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# Prevalence and Causes of Attrition Among Surgical Residents
## A Systematic Review and Meta-analysis

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**IMPORTANCE** Attrition of residents from general surgery training programs is relatively high; however, there are wide discrepancies in the prevalence and causes of attrition reported among surgical residents in previous studies.

**OBJECTIVE** To summarize the estimate of attrition prevalence among general surgery residents.

**DATA SOURCES** We searched the Medline, EMBASE, Cochrane, PsycINFO, and ERIC databases (January 1, 1946, to October 22, 2015) for studies reporting on the prevalence and causes of attrition in surgical residents, as well as the characteristics and destinations of residents who left general surgery training programs. Database searches were conducted on October 22, 2015.

**STUDY SELECTION** Eligibility criteria included all studies reporting on the primary (attrition prevalence) or secondary (causes of attrition and characteristics and destination of residents who leave residency programs) outcomes in peer-reviewed journals. Commentaries, reviews, and studies reporting on preliminary surgery programs were excluded. Of the 41 full-text articles collected from the title/abstract screening, 22 studies (53.7%) met the selection criteria.

**DATA EXTRACTION AND SYNTHESIS** Two reviewers independently collected and summarized the data. We calculated pooled estimates using random effects meta-analyses where appropriate.

**MAIN OUTCOME AND MEASURE** Attrition prevalence of general surgery residents.

**RESULTS** Overall, we included 22 studies that reported on residents (n = 19 821) from general surgery programs. The pooled estimate for the overall attrition prevalence among general surgery residents was 18% (95% CI, 14%-21%), with significant between-study variation ($I^2$ = 96.8%; $P$ < .001). Attrition was significantly higher among female compared with male (25% vs 15%, respectively; $P$ = .008) general surgery residents, and most residents left after their first postgraduate year (48%; 95% CI, 39%-57%). Departing residents often relocated to another general surgery program (20%; 95% CI, 15%-24%) or switched to anesthesia (13%; 95% CI, 11%-16%) and other specialties. The most common reported causes of attrition were uncontrollable lifestyle (range, 12%-87.5%) and transferring to another specialty (range, 19%-38.9%).

**CONCLUSIONS AND RELEVANCE** General surgery programs have relatively high attrition, with female residents more likely to leave their training programs than male residents. Residents most often relocate or switch to another specialty after the first postgraduate year owing to lifestyle-related issues.

Invited Commentary page 272

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Despite the introduction of national regulations on resident duty hour restrictions by the Accreditation Council for Graduate Medical Education (ACGME) in 2003, resident attrition remains a significant issue, particularly in general surgery training programs. General surgery residency programs are among the most competitive training programs to join, and they often attract high-profile applicants.[1-3] However, the attrition rate of general surgery residents (reported to range from 2% to 26%) appears to be relatively higher than other specialties, which poses major challenges at the program, institutional, and postgraduate medical education levels.[4-8]

Although resident attrition is well known to be a significant problem in surgical training, data on factors associated with attrition are unclear. Previous studies have suggested residents may leave general surgery training programs for a variety of reasons, including undesirable lifestyle, excessive work hours, emotional difficulties, performance issues, lack of personal support network, or dissatisfaction with the medical profession altogether.[9] However, to our knowledge, no study has systematically summarized the strength and magnitude of the association between these factors and attrition. Furthermore, data are unclear about the career choices of residents who leave general surgery training programs. Current knowledge indicates that these residents often transfer to other surgical specialties, but may also transfer to nonsurgical specialties or leave medicine altogether.[10]

Therefore, the primary aim of our study was to summarize the current evidence to determine the prevalence of attrition among general surgery residents. Furthermore, we sought to establish the drivers of attrition in general surgery residency programs, identify the characteristics of residents who left their training programs, and examine the destinations of outgoing residents.

### Key Points

**Question** What is the attrition prevalence among surgical residents?

**Findings** This systematic review and meta-analysis found that the pooled estimate of attrition prevalence among general surgery residents was 18%, female residents were more likely to leave than male residents, and residents were most likely to leave after the first postgraduate year owing to an uncontrollable lifestyle. The most common destination of residents who left was relocating to another general surgery program or switch to another specialty.

