Surgery 166 (2019) 726–734

Contents lists available at ScienceDirect

Surgery

journal homepage: www.elsevier.com/locate/surg

Presented at the Academic Surgical Congress 2019

The future of general surgery training: A Canadian resident nationwide Delphi consensus statement

Caroline Huynh, MD[a], Nathalie Wong-Chong, MD, MSc, FRCSC[b], Phil Vourtzoumis, MD, MSc[b], Stephanie Lim, MD[c], Wanda Marini, MD, MSc[d], Gurp Johal, MD, FRCSC[a], Matt Strickland, MD, MBA, FRCSC[c,e], Amin Madani, MD, PhD, FRCSC[f,*], On behalf of the Canadian Association of General Surgeons (CAGS) Resident Committee

[a] Department of Surgery, University of British Columbia, Vancouver, BC, Canada
[b] Department of Surgery, McGill University, Montreal, QC, Canada
[c] Department of Surgery, University of Manitoba, Winnipeg, MB, Canada
[d] Department of Surgery, University of Toronto, Toronto, ON, Canada
[e] Department of Surgery, LAC+USC Medical Center, University of Southern California, Los Angeles, CA, USA
[f] Department of Surgery, Columbia University College of Physicians and Surgeons, New York City, NY, USA

ARTICLE INFO

Article history:
Accepted 24 April 2019
Available online 4 July 2019

ABSTRACT

Background: Several models have been introduced to improve and restructure surgical training, but continued barriers exist. Residents are uniquely positioned to offer perspective on practical challenges and needs of reformatting surgical education. This study aimed to establish a nationwide, Delphi consensus statement on the perceptions of Canadian residents regarding the future of general surgery training.

Methods: Canadian general surgery residents participated in a moderated focus group using the Nominal Group Technique to discuss early subspecialization, competency-based medical education, and transition to practice. Qualitative verbal data were transcribed, categorized into themes, and synthesized into recommendation statements. During an iterative Delphi survey, resident leaders ranked each statement on a 5-point Likert scale of agreement. The survey was terminated once consensus was achieved ($\geq$2 survey rounds and Cronbach's $\alpha \geq 0.80$).

Results: A total of 66 statements were synthesized by 16 members of the Canadian Association of General Surgeons Resident Committee. A total of 49 residents participated in the Delphi consensus, which was achieved after 2 voting rounds (Cronbach's $\alpha = 0.93$). Participants agreed that (1) residency should focus on achieving standardized competencies and milestones based on resident ability to meet specific measurable metrics, (2) early streaming should be offered after "core" milestones and competencies have been achieved, and (3) an explicit period should allow transition-to-independent practice with tailored rotations, greater autonomy, and resident-run clinics. We identified 10 barriers to competency-based medical education implementation.

Conclusion: A nationwide consensus regarding the future of surgical training was established among current residents. These findings can inform and help implement guidelines and national curricula that meet the needs of the trainee and address the many challenges they face during their training.

Introduction

Delivery of surgical care has evolved considerably over the past few decades, with a greater emphasis on patient safety, specialization, patient outcomes, clinical auditing, value-driven care, accountability, and transparency in the operating room, as well as the introduction of novel technologies.[1,2] In light of these changes,

Presented at the 2019 annual meeting of the Academic Surgical Congress.

* Reprint requests: Amin Madani, MD, PhD, FRCSC, Department of Surgery, Columbia University College of Physicians and Surgeons, New York Presbyterian Hospital, Herbert Irving Pavilion 8th Floor, 161 Fort Washington Avenue, New York, NY 10032.
E-mail address: am5134@cumc.columbia.edu (A. Madani).

https://doi.org/10.1016/j.surg.2019.04.025
0039-6060/

surgical training programs have been forced to adapt to this new learning environment. Recent challenges include work-hour restrictions, decreased trainee autonomy, an expectation of more focused training, and increasing reliance on simulation-based training and performance assessments to meet standards of competency.[3–5] There has been a trend toward graduating the chief residents, finishing training with decreased case volumes, greater reliance on additional postresidency training (eg, clinical fellowship), and a decreased sense of autonomy for patient care, bringing into question overall resident preparedness for independent practice.[6,7]

Much effort has been made during the past 2 decades to restructure surgical training to address some of these emerging concerns. Among the various recommendations, 3 general themes have gained increasing popularity and momentum in Canada and elsewhere: (1) earlier subspecialization ("streaming") with training tailored to the intended career path of the individual trainee, (2) training based on the achievement of standardized milestones and competencies, and (3) implementation of a dedicated period of mentorship and graded responsibilities to transition into clinical practice.[2] Despite their generalized acceptance, the recommendations remain highly polarizing topics of debate within the surgical community and substantial obstacles remain related to their method of implementation, timing, and acceptance by training programs and administrators.

Competency-based medical education (CBME) has already been implemented for many years in orthopedics surgery at the University of Toronto (ON, Canada), and recent studies revealed that the use of competencies are a compelling tool to increase efficiency in the delivery of education.[8] After many pilot periods, the CBME model has also been officially launched for more than a year in several subspecialties across Canada, including otolaryngology and anesthesiology.[9,10] Beginning in 2019, the Royal College of Physicians and Surgeons of Canada will be implementing competency by design for surgery trainees to be fully functional by 2020.[11] In 2016, the American Board of Surgery released a statement supporting a competency-based framework to restructure the general surgery training, including evaluation of specific competencies and early subspecialization.[12] A large academic institution recently conducted a pilot study to evaluate entrustable professional activities in two common general surgery disease groups (breast and biliary), revealing various possible methods to evaluate residents, but this approach also raised concerns about the challenge of implementing competency by design itself. These concerns included defining diseases most amenable to competency-based education, relevant training milestones, and a fair and standardized method of evaluation.[13] Before implementing national guidelines and revising surgical curricula, it is critical to explore and elicit the opinions from the residents who will be at the core of these initiatives, to ensure a successful transition that meets their needs and addresses the practical challenges of reformatting surgical residency.

The purpose of this mixed-methods study is to establish a nationwide, Delphi consensus statement on the opinions and perceptions of Canadian general surgery residents regarding the future of general surgery training.

Methods

Study design

A two-part, mixed-methods study was performed that included a qualitative phase (Nominal Group Technique [NGT]) to explore and elicit the opinions and perceptions of general surgery residents followed by a quantitative phase (modified Delphi survey technique) to develop a consensus statement. This study protocol was approved by the institutional review board obtained at McGill University ([Montreal, QC, Canada] Study Number A07-B42-15B) and conforms to the Canadian Tri-Council Policy Statement of Ethical Conduct.

