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Why is Ontario becoming a have not medical province?

The Ontario government has once again been making unilateral decisions for doctors. It is obviously not much of a partnership if one side makes all the decisions. Past decisions have directly impacted surgeons with changes in billing parameters and call situations. Ontario has taken a heavy-handed approach, and historically with most medical direction in this country, as goes Ontario so goes Canada. Other provinces have taken Ontario’s one-sided approach, and it may not be long until this is a Canadian trend. Last year the Quebec government passed legislation that put unprecedented power in the hands of the government — mainly the office of the minister of health. They now hold most of the power in negotiations with the physicians in the province. The newer decisions coming down from Ontario may seem to have less direct impact on surgeons, but will impact us all the same.

Currently there are more than 800 000 Ontarians without a family doctor. About 140 000 people are added to the population of Ontario each year. In the face of these numbers the Ontario government has decided to cut 50 residency positions in family medicine (FM). Although it was estimated that program expansion in the last decade helped to provide care to 2.1 million Ontarians who now have access to primary health care services and are no longer “unattached” patients, the government is now looking to roll this program back. This decision is not in patients’ or physicians’ best interests.

I am unsure of the fiscal reasons for closing FM residency spots without closing medical school positions. If the government was being logical, these cuts would probably have to go hand in hand. As post–medical school training is mandatory, the closing of FM spots will push candidates into specialty training, expanding specialist services over those of FM programs. Specialty care — both for training and practice — is more expensive for the government.

In Quebec, access to primary care is so poor that patients end up in surgical clinics for referral to non-surgical services and for prescription of medication because it is easier to see the specialist than find a family doctor. Patients with no other access to health care who keep coming back to surgical clinics will count against surgical number restrictions. This fine balance of patient care between FM practitioners and specialists is precariously near a tipping point in many regions of the country.

Unilateral government management of health care is not desirable for physicians or the patients who depend on us to treat them promptly and efficiently. We once looked to Ontario, and later to Alberta, as a strong medical leadership group protecting physicians’ and patients’ interests. Certainly the Ontario Medical Association (OMA) is under siege. Once so powerful that it could hold a province hostage by calling for a general strike, the OMA has fallen from prominence. The OMA has seemed to back down from protecting even fees for basic services. Who would have thought that the colonoscopy fee in Quebec would ever be higher than in Ontario? Well that magic line has now been crossed and even eclipsed in all other provinces. The time where we looked to Ontario for leadership might be over, but if we don’t all stand together with Ontario and ensure that physician opinion matters, then our practice profiles are going to change radically — and not for the better.

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Coeditor, Canadian Journal of Surgery

Competing interests: E.J. Harvey is the Chief Medical Officer of Greybox Healthcare (Montréal) and Chairman of the Board of NXTSens Inc. (Montréal).

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Reference

Pourquoi l’Ontario devient-elle une province déficiente sur le plan médical?

Encore une fois, le gouvernement de l’Ontario prend des décisions unilatérales touchant les médecins. De toute évidence, on ne peut parler vraiment de partenariat si un côté prend toutes les décisions. Par le passé, les décisions du gouvernement ont eu une incidence directe sur les chirurgiens quand les paramètres de facturation et les modalités de garde ont été modifiés. L’Ontario a adopté une approche musclée et, historiquement, pour la plupart des orientations médicales dans ce pays, le Canada suit les traces de l’Ontario.

D’autres provinces ont adopté l’approche unilatérale de l’Ontario et l’on observera peut-être bientôt cette tendance dans tout le pays. L’an dernier, le gouvernement du Québec a adopté une loi qui donne un pouvoir sans précédent au ministre de la Santé pour négocier avec les médecins de la province. De prime abord, les récentes décisions en Ontario peuvent sembler avoir une incidence moindre sur les chirurgiens, mais elles auront néanmoins une incidence sur nous tous.

Actuellement, plus de 800 000 citoyens de l’Ontario n’ont pas de médecin de famille. La population de l’Ontario augmente d’environ 140 000 personnes par année. Devant cette situation, le gouvernement de la province a décidé de couper 50 postes de résidence en médecine familiale. On estime que l’expansion du programme au cours des 10 dernières années a permis de fournir des soins à 2,1 millions d’Ontariens qui ont maintenant accès à des services de santé primaires et ne sont donc plus des patients sans médecin attitré. Or, le gouvernement cherche maintenant à réduire ce programme. Cette décision n’est pas dans le meilleur intérêt des patients ou des médecins.

Je ne connais pas les raisons budgétaires qui sont à l’origine de la fermeture de postes de résidence en médecine familiale sans réduction correspondante du nombre de places dans les facultés de médecine. Si le gouvernement faisait preuve de logique, ces 2 mesures auraient probablement été prises en même temps. Comme la formation postdoctorale est obligatoire, la fermeture de postes en médecine familiale forcera les candidats à choisir une formation spécialisée, de sorte que les services de spécialistes prendront de l’expansion au détriment des programmes de médecine familiale. Or, les soins spécialisés — tant au niveau de la formation que de la pratique — coûtent plus cher au gouvernement.