**Meaning** Attrition prevalence is relatively high among general surgery residents and future research should focus on developing strategies to limit resident attrition.

## Methods

### Study Design and Registration

We conducted a systematic review and meta-analysis in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[11] Our predefined protocol was registered at the International Prospective Register of Systematic Reviews (CRD 42015027420).

### Inclusion Criteria and Outcomes

All studies that reported either the primary outcome (prevalence of attrition among general surgery residents) or any of the secondary outcomes (attrition causes, characteristics of residents who left, and destination of residents who left) of interest were included. Commentaries, reviews, and studies not published in peer-reviewed journals were excluded. In addition, studies of preliminary general surgery programs were excluded to avoid including general surgery residents who transferred to their designated specialty program (eg, anesthesia or radiology) after the preliminary year in general surgery.

### Information Sources and Search Strategies

In collaboration with an expert librarian, we conducted a comprehensive search of 5 electronic databases (Medline, EMBASE, ERIC, PsycINFO, and Cochrane Library; January 1, 1946, to October 22, 2015). The search strategy combined terms of surgical residents with terms related to attrition. No language restrictions were applied. The search strategy was peer-reviewed using the Peer Review of Electronic Search Strategy checklist.[12] A full search strategy is included in the eAppendix in the Supplement. Search results from the 5 databases were merged using EndNote (Thomson Reuters Scientific LLC) and duplicate references were discarded. We also searched the references of the included full-text articles to ensure literature saturation, and we contacted experts for additional data sources. Database searches were conducted on October 22, 2015.

### Study Selection, Data Extraction, and Data Items

Two reviewers (Z.K. and M.A.H.) independently screened the titles and abstracts of all studies that resulted from the search to determine eligibility for full-text review, reviewed full-text articles of all potentially relevant articles, and extracted data from eligible full-text articles. Data collection forms were developed to capture variables of interest (eg, author, recruitment period, study design, and sample number); they were piloted on 5 randomly selected studies and refined as appropriate. Disagreements were resolved as a group.

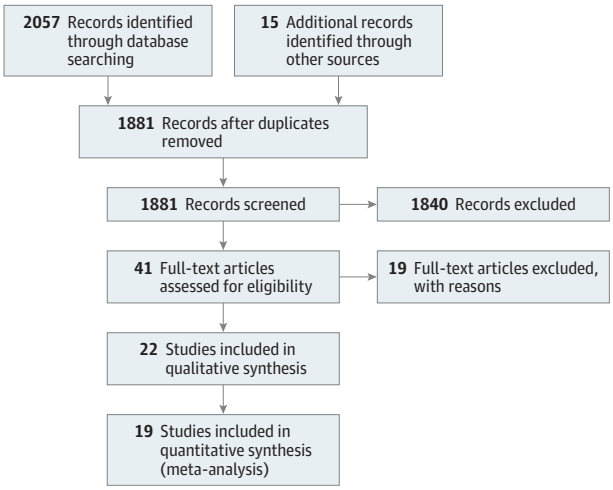
### Assessment of Study Quality

Two reviewers (Z.K. and M.A.H.) independently assessed each included study for quality (or risk of bias) using the Newcastle-Ottawa Scale for cohort studies and modified Newcastle-Ottawa Scale for cross-sectional studies.[13] This instrument assesses the quality of cohort studies in terms of selection of study cohorts, comparability of the cohorts, and outcomes ascertainment using a star system. An overall score ranging from 0 to 9 for cohort studies and 0 to 5 for cross-sectional studies was determined for each study. Cohort studies were categorized as having a high (score <6), moderate (score 6 or 7), or low (score 8 or 9) risk of bias; cross-sectional studies were categorized as having either a high (score <3) or low (score 3-5) risk of bias. Disagreements were discussed and resolved as a group.