Table I
Template of questions used during the semistructured focus group

Early subspecialization ("streaming")
• What are some advantages of early subspecialization?
• What are some disadvantages of early subspecialization?
• What is early subspecialization to you, and how should it be integrated into training?
• What are some of the barriers to implementing early subspecialization?
• What is the role of clinical fellowship when implementing early subspecialization?
Transition-to-practice (TTP)
• What elements should be incorporated into a TTP period?
• How should a TTP period be implemented?
• What are some of the barriers to implementing a TTP period into residency training?
Competency-based medical education (CBME)
• What does competence mean to you?
• What is CBME to you?
• What are some advantages of a training program that is based on CBME model?
• What are some disadvantages of a training program that is based on CBME model?
• How do you define various competencies for surgical training?
• How do you evaluate the achievement of competencies? What are the milestones? What assessment tools with validity evidence would you use?
• How do you integrate assessment tools into training (eg, for formative feedback and summative evaluations)?
• How should programs track the achievement of competencies? Is there a role for electronic portfolios or mobile tracking systems?

Qualitative phase: Nominal group technique

At the Resident Committee retreat during the annual meeting of the Canadian Association of General Surgeons in February 2015, representatives from each general surgery residency program in Canada discussed current and future issues related to the training of general surgery residents. Participants included voted resident leaders tasked with representing the interests of their constituents at their respective institutions on a national level.

NGT was applied to structure the process of ideation throughout this session. NGT is a qualitative methodology used to derive an aggregation of the views of individual group members. Ideas are generated individually, deliberately, and without influential bias from other members and discussed subsequently as a group to prioritize and aggregate the ideas.[14] The session was moderated by two members (A.M. and N.W.C.) with experience in qualitative methodology. When appropriate, definitions for terminology were provided to panelists (eg, "competency-based medical education," "streaming," "validity evidence"). Using a semistructured focus group, participants of the task force were asked to discuss issues related to general surgery training across three domains: early subspecialization, transition to practice (TTP), and CBME. A list of predetermined questions was used to guide the focus group (Table I). Closed-ended, dichotomous questions and interruption of dialogue by the moderators were minimized to avoid bias or leading questions and to encourage discussion. A rank-ordered list was finalized by participants through the combination of similar and redundant items and the exclusion of irrelevant ones.

The focus group was audio recorded and transcribed verbatim. The two investigators (A.M. and N.W.C.) coded the transcriptions independently according to the three general themes. After data extraction, inductive thematic analysis was used to compare, match, merge, and refine additional items that may have emerged through the discussion but had not been identified formally by the focus group through the NGT. The final output from this phase of the study included a comprehensive list of items that served as the basis of the modified Delphi survey.

Quantitative phase: Delphi consensus

The list of items generated from the qualitative phase was then subjected to a Delphi process for external validation and to achieve consensus. This methodology is an iterative and anonymous survey used to establish consensus among members of a panel after several voting rounds under predefined conditions for consensus have been met.[14] Throughout each round, feedback is presented on the results of the previous round, giving participants the opportunity to change their opinion based on the influence of the group but avoiding the risk of bias from influential group members incurred during live group discussions.[14]

Canadian general surgery residents with more than 1 year of postgraduate training who at any time during their residency held a leadership position were invited to participate in a voluntary and anonymous Delphi survey. A leadership position was defined as an active membership within a student body committee, residency program committee, surgery curriculum committee, or any other resident representation (voted or appointed otherwise) at an institutional, provincial, national, or international level. Each round was administered online (http://fluidsurveys.com, Ottawa, Canada) for 4 weeks. Participants were asked to complete a demographic questionnaire and to rank each item according to their level of agreement, using a Likert scale of 1 (strong disagreement) to 5 (strong agreement). A free text, comment box also provided panelists the opportunity to comment on any item or to list additional items that, in their opinion, were not included in each round of the survey. Results from previous rounds were recirculated for each item, using the mean value of the agreement scale.

Statistical analysis

Consensus was predefined as a minimum of two survey rounds and internal consistency (Cronbach's $\alpha > 0.80$), a frequently used measurement in Delphi technique to reflect "homogeneity of opinion."[15] After consensus was achieved, final responses were evaluated to assess for either "positive," "negative," or "no" agreement with each item. An absolute minimum of two-thirds (67%) majority vote was used as the cutoff to characterize each item as "positive agreement" (>67% of respondents ranking the item as either 4 or 5, out of 5), or "negative agreement" (>67% of respondents ranking the item as either 1 or 2, out of 5). Items for which neither positive agreement or negative agreement criteria were achieved were deemed controversial and classified as "no agreement." Quantitative data are reported as *n* (%), mean (standard deviation), and median.

Results

Qualitative results

A total of 16 members of the Resident Committee of the Canadian Association of General Surgeons, including 1 from each general surgery residency program in Canada participated in a semistructured focus group that lasted 2 h. All were general surgery residents (median age: 30 y [28–31 y], male: 8 [50%]) in postgraduate year (PGY) 1 (6%), PGY 2 (6%), PGY 3 (44%), PGY 4 (31%), and PGY 5 (13%) level of training.

Through the NGT and focus group, a total of 66 items were synthesized and categorized into the 3 themes: early subspecialization ($n = 20$), CBME ($n = 26$), and TTP ($n = 20$). These were included in the subsequent Delphi process.

Quantitative results

A total of 94 general surgery resident leaders were invited to complete each round of the Delphi survey. Participating were 49 respondents (52% response rate) and 42 respondents (45% response rate) from 15 training programs throughout the country in the first and second rounds of the Delphi process, respectively. Demographic data were similar among panelists in both rounds of the survey (Table II). Consensus was achieved after 2 voting rounds (round 1: Cronbach's $\alpha = 0.92$; round 2: Cronbach's $\alpha = 0.93$) and summarized for each domain (Table III, Table IV, and Table V).

