of social media as a mentoring tool for women in surgery | Surgical residents identified using social media to build a network of mentors (p=0.031). |
| Fassiotto et al5 | 2018 | Graduate Medical Evaluation | Quantitative survey | To determine the difference if any in evaluation scores for women and men faculty | Women scored lower across the board for specialties with fewer women such as surgery (p=0.001) |

**Around the globe**

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.25–26 Women are choosing surgery at lower

| Table 2 | Career development |
|---------|-------------------|
| Author  | Year | Participants | Type of study | Study objective | Findings |
| Jonasson6 | 1993 | American College of Surgeons (ACS) | Review | To establish the barriers for women surgeons career advancement | Multiple factors impede advancement which include: stereotypes, sexism and family demands. |
| Jonasson6 | 2002 | ACS Membership | Survey | To understand the representation of women in leadership roles in surgery | Percentage of women in societies in 2001: ACS 4.4% ASA 2.2 % Society of University Surgeons 3.3% Percentage of women among the board of directors of ABMS certifying boards 12 (6.3%) |
| Ahmadiyeh et al17 | 2010 | Surgeons | Qualitative | To identify elements of career satisfaction for women surgery | Women value a career which values the whole person beyond surgery |
| Zhuge et al7 | 2011 | Review | To review the glass-ceiling phenomenon in surgery and identify causes strategies | The glass-ceiling phenomenon is impacted by three themes: gender roles, sexism and lack of mentors. |
| Sexton et al6 | 2012 | Members of the American Association of Medical Colleges | Survey | To determine the distribution of men and women across professional rank and to estimate when 50% of professorship will be women | Rate of women surgeons progressing to full professorship is a slow slope of line of increase compared with rate of women entering medicine, and surgery (0.36 vs 0.75 vs 0.99) |
| Healy et al14 | 2012 | Review of literature | To understand the definition of role model, mentoring in surgery | Women (75%) identified role models and mentors as positive but challenging to identify a women surgeon mentor. |
| Weiss et al8 | 2013 | Residents in Surgical Residency in the U.S. Residents in medical schools Programme Chairs/Directors | Survey -cohort study | To determine the number of women in leadership positions as either a Chair, Programme Director (PD), Chief and Associate Director (AD) | Percentage of Women in the following positions: Chairs 8 (3%) PD 25 (10%) Chiefs 157 (10%) AD 35 (24%) |
| Cochran et al6 | 2013 | Surgical Residents and Faculty | Survey | To find out if women surgeons perceive different barriers than men counterparts in academia | Women surgeons feel and perceive excluded from the dominant culture in surgical departments |
| Seemann et al8 | 2016 | Women surgeons across Canadian Academic Centers | Survey | To explore women advancement and career satisfaction in surgery | Lack of gender equality, appropriate mentorship and accommodations for women |

AAOS, American Academy of Orthopaedic Surgeons; ABMS, American Board of Medical Specialties; ASA, American Surgical Association.
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. To a lesser scale, women report the demands of family life as a barrier, which is easily overcome with support. As seen in cardiothoracic surgery with steady growth of women sitting for board certification while other areas such as urology ortho-vascular surgery lag behind.41–42 (table 5).

Women in surgical specialties report career satisfaction despite the barriers. In Switzerland, women surgeons report career satisfaction despite the barriers. Canadian authors predict a wave of change across the surgical subspecialties. 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 46 47 The responsibilities inherit to women managing a home and career while working is a challenge faced by many professional women but easily overcome with support from within and outside the profession.41 45 46

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.40–52

A redesign of the daily work, career advancement and scholarly demands could attract more women to surgery. 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 Without a change or a restructuring in surgical career advancement, the profession will lose women behind. And perhaps more damning to the profession is the missed opportunities of brilliant women surgeons as leaders.5 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