### Data Synthesis and Analysis

For categorical general surgery residents, pooled estimates (proportions) of attrition prevalence and characteristics and destinations of residents who left were calculated using random-effects meta-analyses.[14] Between-study heterogeneity was examined using $I^2$ statistic. A high level of heterogeneity was indicated by an $I^2$ statistic value of 75% and greater.[15,16] In addition, we examined attrition prevalence of residents from categorical general surgery programs based on the following subgroups: timing of study (before vs after the ACGME 80-hour policy implementation) and whether attrition was voluntary or involuntary (dismissal). We also conducted a sensitivity analysis to assess the robustness of our results by restricting the analysis to studies that only reported results from multiple training programs. In addition, we examined the influence of each study on the overall estimate by excluding one study at a time and rerunning the meta-analysis. All statistical analyses were performed using Stata version 13 (StataCorp LP), with a $P$ value of less than .05 for statistical tests considered statistically significant.[17]

Figure 1. PRISMA Flow Diagram of Included Articles




## Results

### Overall Description of Included Studies

A total of 1881 citations were identified through the electronic database searches, with 15 additional studies identified through scanning references (**Figure 1**). Of these, 41 full-text articles were reviewed, and 22 studies were included in this systematic review.[9,10,18-37]

### Study Characteristics

A total of 22 studies reported on general surgery residency programs from the United States (n = 20), Pakistan (n = 1), and China (n = 1) and including a total of 19 821 residents (**Table**). Ten studies were cross-sectional and 12 were retrospective cohort in design. Ten studies reported results from multiple training programs, whereas 12 studies reported results from a single training program. Duration of follow-up ranged from 1 to 20 years. With respect to study quality, 9 studies were at low risk

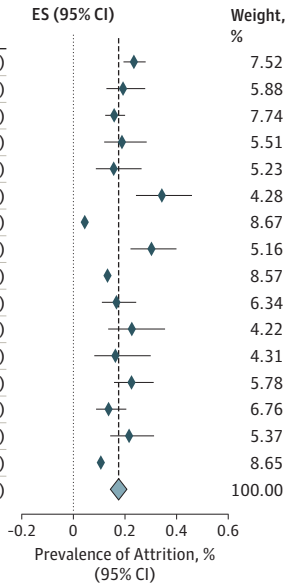
Table. Characteristics of the Included Studies for General Surgery Residents

| Source | Country | Survey Period | Survey Duration, y | Study Design | Sample Size | Training Program |
|---|---|---|---|---|---|---|
| Bongiovanni et al,[18] 2015 | US | 2014-2015 | 1 | Cross-sectional | 19 | Multiple |
| Gifford et al,[20] 2014 | US | 2004-2013 | 10 | Cross-sectional | 371 | Multiple |
| Nadeem et al,[19] 2014 | Pakistan | 2005-2011 | 6 | Cross-sectional | 106 | Single |
| Falcone,[21] 2014 | US | 1992-2011 | 20 | Retrospective cohort | 104 | Single |
| Brown et al,[22] 2014 | US | 1999-2009 | 10 | Retrospective cohort | 85 | Single |
| Sullivan et al,[23] 2013 | US | 2008-2009 | 2 | Retrospective cohort | 2033 | Multiple |
| Yaghoubian et al,[24] 2012 | US | 1999-2010 | 11 | Retrospective cohort | 348 | Multiple |
| Alterman et al,[25] 2011 | US | 1990-2008 | 18 | Retrospective cohort | 70 | Single |
| Kelz et al,[28] 2010 | US | 2005-2009 | 5 | Prospective cohort | 64 | Single |
| Yeo et al,[26] 2010 | US | 2007-2008 | 1 | Retrospective cohort | 6303 | Multiple |
| Wang et al,[27] 2010 | China | 2003-2008 | 5 | Cross-sectional | 88 | Single |
| Longo et al,[29] 2009 | US | 1986-2006 | 20 | Retrospective cohort | 99 | Single |
| Andriole et al,[31] 2008 | US | 1994-2000 | 6 | Retrospective cohort | 43 | Single |
| Naylor et al,[30] 2008 | US | 1991-2000 | 10 | Retrospective cohort | 111 | Single |
| Everett et al,[32] 2007 | US | 2001-2004 | 4 | Cross-sectional | 2555 | Multiple |
| Leibrandt et al,[10] 2006 | US | 2003-2004 | 1 | Cross-sectional | 148 | Multiple |
| Dodson and Webb,[9] 2005 | US | 1990-2003 | 13 | Case-control | 120 | Single |
| Morris et al,[33] 2003 | US | 2000-2001 | 1 | Cross-sectional | 167 | Multiple |
| Farley and Cook,[34] 2001 | US | 1996-2001 | 5 | Cross-sectional | 53 | Multiple |
| Bergen et al,[35] 1998 | US | 1984-1996 | 12 | Retrospective cohort | 132 | Single |
| Aufses et al,[36] 1998 | US | 1982-1996 | 14 | Retrospective cohort | 88 | Single |
| O'Leary and Capote,[37] 1997 | US | 1990-1995 | 5 | Cross-sectional | 7029 | Multiple |