Most residents agreed that, although early streaming should not be discouraged, it should be offered to those in their last clinical years as a bridge to one's intended career path, but after "core" general surgery milestones and competencies have been achieved (Table III). Important considerations before changing current

Table II
Baseline characteristics of the focus group participants and Delphi survey participants for each round

	Focus group ($n = 16$)	Delphi round 1 ($n = 49$)	Delphi round 2 ($n = 42$)
Age (y)	30 [29–31]	30 [28–31]	30 [29–31]
Male/female	8 (50%)/ 8 (50%)	26 (53%)/ 23 (47%)	25 (60%)/ 17 (40%)
Postgraduate year			
1	1 (6%)	0 (0%)	0 (0%)
2	1 (6%)	7 (14%)	6 (14%)
3	7 (44%)	11 (22%)	9 (21%)
4	5 (31%)	11 (22%)	10 (24%)
5	2 (13%)	10 (20%)	9 (21%)
6	0 (0%)	8 (16%)	6 (14%)
7	0 (0%)	2 (4%)	2 (5%)
Program			
University of British Columbia	1 (6%)	3 (6%)	3 (7%)
University of Alberta	1 (6%)	1 (2%)	1 (2%)
University of Calgary	1 (6%)	2 (4%)	2 (5%)
University of Saskatchewan	1 (6%)	1 (2%)	2 (5%)
University of Manitoba	1 (6%)	4 (8%)	3 (7%)
Northern Ontario School of Medicine	1 (6%)	1 (2%)	1 (2%)
McMaster University	1 (6%)	3 (6%)	1 (2%)
University of Toronto	2 (13%)	15 (31%)	12 (29%)
Queen's University	1 (6%)	6 (12%)	5 (12%)
University of Ottawa	1 (6%)	2 (4%)	1 (2%)
Université de Sherbrooke	1 (6%)	1 (2%)	2 (5%)
Université Laval	1 (6%)	1 (2%)	1 (2%)
McGill University	1 (6%)	7 (14%)	5 (12%)
Dalhousie University	1 (6%)	1 (2%)	2 (5%)
Memorial University	1 (6%)	1 (2%)	1 (2%)
Intentions to pursue additional postresidency training (eg, fellowship)	11 (81%)	41 (84%)	33 (79%)
Planned practice			
Academic centre	10 (63%)	38 (78%)	32 (76%)
Community hospital	5 (31%)	12 (24%)	11 (26%)
Rural hospital	4 (25%)	8 (16%)	10 (24%)

NOTE: Results are presented as *n* (%) or median [interquartile range].

Table III
Delphi consensus results for items related to early subspecialization ("streaming")

Item	Round 1 ($n = 49$)			Round 2 ($n = 42$)			Final consensus*
	5 or 4	3	2 or 1	5 or 4	3	2 or 1	
General surgery training should be redesigned by introducing "streaming" in addition to foundational training?	26 (53%)	11 (22%)	12 (24%)	23 (55%)	16 (38%)	3 (7%)	No consensus
Early subspecialization and branching during residency into "streams" should be:							
• Optional	29 (59%)	12 (24%)	8 (16%)	24 (57%)	10 (24%)	8 (19%)	No consensus
• Offered during the PGY-3	11 (22%)	13 (27%)	23 (47%)	6 (14%)	19 (45%)	17 (40%)	No consensus
• Offered during the PGY-4	25 (51%)	15 (31%)	8 (16%)	28 (67%)	8 (19%)	6 (14%)	Positive
• Offered during the PGY-5 as a bridge to one's intended career path (eg, job or fellowship)	38 (78%)	5 (10%)	5 (10%)	34 (81%)	2 (5%)	6 (14%)	Positive
• Offered only after all "core" general surgery competencies have been achieved	34 (69%)	12 (24%)	3 (6%)	40 (95%)	2 (5%)	0 (0%)	Positive
• Offered to residents intending to become community or rural general surgeons	23 (47%)	16 (33%)	8 (16%)	20 (48%)	15 (36%)	7 (17%)	No consensus
• Offered to residents intending to pursue additional postresidency fellowship training	34 (69%)	10 (20%)	4 (8%)	34 (81%)	6 (14%)	2 (5%)	Positive
• Discouraged	5 (10%)	10 (20%)	33 (67%)	8 (19%)	5 (12%)	29 (69%)	Negative
Postgeneral surgery training (eg, fellowships) should be flexible and adaptable to complement streams, to meet the needs of the trainee and community?	34 (69%)	11 (22%)	2 (4%)	33 (79%)	9 (21%)	0 (0%)	Positive
Barriers to changing current general surgery training to one that is based on early subspecialization and streaming include:							
• Providing appropriate resident coverage for services that are not part of particular stream	35 (71%)	10 (20%)	2 (4%)	35 (83%)	6 (14%)	1 (2%)	Positive
• Defining "core" training that is essential to all general surgeons	39 (80%)	7 (14%)	3 (6%)	34 (81%)	7 (17%)	1 (2%)	Positive
• Prioritizing and ensuring core competencies are achieved before taking additional rotations tailored to their chosen career	30 (61%)	13 (27%)	3 (6%)	33 (79%)	6 (14%)	2 (5%)	Positive
• Providing flexibility to residents who may not have committed themselves to a particular stream	28 (57%)	19 (39%)	1 (2%)	30 (71%)	8 (19%)	4 (10%)	Positive
• Providing flexibility to residents who have committed themselves too early in residency and are considering changing stream	29 (59%)	16 (33%)	3 (6%)	33 (79%)	9 (21%)	0 (0%)	Positive
• Fair distribution of rotations to all residents, regardless of which stream they wish to pursue	37 (76%)	9 (18%)	1 (2%)	34 (81%)	2 (5%)	6 (14%)	Positive
• Ensuring that a stream does not overlap with further training that will be obtained after residency (eg, "mini-fellowship")	23 (47%)	16 (33%)	10 (20%)	16 (38%)	16 (38%)	9 (21%)	No consensus
• Changing the training paradigm and hospital culture for a smooth transition	28 (57%)	14 (29%)	6 (12%)	25 (60%)	14 (33%)	3 (7%)	No consensus
• Ensuring that streams are designed to meet the needs of the workforce and community	31 (63%)	10 (20%)	7 (14%)	26 (62%)	13 (31%)	3 (7%)	No consensus
• Ensuring transparent and effective communication between training programs offering streams and postgeneral surgery training programs (eg, fellowship)	31 (63%)	14 (29%)	4 (8%)	25 (60%)	15 (36%)	2 (5%)	No consensus

NOTE: Items were ranked according to level of importance to avoid morbidity on a Likert scale of 1 to 5 (1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree). Ratings reported as *n* (%).
PGY, postgraduate year.
* Consensus characterized as "positive agreement" (>67% rank 4 or 5), "negative agreement" (>67% rank 1 or 2), or "no agreement" (>67% rank 3 or neither positive or negative agreement criteria achieved).

training to one that is based on early subspecialization included the following: providing appropriate resident coverage for services that are not part of a particular stream, defining "core" training that is essential to all general surgeons, prioritizing and ensuring that residents achieve these core competencies before allowing them to take additional rotations that are tailored to their intended career path, and providing adequate flexibility to residents who may have either committed themselves too early and are considering a career change or who have not committed themselves to a particular career path. Furthermore, respondents agreed that it is fundamental for rotations to be distributed fairly to all residents, regardless of which stream they wish to pursue.