| Author | Year | Participants | Type of study | Study objective | Findings |
|--------|------|--------------|---------------|-----------------|----------|
| Kaderli et al. | 2011 | Board certified women surgeons and surgical residents in Switzerland | Survey | To analyse women surgeons current personal and professional lives | 189 (59.4%) surveys returned, 70% reported career satisfaction however identified discrimination towards pregnancy, rigid work hours, poor structured residency |
| McHugh et al. | 2011 | Basic Surgical Training Residents and Royal College of Surgeons in Ireland | Quantitative | To identify modifiable factors to encourage surgical training recruitment | 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 |
| Kwong | 2012 | Surgeons in Hong Kong | Quantitative survey | To evaluate the attitudes of women and men towards work, personal life and work–life balance | 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). |
| Borracci et al. | 2013 | Medical students at the Universidad of Buenos Aires and Surgeons | Observation case control analysis | To analyse the relationship between choosing or not choosing surgery | 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 |
| Okoshi et al. | 2014 | Kyoto University Hospital and School of Medicine | Descriptive study | To study gender inequality in Japanese academic surgery | There are no women professors/associates in surgical medicine and one lecturer (2.3%). |
| Kerr et al. | 2015 | Women Junior Doctors and Medical Students in the United Kingdom | Survey | To understand decision making process in choosing a surgical career | 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. |
| Yorozuya et al. | 2015 | Women surgeons in Japan | Quantitative | To clarify the role of mentors among Japanese women surgeons | 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. |
| Cruz et al. | 2016 | Graduates of the Department of Surgery University of Puerto Rico | Retrospective | To evaluate the gender distribution of General Surgery Residents between 1958 and 2014 | Women represent 36% of surgical residents while 50% of all medical residents are women. |
| Steklacova et al. | 2016 | European National Neurosurgery Societies | Survey | To establish the rates of gender inequality across Europe within neurosurgery | 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) |
| Dingemann | 2017 | Female Surgeons in Germany | Descriptive | To present the challenges, current climate, gender disparities facing women surgeons in Germany | With support for a balanced work–life and mentorship women have successful careers in surgery. |
| Retrouvey and Gdalevitch | 2018 | Women Plastic Surgeons of Canada | Survey | To explore the role of Women Plastic Surgeons of Canada | 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 |
Table 5: Women in surgical specialty

| Author                        | Year | Participants                      | Type of study | Study objectives                                                                 | Findings                                                                 |
|-------------------------------|------|-----------------------------------|---------------|----------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Caniano et al<sup>45</sup>     | 2004 | Paediatric women surgeons         | Survey        | To maintain surgery and paediatric surgery as a premier career choice             | Seventy-nine (83%) surveys returned identified insufficient protected time, clinical load, on-call, lack of mentorship and departmental support as barriers. |
| Benzil                        | 2009 | American Association of Neurological Surgeons | White Paper  | To attract women to neurosurgery services                                         | Mentors, role models and exposure can encourage women in medical school to consider the specialty |
| Hamilton et al<sup>42</sup>    | 2012 | Women surgeons                    | Survey        | To identify aspects of pregnancy and childbearing factors that impact residency and clinical practice | Women orthopaedic surgeons/residents who work more than 60 hours a week are at higher risk for preterm deliveries compared with the general population |
| Dageforde et al<sup>43</sup>   | 2012 | Women medical residents           | Survey        | To find the elements which will encourage women to vascular surgery and leadership | Overall perceptions of women in surgery need to change |
| Grimsby and Wolter<sup>44</sup> | 2013 | Urology resident                  | Commentary    | To explore the experience of urology residency for a woman                         | Less than 10% of all urologist are women urologist and there needs to be mentorship and exterminating sexual harassment |
| Hill et al<sup>45</sup>        | 2013 | Graduate Medical Students and American Academy of Orthopedic Surgical Residents | Survey        | To understand what residents think of orthopaedic surgery and what hinders women from choosing the specialty | Women constitute 12.3% of all orthopaedic specialty and 15% of full-time faculty. Increased exposure to orthopaedic residency and mentorship can encourage women to enter the specialty |
| Renfrow et al<sup>46</sup>     | 2016 | American Association of Neurological Surgeons | Retrospective survey | To characterise the enrollment, attrition, and post attrition | 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. |
| Weiss and Teuscher<sup>47</sup> | 2016 | Council of Orthopedic Residency Directors within | Survey        | To understand the influence of maternity policy and choosing a surgical specialty | 45 programme directors responded (31%) of those 80% have written maternity policies and 36% have formal and informal; 49% have paternity leave policy. There is a general lack of uniformity, which warrants transparency and discussion. |
| Garza et al<sup>48</sup>       | 2017 | Plastic Surgery Program Directors | Survey        | To investigate issues related to pregnancy                                       | 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. |
| Chambers et al<sup>49</sup>    | 2018 | Orthopaedic surgery               | Quantitative survey | To quantify discrepancy across surgical specialties among residents and faculty | 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. |

the labour laws protect women needing time off for pregnancy and childbirth; 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.<sup>51</sup> Quantitative studies identified women residents having a child during surgery residency has no negative impact on training or graduation.<sup>21 19–44</sup> 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.<sup>19–44</sup> 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.<sup>4 6–8 19 27</sup> There needs to be a systematic and deliberate attempt to encourage women surgeons to advance into leadership positions.

There needs to a 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 number 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.
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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