Abbreviation: US, United States.

Figure 2. Attrition Prevalence in General Surgery Residents

| Study | Follow-up Period | No. of Residents Left | Total No. of Participants | ES (95% CI) |
|---|---|---|---|---|
| Gifford et al,[20] 2014 | 2004-2013 | 87 | 371 | 0.23 (0.19-0.28) |
| Falcone,[21] 2014 | 1992-2011 | 20 | 104 | 0.19 (0.13-0.28) |
| Yaghoubian et al,[24] 2012 | 1999-2010 | 55 | 348 | 0.16 (0.12-0.20) |
| Brown et al,[22] 2014 | 1999-2009 | 16 | 85 | 0.19 (0.12-0.28) |
| Kelz et al,[28] 2010 | 2005-2009 | 10 | 64 | 0.16 (0.09-0.26) |
| Alterman et al,[25] 2011 | 1990-2008 | 24 | 70 | 0.34 (0.24-0.46) |
| Yeo et al,[26] 2010 | 2007-2008 | 278 | 6303 | 0.04 (0.04-0.05) |
| Longo et al,[29] 2009 | 1986-2006 | 30 | 99 | 0.30 (0.22-0.40) |
| Everett et al,[32] 2007 | 2001-2004 | 338 | 2555 | 0.13 (0.12-0.15) |
| Dodson and Webb,[9] 2005 | 1990-2003 | 20 | 120 | 0.17 (0.11-0.24) |
| Farley and Cook,[34] 2001 | 1996-2001 | 12 | 53 | 0.23 (0.13-0.36) |
| Andriole et al,[31] 2008 | 1994-2000 | 7 | 43 | 0.16 (0.08-0.30) |
| Naylor et al,[30] 2008 | 1991-2000 | 25 | 111 | 0.23 (0.16-0.31) |
| Bergen et al,[35] 1998 | 1984-1996 | 18 | 132 | 0.14 (0.09-0.21) |
| Aufses et al,[36] 1998 | 1982-1996 | 19 | 88 | 0.22 (0.14-0.31) |
| O'Leary and Capote,[37] 1997 | 1990-1995 | 748 | 7029 | 0.11 (0.10-0.11) |
| Overall: $I^2$ = 96.81%, $P$ < .001 | | | | 0.18 (0.14-0.21) |




ES indicates estimate.

of bias, 10 were at moderate risk of bias, and 3 were at high risk of bias (eTable 1 and eTable 2 in the Supplement). Of the 22 total studies, only 19 were included in the meta-analyses. The 2 studies conducted outside of the United States were excluded from the meta-analysis owing to significant heterogeneity in international training programs, and 1 study that only reported qualitative data on the causes of attrition was also excluded.[18]