Most respondents agreed that general surgery residency should incorporate an explicit period of training, at the end of which allows residents to make the transition from residency to independent practice (Table IV). They further agreed that this period of training should be designed to provide chief residents the option to take additional rotations tailored to their intended career path with greater autonomy and patient ownership and with opportunities to develop skills related to managing and running a practice (eg, coding/billing, time management, contract negotiation, etc). There was also an overwhelming agreement that a TTP period should incorporate "resident clinics," whereby trainees manage patients longitudinally, with adequate supervision from attending surgeons, and with respect to all preoperative workup, operative interventions, postoperative management, and outpatient follow-up of the same patients by the same resident. Nevertheless, there was no agreement regarding the optimal timing of general surgery licensing examinations (eg, Royal College of Physicians and Surgeons of Canada general surgery specialty examination, American Board of Surgery qualifying and certifying examinations) to accommodate a TTP period at the end of residency.

The panelists agreed that general surgery residency should be restructured to incorporate a model that focuses on the achievement of standardized competencies and milestones throughout various levels of training. The residency should be based on the ability of the resident to meet specific and measurable metrics (Table V). Despite the fact that such a model was believed to provide trainees with increased clarity of expectations and help address and remediate deficiencies early and effectively, many

Table IV
Delphi consensus results for items related to establishing a "transition to practice" period

Item	Round 1 ($n = 49$)			Round 2 ($n = 42$)			Final consensus*
	5 or 4	3	2 or 1	5 or 4	3	2 or 1	
General surgery training should incorporate an explicit period of training at the end of residency that allows residents to make the transition from training to independent practice?	39 (80%)	7 (14%)	2 (4%)	36 (86%)	3 (7%)	3 (7%)	Positive
A "transition to practice" period should be:							
• Mandatory for all residents	28 (57%)	10 (20%)	10 (20%)	25 (60%)	8 (19%)	9 (21%)	No consensus
• Optional	17 (35%)	5 (10%)	25 (51%)	13 (31%)	14 (33%)	15 (36%)	No consensus
• Standardized	26 (53%)	10 (20%)	10 (20%)	23 (55%)	10 (24%)	9 (21%)	No consensus
• Designed to provide the option to take additional rotations tailored to one's intended career path	47 (96%)	2 (4%)	0 (0%)	42 (100%)	0 (0%)	0 (0%)	Positive
A "transition to practice" period should be designed to provide chief residents with:							
• Greater autonomy and patient ownership	46 (94%)	3 (6%)	0 (0%)	39 (93%)	2 (5%)	1 (2%)	Positive
• Opportunities for "shadow-billing"	44 (90%)	3 (6%)	2 (4%)	41 (98%)	0 (0%)	1 (2%)	Positive
• Opportunities to run general surgery "resident clinics"†	48 (98%)	0 (0%)	1 (2%)	40 (95%)	1 (2%)	1 (2%)	Positive
An explicit "transition to practice" period should provide trainees with exposure to the following practice management areas:							
• Coding and billing	47 (96%)	2 (4%)	0 (0%)	40 (95%)	1 (2%)	1 (2%)	Positive
• Finding a job	46 (94%)	2 (4%)	1 (2%)	39 (93%)	2 (5%)	1 (2%)	Positive
• Developing a network for referring physicians	34 (69%)	10 (20%)	5 (10%)	31 (74%)	9 (21%)	2 (5%)	Positive
• Scheduling operations	34 (69%)	12 (24%)	3 (6%)	32 (76%)	8 (19%)	2 (5%)	Positive
• Hiring administrative staff	25 (51%)	15 (31%)	9 (18%)	25 (60%)	11 (26%)	6 (14%)	No consensus
• Recruiting patients	21 (43%)	16 (33%)	12 (24%)	11 (26%)	27 (64%)	4 (10%)	No consensus
• Issues pertaining to insurance	36 (73%)	12 (24%)	1 (2%)	31 (74%)	11 (26%)	0 (0%)	Positive
• Time management	31 (63%)	16 (33%)	2 (4%)	29 (69%)	11 (26%)	2 (5%)	Positive
• Negotiating a contract	41 (84%)	5 (10%)	3 (6%)	30 (71%)	8 (19%)	4 (10%)	Positive
• Managing a practice	45 (92%)	3 (6%)	1 (2%)	39 (93%)	2 (5%)	1 (2%)	Positive
• Improving one's marketability for being hired as an attending	41 (84%)	6 (12%)	2 (4%)	30 (71%)	5 (12%)	7 (17%)	Positive
To accommodate a "transition to practice" period at the end of residency, the general surgery licensing examination should be:‡							
• At the end of the PGY-4	13 (27%)			13 (31%)			No consensus
• At the beginning of the PGY-5	13 (27%)			10 (24%)			
• In the middle of the PGY-5	11 (22%)			8 (19%)			
• Maintained in its current form at the end of the PGY-5	12 (24%)			11 (26%)			

NOTE: Items were ranked according to level of importance to avoid morbidity on a Likert scale of 1 to 5 (1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree). Ratings reported as *n* (%).
PGY, postgraduate year.
* Consensus characterized as "positive agreement" (>67% rank 4 or 5), "negative agreement" (>67% rank 1 or 2), or "no agreement" (>67% rank 3 or neither positive or negative agreement criteria achieved).
† *Surgery* "*resident clinics*," longitudinal management of patients including all preoperative workup, operative interventions, postoperative management, and outpatient follow-up of the same patients by the same resident, with appropriate supervision from attending surgeon.
‡ Item was rated using a single-response multiple choice format.

barriers were also identified to prevent the successful implementation of such a system (Table V). Furthermore, most respondents believe that performance-based assessments should be used to evaluate the level of competence of the graduating chief residents.

Discussion

Surgical care has changed considerably during the past 3 decades and this has placed substantial pressure on training programs to improve the efficiency and effectiveness of training and to ensure that graduates who enter the workforce have met the basic standards deemed necessary for patient safety.[1,2] The implementation of work-hour restrictions, CBME curricula, various simulation-based curricula for learning, and assessment are just a few of the many examples reflecting these changes.[4,16] Within this context, there are increasing concerns that many graduating chief residents are finishing residency training with a decreased overall preparedness for independent practice.[6,7] Despite the commitment of surgical educators, program directors, administrators, accreditations bodies, and surgical societies to overcome these issues, many obstacles remain. As surgical training changes, it is essential to develop guidelines that take into account the needs of trainees who are at the frontline of these changes and have valuable perspectives to help guide these efforts. This study established a nationwide resident consensus in Canada with regard to three major themes: early subspecialization ("streaming"), establishment of a training program based on the achievement of standardized milestones and competencies, and the implementation of a dedicated period of mentorship and graded responsibilities to transition into clinical practice.

Early subspecialization refers to providing a curriculum that allows tailoring within surgical training to the intended career path of the trainees. The current practice and case mix of general surgeons remain heterogenous and quite diversified, encouraging a surgical training that is broad in regard to technical and operative skills.[17] Specialization related to surgical outcomes has been the subject of much debate, and many studies and systematic reviews from various subspecialties suggest that an increased volume of practice does confer an outcome benefit in the fields of colorectal, endocrine, hepatobiliary, pancreatic, thoracic, and bariatric surgery.[18–27] One specific study reviewed data on the volume-outcome relationships of surgeons, with all operations combined, and acknowledged this positive correlation as well.[28] A great proportion of residents believe that the pursuit of fellowships is necessary to meet their career goals.[7] Further professional and technical skills development, access to jobs, surgical autonomy, networking, and future practice management are among the reasons some of our graduates pursue additional training.[29] In Canada, the perceived paucity of the general surgery job market has been cited as another factor leading trainees to pursue fellowships and subspecializations during the past

Table V
Delphi consensus results for items related to "competency-based training"

Item	Round 1 ($n = 49$)			Round 2 ($n = 42$)			Final consensus*
	5 or 4	3	2 or 1	5 or 4	3	2 or 1	
General surgery training should be restructured to incorporate some degree of a competency-based training	36 (73%)	9 (18%)	4 (8%)	36 (86%)	5 (12%)	1 (2%)	Positive
Graduating chief general surgery residents' level of "competence" should be evaluated using performance-based assessments (in the operating room or in a simulated environment) in addition to the final licensing examinations (oral and written)?	37 (76%)	8 (16%)	4 (8%)	30 (71%)	4 (10%)	8 (19%)	Positive
Competency-based training for general surgery training would:							
• Bridge the training gaps between residency programs across the country and provide a more standardized curriculum for all general surgery residents	17 (35%)	23 (47%)	9 (18%)	19 (45%)	19 (45%)	4 (10%)	No consensus
• Ensure higher educational standards of residency training nationwide	21 (43%)	17 (35%)	11 (22%)	21 (50%)	17 (40%)	4 (10%)	No consensus
• Provide residents with increased clarity of expectations and objectives throughout training	41 (84%)	4 (8%)	4 (8%)	39 (93%)	3 (7%)	0 (0%)	Positive
• Improve the quality and efficiency of surgical training	28 (57%)	17 (35%)	4 (8%)	27 (64%)	13 (31%)	2 (5%)	No consensus
• Allow training programs to address deficiencies early and to remediate milestones effectively	34 (69%)	11 (22%)	4 (8%)	35 (83%)	5 (12%)	2 (5%)	Positive
• Improve collegiality, equity, and sharing of operative cases among residents	10 (20%)	15 (31%)	24 (49%)	6 (14%)	13 (31%)	23 (55%)	No consensus
• Minimize time spent on activities not related to residents' ultimate clinical practice	28 (57%)	11 (22%)	10 (20%)	22 (52%)	14 (33%)	6 (14%)	No consensus
• Reduce time spent on activities that are indirectly related to residents' ultimate clinical practice? (eg, developing surgical skills in other areas/subspecialties that may improve overall performance)	18 (37%)	22 (45%)	9 (18%)	14 (33%)	25 (60%)	3 (7%)	No consensus
• Further worsen continuity of care of patients among residents	23 (47%)	16 (33%)	10 (20%)	9 (21%)	22 (52%)	11 (26%)	No consensus
• Improve patient safety	10 (20%)	24 (49%)	15 (31%)	7 (17%)	21 (50%)	14 (33%)	No consensus
• Reduce residents' willingness and motivation to further achieve excellence and mastery after reaching fundamental milestones	15 (31%)	15 (31%)	19 (39%)	4 (10%)	7 (17%)	31 (74%)	Negative
• Give trainees a false impression of long-term retention of competence after finally achieving a milestone	24 (49%)	13 (27%)	12 (24%)	8 (19%)	21 (50%)	13 (31%)	No consensus
• Diminish mentoring by faculty and other role models	10 (20%)	17 (35%)	22 (45%)	3 (7%)	15 (36%)	24 (57%)	No consensus
Barriers to changing current training to one that is based on the achievement of year-specific milestones ("competencies") include:							
• Providing clear, specific, and unambiguous definitions of the various "competencies"	40 (82%)	8 (16%)	1 (2%)	37 (88%)	5 (12%)	0 (0%)	Positive
• Providing clear, specific, and unambiguous definitions of the standards that define "competent" intraoperative and perioperative performance	39 (80%)	8 (16%)	2 (4%)	40 (95%)	2 (5%)	0 (0%)	Positive
• Availability of valid methods/tools to evaluate achievement of milestones	41 (84%)	7 (14%)	1 (2%)	39 (93%)	3 (7%)	0 (0%)	Positive
• Availability of user-friendly and convenient methods/tools for staff to evaluate residents in a timely fashion (eg, mobile apps)	38 (78%)	7 (14%)	4 (8%)	29 (69%)	9 (21%)	4 (10%)	Positive
• Providing ongoing/longitudinal assessments to ensure that competencies that have already been attained are maintained over time	41 (84%)	6 (12%)	2 (4%)	37 (88%)	3 (7%)	2 (5%)	Positive
• Availability of evaluation forms that provide meaningful and effective feedback to residents throughout training to highlight both strengths and weaknesses	34 (69%)	11 (22%)	4 (8%)	37 (88%)	3 (7%)	2 (5%)	Positive
• Infrastructure to pinpoint residents' weaknesses and provide adequate opportunities and feedback to improve those specific weaknesses to achieve "competence"	37 (76%)	11 (22%)	1 (2%)	38 (90%)	3 (7%)	1 (2%)	Positive
• Availability of e-portfolio that allows longitudinal progress tracking of milestones throughout residency	30 (61%)	15 (31%)	4 (8%)	11 (26%)	23 (55%)	8 (19%)	No consensus
• Ability for faculty to be versatile to accommodate trainees at various training stages	31 (63%)	15 (31%)	3 (6%)	22 (52%)	12 (29%)	8 (19%)	No consensus
• Logistic and scheduling issues to flexibly and fluidly change residents' rotations to ensure all residents are meeting their milestones (ie, logistic burden)	38 (78%)	11 (22%)	0 (0%)	36 (86%)	4 (10%)	2 (5%)	Positive
• Providing appropriate resident coverage for services that are underserviced	34 (69%)	14 (29%)	1 (2%)	29 (69%)	12 (29%)	1 (2%)	Positive
• Providing a remediation system for residents who are somewhat competent (lacking some, but not all, elements of competency) or incompetent	36 (73%)	7 (14%)	6 (12%)	28 (67%)	12 (29%)	2 (5%)	Positive