## Primary Outcome: Attrition Prevalence

Sixteen studies reported the prevalence of attrition among general surgery residents (eTable 3 in the Supplement). The pooled estimate for the overall attrition prevalence among general surgery residents was 18% (95% CI, 14%-21%; $P$ < .001), with significant between-study variation ($I^2$ = 96.8%; $P$ < .001) (**Figure 2**). Most of the residents left voluntarily (range, 60%-96.4%). Dismissal rates ranged from 6.25% to 50% (eTable 3 in the Supplement). The pooled estimate of attrition prevalence reported from studies before the ACGME 80-hour work policy implementation was 17% (95% CI, 12%-21%; $P$ < .001; $I^2$ = 74.8%; n = 7 studies) compared with 14% (95% CI, 0%-29%; $P$ < .001; $I^2$ = 97.5%; n = 3 studies) after the 80-hour work policy implementation; this difference was not statistically significant ($P$ = .43).

## Secondary Outcomes

The most common cause of attrition was uncontrollable lifestyle during general surgery resident training (range, 12%-87.5%). The second most common reason of attrition was choosing to join another specialty (range, 19%-38.9%). Other reported causes included poor performance, dismissal, family or spousal factors, health issues, and financial burden (eTable 4 in the Supplement). Owing to the significant variability in the reporting of this outcome across studies, a meta-analysis was not possible.

With respect to characteristics of residents who left, most studies focused on reporting the sex and postgraduate year (PGY) level of these residents (eTable 5 and eTable 6 in the Supplement). Only studies that reported complete data stratified by sex or PGY level of residents who left their training programs were included for subgroup analyses to minimize the risk of selection bias. Meta-analysis of attrition prevalence by sex showed attrition prevalence of 25% among female residents enrolled in general surgery programs (95% CI, 16%-34%; $P$ < .001; $I^2$ = 88.2%; n = 11 studies) compared with 15% for male residents (95% CI, 11%-20%; $P$ < .001; $I^2$ = 96.7%; n = 11 studies) (**Figure 3**). Formal testing for subgroup differences revealed that female residents had significantly higher attrition prevalence (10% higher) than male residents ($P$ = .008). Of the total number of residents who left a general surgery program, 48% (n = 816) left after the PGY 1 level (95% CI, 39%-57%; $P$ < .001; $I^2$ = 91.7%; n = 11 studies) and 28% (n = 596) after the PGY 2 level (95% CI, 22%-33%; $P$ < .001; $I^2$ = 78.02%; n = 11 studies) (eFigure 1 in the Supplement).

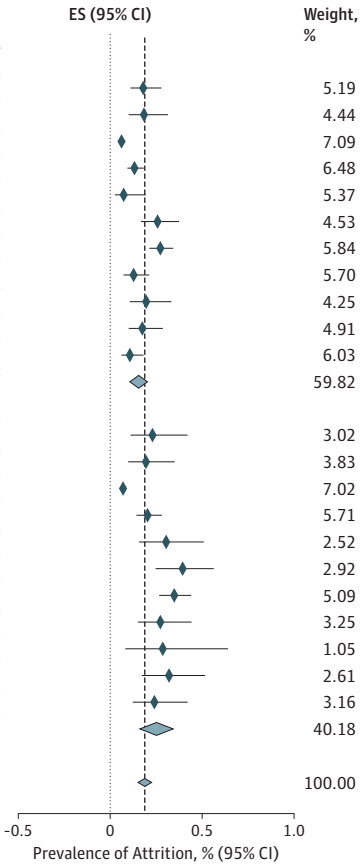
Overall, of all the residents who left, only 20% (95% CI, 15%-24%; n = 317; $P$ < .001; $I^2$ = 72.2%; n = 8 studies) relocated to another general surgery program, whereas most switched to another field or specialty (eFigure 2 in the Supplement). Anesthesia appeared to be the most popular nongeneral surgery medical specialty training program for residents who left (13% of residents [n = 241] who left; 95% CI, 11%-16%; $P$ < .001; $I^2$ = 40.7%; n = 11 studies) (eFigure 3 in the Supplement). Plastic surgery, radiology, and family medicine were other common specialties that attracted general surgery residents (eTable 7 in the Supplement).