NOTE: Items were ranked according to level of importance to avoid morbidity on a Likert scale of 1 to 5 (1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree). Ratings reported as *n* (%).

* Consensus characterized as "positive agreement" (>67% rank 4 or 5), "negative agreement" (>67% rank 1 or 2), or "no agreement" (>67% rank 3 or neither positive or negative agreement criteria achieved).

decade, regardless of their intentions to pursue careers in the community or academic centers.[30] With this framework, residents can benefit from having dedicated rotations prior to fellowship or practice.[31] In our study, most residents agreed that, after core general surgery milestones and competencies have been achieved, early subspecialization and streaming should not be discouraged but rather offered to interested residents in their last clinical years. Residents agreed that before implementing such a system, it is important to find a way to prioritize core training that is essential for every general surgeon before allowing residents to concentrate on their specific rotations. To help make this possible, they recommended providing adequate coverage for services that are not part of a particular stream, as well as a fair distribution of rotations to all residents within a training program. This approach may ultimately be difficult to achieve and requires solutions that are tailored to specific training programs based on many factors (eg, program size, total number and case volume of "popular" services, availability of residents to cross cover, work-hour regulations restricting coverage, and availability of resources to alleviate resident coverage such as physician assistants and other healthcare personnel). Finally, for any change to be sustainable and to avoid any unplanned consequences, surveyed residents recommended providing adequate flexibility to residents who may have committed themselves too early, are considering a career change, or are not committed to a particular career path.

CBME is a new and alternative model of education and training that relies on the achievement of key milestones and competencies deemed necessary for independent practice. In Canada, the Royal College of Physicians and Surgeons of Canada has committed itself to implement this pedagogic model based on changes in surgical care and surgical training. CBME was first introduced in anesthesiology and otolaryngology in 2017 and 2018, respectively. Before implementation of CBME for specific specialties, program directors, in concert with residents, education researchers, educators, and licensing and accreditation bodies as well as allied health care professionals, performed thorough literature reviews and qualitative studies to identify potential advantages and challenges. Advantages include a personalized program to match the needs of the trainees, an efficient training system, and a regular feedback system.[32,33] For instance, residents who may be doing well will have the opportunity to receive feedback more frequently, be aware early of already-achieved goals, and therefore, direct their education to meet their educational needs and aspirations. In contrast, residents who may be falling behind will be identified earlier and receive timely feedback. These residents would be given the opportunity to improve earlier and strive to meet specific goals. Potential challenges include maintaining shared definitions of competencies, defining outcome measurements, and creating tools to evaluate them.[32,33] In otolaryngology, several performance assessments, including global and task-specific rating scales and checklists, were identified and implemented as part of the curriculum.[34] Other tools with a wide range of validity evidence used to evaluate entrustable professional activities in surgical specialties include multiple-choice examinations, operative performance rating systems, objective structured clinical examinations, objective structured assessment of technical skills, workplace-based assessments, and simulation.[13,35–37] In 2015, a Delphi survey was performed among Canadian general surgery program directors who identified 101 unique procedures and tasks categorized as junior and/or senior level and provided a very broad framework for a competency-based, pedagogic model.[3] As outlined in this study, however, important practical issues remain to be addressed before a CBME model can be implemented successfully. Perhaps one of the greatest challenges is the lack of consensus and ongoing understanding of the term "competence," as well as a robust methodology to measure standards that define competence. With regard to intraoperative performance, there is a wealth of evidence suggesting that adverse events, complications, and overall surgical performance are highly correlated with cognitive behaviors and advanced mental processes that are responsible for intraoperative decision-making and judgment.[38–44] Nevertheless, these skills are substantially underrepresented, and most performance assessment tools remain task-specific and lack robust measurement properties of these advanced skills. A recent qualitative study developed a universal framework for intraoperative performance and defined 5 distinct domains: psychomotor skills, declarative knowledge, advanced cognitive skills, interpersonal skills, and personal resourcefulness.[45] Within the advanced cognitive skills domain, there is a strong focus on cognitive behaviors that exemplify surgical expertise. To produce a standardized definition of competence, it may be more feasible eventually to diverge away from having procedure-specific and task-specific definitions and implement a system whereby competence is achieved by one's ability to excel in these 5 domains and exemplify these important behaviors that are strongly linked to surgical expertise. Once adequate assessment tools have been developed, most respondents agreed with the idea of having a training program that focuses on individual resident achievement of standardized competencies and milestones tailored to various levels of training, and whose progression through these milestones is based on their ability to meet specific and measurable metrics. Although such a model was believed theoretically to provide trainees with more clarity in regard to expectations and remediate deficiencies early, other challenges included the logistics of providing and receiving evaluations, defining weaknesses followed by appropriate remediation, and providing appropriate resident coverage while promoting flexibility in scheduling resident rotations.

The idea of a TTP period seems to arise from a perceived lack of preparedness and confidence of chief residents to start independent practice.[6,7] A common concern is that fellowship periods may have replaced the role of the chief resident, where there is a gradual development of autonomy for TTP, specifically with regard to patient ownership, certain key operative skills, and research.[46] Development of autonomy is critical for surgical practice, and most residents report that they have not achieved it within the allotted time of a 5-y training program.[47] In light of this trend, pilot projects at various academic institutions have been implemented with the aim to provide graduating chief residents with a period of independent decision-making, operative autonomy, mentoring by senior surgeons, and experience with practice management.[48,49] In a recent study at a single institution, a period of structured operative autonomy for chief residents was adopted, which provided them with an opportunity to slowly transition to a simulated year of practice. This program not only improved resident autonomy but did so without any negative impact on patient outcomes.[50] In addition, the Zwisch model of intraoperative autonomy has been shown to be a valuable and feasible framework to help develop and assess autonomy and readiness for independent practice.[51,52] In our study, most residents agreed that a new curriculum for general surgery residency should incorporate an explicit period at the end of training that allows residents to make a smoother transition from residency to independent practice, especially with dedicated "resident clinics," options to take additional rotations tailored to their intended career path, with more autonomy and patient ownership, as well as opportunities to develop skill sets related to managing and running a practice.

This study has a few limitations worth highlighting. For the initial qualitative component of the study, resident leaders, despite being representative of each general surgery training program in

Canada, were only the members of the Resident Committee of the Canadian Association of General Surgeons, which may not have been an adequate breadth of representation of all opinions of residents in the Canadian general surgery residencies to determine the items of the initial survey. Furthermore, panelists for the Delphi consensus included general surgery residents who at any time during their residency held a leadership position. This definition may have also potentially biased opinions. Nevertheless, participants of both phases of this study included a diverse group of residents from all training programs, with a distribution that was consistent with program size and a sample whose intended careers paths were representative of today's workforce.

In conclusion, this mixed-methods study established a nationwide consensus on the opinions and perceptions of Canadian general surgery residents regarding the future of general surgery training. These findings can be used by licensing bodies and surgical societies to implement guidelines and national curricula that meet the needs of trainees and address the many challenges that would otherwise prevent a successful transition.

Acknowledgments

We acknowledge the contribution and participation of all surgical residents in this study.

Conflict of interest

The authors have indicated that they have no conflicts of interest regarding the content of this article.