## Sensitivity Analyses

First, we conducted a sensitivity analysis for attrition prevalence by removing 1 study at a time and rerunning the meta-

Figure 3. Attrition Prevalence by Sex in General Surgery Residents

| Study | No. of Residents Left | Total No. of Residents | ES (95% CI) | Weight, % |
|---|---|---|---|---|
| Male residents | | | | |
| Falcone,[21] 2014 | 14 | 78 | 0.18 (0.11-0.28) | 5.19 |
| Brown et al,[22] 2014 | 9 | 49 | 0.18 (0.10-0.31) | 4.44 |
| Sullivan et al,[23] 2013 | 81 | 1317 | 0.06 (0.05-0.08) | 7.09 |
| Yaghoubian et al,[24] 2012 | 29 | 220 | 0.13 (0.09-0.18) | 6.48 |
| Kelz et al,[28] 2010 | 3 | 41 | 0.07 (0.03-0.19) | 5.37 |
| Longo et al,[29] 2009 | 17 | 66 | 0.26 (0.17-0.37) | 4.53 |
| Gifford et al,[20] 2014 | 48 | 176 | 0.27 (0.21-0.34) | 5.84 |
| Dodson and Webb,[9] 2005 | 11 | 87 | 0.13 (0.07-0.21) | 5.70 |
| Farley and Cook,[34] 2001 | 9 | 46 | 0.20 (0.11-0.33) | 4.25 |
| Aufses et al,[36] 1998 | 11 | 63 | 0.17 (0.10-0.29) | 4.91 |
| Bergen et al,[35] 1998 | 11 | 103 | 0.11 (0.06-0.18) | 6.03 |
| Subtotal: $I^2$ = 86.72%, $P$ < .001 | | | 0.15 (0.11-0.20) | 59.82 |
| Female residents | | | | |
| Falcone,[21] 2014 | 6 | 26 | 0.23 (0.11-0.42) | 3.02 |
| Brown et al,[22] 2014 | 7 | 36 | 0.19 (0.10-0.35) | 3.83 |
| Sullivan et al,[23] 2013 | 50 | 716 | 0.07 (0.05-0.09) | 7.02 |
| Yaghoubian et al,[24] 2012 | 26 | 128 | 0.20 (0.14-0.28) | 5.71 |
| Kelz et al,[28] 2010 | 7 | 23 | 0.30 (0.16-0.51) | 2.52 |
| Longo et al,[29] 2009 | 13 | 33 | 0.39 (0.25-0.56) | 2.92 |
| Gifford et al,[20] 2014 | 39 | 112 | 0.35 (0.27-0.44) | 5.09 |
| Dodson and Webb,[9] 2005 | 9 | 33 | 0.27 (0.15-0.44) | 3.25 |
| Farley and Cook,[34] 2001 | 2 | 7 | 0.29 (0.08-0.64) | 1.05 |
| Aufses et al,[36] 1998 | 8 | 25 | 0.32 (0.17-0.52) | 2.61 |
| Bergen et al,[35] 1998 | 7 | 29 | 0.24 (0.12-0.42) | 3.16 |
| Subtotal: $I^2$ = 88.17%, $P$ < .001 | | | 0.25 (0.16-0.34) | 40.18 |
| Heterogeneity between groups: $P$ = .06 | | | | |
| Overall: $I^2$ = 87.15%, $P$ < .001 | | | 0.19 (0.15-0.23) | 100.00 |




ES indicates estimate.

analysis to see the effect of each study. No single study changed the prevalence of overall attrition among general surgery residents by more than 2%. Second, we conducted sensitivity analyses by restricting our meta-analyses to studies that only reported results from multiple training programs. The pooled estimates for all outcomes were nearly identical in multiple programs only vs all studies (eFigure 3, eFigure 4, eFigure 5, eFigure 6, and eFigure 7 in the Supplement).

## Discussion

Overall, 22 studies included in our systematic review reported attrition from general surgery programs. The overall rate of attrition among general surgery residents was 18% (95% CI, 14%-21%). The most common cause of attrition from general surgery residency was uncontrollable lifestyle, followed by choosing to join another specialty. Nearly 50% of residents left after the PGY 1 level, and 30% left after PGY 2. Female residents were more likely to leave than male residents (25% vs 15%, respectively). Of the residents who left, 20% relocated to another general surgery program (often owing to family or geographic preference),[32] and 13% changed their specialty to anesthesia.