References

1. Webber EM, McAlister VC, Gorman L, Taber S, Harris KA. The past and future of the generalist general surgeon. *Can J Surg*. 2014;57:6–7.
2. Webber EM, Ronson AR, Gorman LJ, Taber SA, Harris KA. The future of general surgery: Evolving to meet a changing practice. *J Surg Educ*. 2016;73:496–503.
3. Szasz P, Louridas M, de Montbrun S, Harris KA, Grantcharov TP. Consensus-based training and assessment model for general surgery. *Br J Surg*. 2016;103:763–771.
4. Sudarshan M, Hanna WC, Jamal MH, Nguyen LH, Fraser SA. Are Canadian general surgery residents ready for the 80-hour work week? A nationwide survey. *Can J Surg*. 2012;55:53–57.
5. Safavi A, Lai S, Butterworth S, Hameed M, Schiller D, Skarsgard E. Does operative experience during residency correlate with reported competency of recent general surgery graduates? *Can J Surg*. 2012;55:S171–S177.
6. Elfenbein DM. Confidence crisis among general surgery residents: A systematic review and qualitative discourse analysis. *JAMA Surg*. 2016;151:1166–1175.
7. Nadler A, Ashamalla S, Escallon J, Ahmed N, Wright FC. Career plans and perceptions in readiness to practice of graduating general surgery residents in Canada. *J Surg Educ*. 2015;72:205–211.
8. Nousiainen MT, Mironova P, Hynes M, et al. Eight-year outcomes of a competency-based residency training program in orthopedic surgery. *Med Teach*. 2018:1–13.
9. Faucett EA, Barry JY, McCrary HC, Saleh AA, Erman AB, Ishman SL. Otolaryngology resident education and the Accreditation Council for Graduate Medical Education Core Competencies: A systematic review. *JAMA Otolaryngol Head Neck Surg*. 2018;144:360–370.
10. Stodel EJ, Wyand A, Crooks S, Moffett S, Chiu M, Hudson CC. Designing and implementing a competency-based training program for anesthesiology residents at the University of Ottawa. *Anesthesiol Res Pract*. 2015;2015:713038.
11. *Competence by Design (CBD)*. 2019. Royal College of Physicians and Surgeons of Canada, Ottawa, Canada. Available from: http://www.royalcollege.ca/portal/page/portal/rc/common/documents/canmeds/cbd/what_is_cbd_e.pdf. Accessed February 26, 2015.
12. *The American Board of Surgery envisions a new paradigm for general surgery training, with greater autonomy and flexibility [press release]*. Philadelphia, PA: American Board of Surgery Inc; 2016.
13. Steiman J, Sullivan SA, Scarborough J, et al. Measuring competence in surgical training through assessment of surgical entrustable professional activities. *J Surg Educ*. 2018;75:1452–1462.
14. Jones J, Hunter D. Consensus methods for medical and health services research. *BMJ*. 1995;311:376–380.
15. Louridas M, Szasz P, Montbrun S, Harris KA, Grantcharov TP. Optimizing the selection of general surgery residents: A national consensus. *J Surg Educ*. 2017;74:100–107.
16. Moorman ML, Capizzani TR, Feliciano MA, French JC. A competency-based simulation curriculum for surgical resident trauma resuscitation skills. *Int J Crit Illn Inj Sci*. 2017;7:241–247.
17. Decker MR, Dodgion CM, Kwok AC, et al. Specialization and the current practices of general surgeons. *J Am Coll Surg*. 2014;218:8–15.
18. Biondo S, Kreisler E, Millan M, et al. Impact of surgical specialization on emergency colorectal surgery outcomes. *Arch Surg*. 2010;145:79–86.
19. Anwar S, Fraser S, Hill J. Surgical specialization and training—Its relation to clinical outcome for colorectal cancer surgery. *J Eval Clin Pract*. 2012;18:5–11.
20. Archampong D, Borowski D, Wille-Jorgensen P, Iversen LH. Workload and surgeon's specialty for outcome after colorectal cancer surgery. *Cochrane Database Syst Rev*. 2012:CD005391.
21. Adam MA, Thomas S, Youngwirth L, et al. Is there a minimum number of thyroidectomies a surgeon should perform to optimize patient outcomes? *Ann Surg*. 2017;265:402–407.
22. Al-Qurayshi Z, Robins R, Hauch A, Randolph GW, Kandil E. Association of surgeon volume with outcomes and cost savings following thyroidectomy: A national forecast. *JAMA Otolaryngol Head Neck Surg*. 2016;142:32–39.
23. Al-Qurayshi Z, Robins R, Buell J, Kandil E. Surgeon volume impact on outcomes and cost of adrenal surgeries. *Eur J Surg Oncol*. 2016;42:1483–1490.
24. Alsfasser G, Leicht H, Günster C, Rau BM, Schillinger G, Klar E. Volume-outcome relationship in pancreatic surgery. *Br J Surg*. 2016;103:136–143.
25. Gooiker GA, van Gijn W, Wouters MW, et al. Systematic review and meta-analysis of the volume-outcome relationship in pancreatic surgery. *Br J Surg*. 2011;98:485–494.
26. Huo YR, Phan K, Morris DL, Liauw W. Systematic review and a meta-analysis of hospital and surgeon volume/outcome relationships in colorectal cancer surgery. *J Gastrointest Oncol*. 2017;8:534–546.
27. Mamidanna R, Ni Z, Anderson O, et al. Surgeon volume and cancer esophagectomy, gastrectomy, and pancreatectomy: A population-based study in England. *Ann Surg*. 2016;263:727–732.
28. Morche J, Mathes T, Pieper D. Relationship between surgeon volume and outcomes: A systematic review of systematic reviews. *Syst Rev*. 2016;5:204.
29. Watanabe Y, Madani A, Bilgic E, et al. Don't fix it if it isn't broken: A survey of preparedness for practice among graduates of Fellowship Council-accredited fellowships. *Surg Endosc*. 2017;31:2287–2298.
30. Decker MR, Bronson NW, Greenberg CC, Dolan JP, Kent KC, Hunter JG. The general surgery job market: Analysis of current demand for general surgeons and their specialized skills. *J Am Coll Surg*. 2013;217:1133–1139.
31. Osman H, Parikh J, Patel S, Jeyarajah DR. Are general surgery residents adequately prepared for hepatopancreatobiliary fellowships? A questionnaire-based study. *HPB (Oxford)*. 2015;17:265–271.
32. Boet S, Pigford AA, Naik VN. Program director and resident perspectives of a competency-based medical education anesthesia residency program in Canada: A needs assessment. *Korean J Med Educ*. 2016;28:157–168.
33. Fraser AB, Stodel EJ, Chaput AJ. Curriculum reform for residency training: Competence, change, and opportunities for leadership. *Can J Anaesth*. 2016;63:875–884.
34. Wagner N, Fahim C, Dunn K, Reid D, Sonnadara RR. Otolaryngology residency education: A scoping review on the shift towards competency-based medical education. *Clin Otolaryngol*. 2017;42:564–572.
35. Garofalo M, Aggarwal R. Obstetrics and gynecology modified Delphi survey for entrustable professional activities: Quantification of importance, benchmark levels, and roles in simulation-based training and assessment. *Cureus*. 2018;10:e3051.
36. Dwyer T, Wright S, Kulasegaram KM, et al. How to set the bar in competency-based medical education: Standard setting after an objective structured clinical examination (OSCE). *BMC Med Educ*. 2016;16:1.
37. Kassam A, Cowan M, Donnon T. An objective structured clinical exam to measure intrinsic CanMEDS roles. *Med Educ Online*. 2016;21:31085.
38. White EJ, McMahon M, Walsh MT, Coffey JC, O Sullivan L. Toward a model of human information processing for decision-making and skill acquisition in laparoscopic colorectal surgery. *J Surg Educ*. 2018;75:749–757.
39. Madani A, Watanabe Y, Bilgic E, et al. Measuring intra-operative decision-making during laparoscopic cholecystectomy: Validity evidence for a novel interactive Web-based assessment tool. *Surg Endosc*. 2017;31:1203–1212.
40. Rogers SO, Gawande AA, Kwaan M, et al. Analysis of surgical errors in closed malpractice claims at 4 liability insurers. *Surgery*. 2006;140:25–33.
41. Gawande AA, Thomas EJ, Zinner MJ, Brennan TA. The incidence and nature of surgical adverse events in Colorado and Utah in 1992. *Surgery*. 1999;126:66–75.
42. Sanfey H, Williams RG, Chen X, Dunnington GL. Evaluating resident operative performance: A qualitative analysis of expert opinions. *Surgery*. 2011;150:759–770.
43. Way LW, Stewart L, Gantert W, et al. Causes and prevention of laparoscopic bile duct injuries: Analysis of 252 cases from a human factors and cognitive psychology perspective. *Ann Surg*. 2003;237:460–469.
44. Cuschieri A, Francis N, Crosby J, Hanna GB. What do master surgeons think of surgical competence and revalidation? *Am J Surg*. 2001;182:110–116.
45. Madani A, Vassiliou MC, Watanabe Y, et al. What are the principles that guide behaviors in the operating room?: Creating a framework to define and measure performance. *Ann Surg*. 2017;265:255–267.

46. Mattar SG, Alseidi AA, Jones DB, et al. General surgery residency inadequately prepares trainees for fellowship: Results of a survey of fellowship program directors. *Ann Surg*. 2013;258:440–449.
47. George BC, Bohnen JD, Williams RG, et al. Readiness of US general surgery residents for independent practice. *Ann Surg*. 2017;266:582–594.
48. Cogbill TH, Shapiro SB. Transition from training to surgical practice. *Surg Clin North Am*. 2016;96:25–33.
49. Jarman BT, O'Heron CT, Kallies KJ, Cogbill TH. Enhancing confidence in graduating general surgery residents: Establishing a chief surgery resident service at an independent academic medical center. *J Surg Educ*. 2018;75:888–894.
50. Wojcik BM, Fong ZV, Patel MS, et al. Structured operative autonomy: An institutional approach to enhancing surgical resident education without impacting patient outcomes. *J Am Coll Surg*. 2017;225:713–724 e2.
51. George BC, Teitelbaum EN, Meyerson SL, et al. Reliability, validity, and feasibility of the Zwisch scale for the assessment of intraoperative performance. *J Surg Educ*. 2014;71:e90–e96.
52. Sandhu G, Magas CP, Robinson AB, Scally CP, Minter RM. Progressive entrustment to achieve resident autonomy in the operating room: A national qualitative study with general surgery faculty and residents. *Ann Surg*. 2017;265:1134–1140.