There is a paucity of data available on surgical resident attrition from specialties other than general surgery. However, it appears that the overall prevalence of attrition among general surgery residents is comparable with that of obstetrics and gynecology (range, 3.6%-21.6%)[38-41] and neurosurgery (range, 14%-42.6%) residents,[42,43] but relatively higher than ophthalmology (1.15%),[44] otolaryngology (6%),[45] and orthopedics (5.3%) residents.[46]

A potential explanation for the wide range of overall attrition rates among different surgical specialties may be variable demands of different surgical training programs. For instance, compared with ophthalmology, general surgery training programs generally have greater clinical demands, which can have significant consequences on resident lifestyle; uncontrollable lifestyle was identified as the most common cause of attrition in our review. Furthermore, residents from other nonsurgical training programs, such as internal medicine and emergency medicine, which are known to be more "lifestyle friendly," have lower reported rates of attrition than the more clinically demanding programs, such as general surgery and neurosurgery.[31,40] In addition, we found that surgical residents who left their training programs most often switched to lifestyle-friendly specialties such as anesthesia and family medicine. This trend has also been noticed among graduat-

ing medical students who strongly consider lifestyle factors when deciding on which medical specialty to pursue as a career.[47-50]

We also found a quarter of female residents left their surgical training programs compared with 15% of male residents. Several potential factors may account for this difference, such as a lack of appropriate role models for female residents, particularly in surgical academia[51-54]; perception of sex discrimination; negative attitudes toward women in surgery; and sexual harassment.[54-56] In addition, in a national survey of general surgery residents from the United States that included 248 of 249 total training programs, women were found less likely than men to report that their program provides support, and that they can turn to faculty when having difficulties.[57]

National policies on resident duty hour restrictions were implemented by the ACGME in 2003 in an attempt to regulate resident hours and improve resident lifestyle without compromising clinical care and resident training. However, a recent systematic review conducted by Ahmed and colleagues[58] showed that implementation of the current 80-hour-a-week policy did not improve general surgery resident lifestyle. Furthermore, the recently reported Flexibility in Duty Hour Requirements for Surgical Trainees Trial involving 117 general surgery programs showed that residents randomized to the flexible-policy arm were not more likely dissatisfied with overall well-being than those randomized to the standard-policy arm (adhering to the existing ACGME hour restrictions). However, flexible-policy residents were more likely to perceive negative effects of duty hours on time for family and friends and were more likely to be dissatisfied with time for rest.[59]

There may be other more effective ways of retaining surgical trainees than targeting work hours policy, such as formally assigning mentors to support residents early in their training.[60] In addition, more exposure to surgical rotations during undergraduate medical education might facilitate appropriate career choices.[61,62] Moreover, being attached to one team during a surgical rotation may not give students a complete picture of residency training.[63-65] Hence, longer and varied rotations may help medical students make more informed career choices. Furthermore, adding a transition year between medical school and residency training with rotations in the general specialties, such as general surgery and internal medicine (which is the case in the United Kingdom and many other countries), might help students recognize the actual demands of general surgery training programs. Last, effective screening processes for applicants to surgical residencies may help reduce attrition. Kelz and colleagues[28] have proposed novel application screening methods that include essay requirements for applicants focusing on stress management, prioritization, and organizational abilities, which are all qualities needed to succeed as a surgical resident. Further study into novel models such as these may help identify appropriate candidates for surgical programs, especially because traditional methods of evaluation, such as medical school attended, surgery clerkship performance, US Medical Licensing Examination scores, and American Board of Surgery In-Training Examination scores, have failed to predict attrition.[19,20,22,25,32]

### Limitations

The results of our study should be interpreted in light of some limitations. First, there was considerable heterogeneity between studies, which remained high even when we restricted the analysis to studies reporting data from multiple training programs. This might be partially due to program-specific factors such as the size and the type of program (university, community, and military programs). Second, most of the studies did not adequately control for confounding factors such as age, sex, medical school attended, and program type. Third, the duration of follow-up among studies varied widely (range, 1-20 years of follow-up). Fourth, because most of the included studies were conducted in the United States, the results cannot be generalized to training programs outside of the United States. Finally, nearly all of the studies included were retrospective in design, and more than half reported data from a single training program. However, sensitivity analysis that only included multiple programs studies did not change our conclusions.

## Conclusions

In this systematic review and meta-analysis, we found that the pooled estimate of overall attrition among general surgery residents was 18%, and the most common cause of attrition was uncontrollable lifestyle. Female residents were more likely to leave their training program compared with male residents, with most (about 80%) of the residents leaving within the first 2 years of training. Residents often relocated to another general surgery program or changed specialty to more lifestyle-friendly specialties. Future studies should focus on developing interventions to limit resident attrition.

ARTICLE INFORMATION

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**Author Contributions:** Drs Khoushhal and Al-Omran had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.
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*Acquisition, analysis, or interpretation of data:*

Khoushhal, Hussain, Greco, Verma, Rotstein, Al-Omran.
*Drafting of the manuscript:* Khoushhal.
*Critical revision of the manuscript for important intellectual content:* All authors.
*Statistical analysis:* Khoushhal, Hussain, Mamdani, Al-Omran.
*Administrative, technical, or material support:* Khoushhal, Verma, Al-Omran.
*Study supervision:* Greco, Al-Omran.

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Invited Commentary

# Preventing General Surgery Residency Attrition—It Is All About the Mentoring

Julie A. Freischlag, MD; Michelle M. Silva, BA

**While it is no secret** that general surgery residency attrition poses a threat to the US surgical workforce, facts around the causes and prevalence have been ambiguous. The data summarized by Khoushhal and colleagues[1] in "Prevalence and Causes of Attrition Among Surgical Residents: A Systematic Review and Meta-analysis" provide insights that can inform retention strategies.

What can be done to stem the tide of surgical resident attrition? I cannot say enough about the power of mentorship, which has been cited by many studies as a critical retention tool during and after residency.[2,3] We mentor to help people reach their full potential: we cheer them on when they succeed and guide them when they encounter obstacles.

Related article page 265

Surgical residency is notoriously arduous and the longer hours compared with other specialties can take a toll on some residents. That's why it's important for mentors to keep a watchful eye on resident mentees. Those who are thinking about leaving may be too overwhelmed to see how their talents have great value. As educators and clinicians, we have a responsibility to cultivate—not waste—this valuable potential.

At the University of California Davis School of Medicine, we have established a mentorship culture that comes from a fundamental recognition that it builds community and makes all of us more successful. For example, our speed mentoring program enables junior faculty to get advice from chairs and department directors on topics such as improving time management, developing a national reputation, and obtaining research funding. In addition, we emphasize a collaborative and supportive resident environment in each department. Great examples of this include our general surgery and vascular surgery residency programs, which have fostered a sense of camaraderie that has enabled residents to listen to each other, collaborate on research, and enjoy outside activities together. Two female vascular surgery faculty members and I recently took 4 vascular surgery residents wine tasting in Napa County, California. These kinds of collegial activities have been cited as indicators of resident satisfaction.[4]

Mentorship and support is especially important for women. I was disheartened that this study showed a quarter of women leave surgical training programs compared with 15% of male residents. As a woman who has built a career in a traditionally male-dominated field, I can understand the unique challenges that female residents face, particularly conscious and unconscious biases that remain pervasive despite recent efforts for equality. Mentors for women don't have to be women—most of my early mentors were men—and male vascular surgeons do play a critical role in developing the careers of female residents, especially in parts of the country where there are few or no female vascular surgeon mentors.[5,6]

Ralph Waldo Emerson said, "Our chief want in life is somebody who will make us do what we can."[7] My mentors pushed me to reach higher when I could, and to keep going when times