Au Québec, l’accès aux soins primaires est si limité que les patients se rendent dans des cliniques chirurgicales pour obtenir une référence pour des services non chirurgicaux ou des ordonnances de médicaments, car il est plus facile de consulter un spécialiste que de trouver un médecin de famille. Les patients n’ayant aucun autre accès aux soins de santé qui continueraient d’aller dans des cliniques chirurgicales compteront dans l’application des limites imposées au nombre de consultations effectuées par les chirurgiens. Cet équilibre délicat entre les soins des médecins de famille et les soins des spécialistes est près du point de bascule dans de nombreuses régions du pays.

La gestion unilatérale des soins de santé par le gouvernement n’est souhaitable ni pour les médecins ni pour les patients, qui comptent sur nous pour être traités rapidement et efficacement. L’Ontario (et plus tard l’Alberta) a déjà été perçu comme modèle de leadership médical solide qui protégeait les intérêts des médecins et des patients. Certes, l’Association médicale de l’Ontario (AMO) est en état de siège. Elle, qui a déjà été si puissante qu’elle pouvait tenir la province en otage en lançant un appel à la grève générale, a perdu du terrain. L’AMO a semblé renoncer à protéger les honoraires des médecins même pour des services de base. Qui aurait cru que les honoraires pour une coloscopie au Québec seraient un jour plus élevés qu’en Ontario? Eh bien, cette ligne magique a été franchie et même éclipsée dans toutes les autres provinces. Le temps où nous pouvions nous attendre à du leadership de la part de l’Ontario pourrait bien être révolu, mais si nous ne sommes pas solidaires des médecins de l’Ontario, si nous ne veillons pas à ce que les opinions des médecins soient prises en compte, nos profils de pratique vont changer radicalement — et non pour le mieux.

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Référence
A small grant funding program to promote innovation at an academic research hospital

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Innovation in health care is an important strategy to improve quality of care. While research by its very nature generates new knowledge, it often does not directly improve clinical outcomes. Improvement in clinical care requires innovation, such as new technology or models of care, in addition to research.

The innovation pathway starts with an idea and ends with successful application.1 The challenge for health care institutions with limited funds is how to encourage clinical innovation at the earliest stages. In research, “seed” grants with small amounts of money have been effective in allowing researchers to obtain valuable pilot data to test novel ideas that can be further explored through larger grants when indicated. While grants are a standard approach to support research, there has been little attention to seed funding for idea development in clinical settings.2 Although possibly insufficient to complete an entire research project, small grants have the potential advantage of allowing a greater number of projects to test new ideas. We propose that small grants are a useful strategy to stimulate innovation in a health care setting.

In July 2010, a small grant innovation funding program was initiated at the Hospital for Sick Children (SickKids) for the Perioperative Services group. The program awarded relatively small funds (up to $10 000) in order to stimulate innovation. Of 48 applications, 26 (54.2%) different innovation projects were funded for a total allocation of $227 870. This program demonstrated the ability of small grants to stimulate many applications with novel ideas, a wide range of innovations and reasonable academic productivity.

Summary

Innovation is important for the improvement of health care. A small grant innovation funding program was implemented by the Hospital for Sick Children (SickKids) for the Perioperative Services group, awarding relatively small funds (approximately $10 000) in order to stimulate innovation. Of 48 applications, 26 (54.2%) different innovation projects were funded for a total allocation of $227 870. This program demonstrated the ability of small grants to stimulate many applications with novel ideas, a wide range of innovations and reasonable academic productivity.
granted was sufficient to complete the original objectives proposed. Additional funding to supplement the initial grant was obtained by 15% of applicants, totaling $233,700. Of the 48 applicants, 86% were satisfied with the small grant innovation funding program, and the majority agreed that the availability of many small grants was better than few large grants. The types of innovations from the small grant innovation funding program were extremely diverse. Of the 26 funded projects, 50% of the innovations created or will create beneficial change in clinical care, including the creation of a computer algorithm to reduce out-of-window wait times, assessment of clinically relevant doses of hypertonic saline in children undergoing cardiac catheterization during general anesthesia, analysis of laryngotracheal vasculature using corrosion casting, and the development of multidimensional strategies to improve the quality of the prebriefing component of the SickKids surgical safety check list. Novel devices were created in 31% of the 26 funded projects, including a pediatric intubating facemask; a bedwetting alarm for urinary incontinence in children with neurogenic bladder; and the development of software and hardware to track, measure and compare the movement of instruments in a laparoscopic simulator. Innovative educational models were developed in 19% of the projects, consisting of integrating telemedicine into an outpatient surgical clinic, casting simulation, developing a bronchoscopy training platform, and creating an educational program regarding communication in resuscitation roles in the critical care unit. Of the funded projects, 27% led to an average of 2 published papers, 27% were at the stage of preparing a manuscript, 31% led to an average of 2 abstracts, and 35% were at the stage of submitting an abstract.

Innovation in health care has the potential to enhance many processes to improve access, quality and affordability through new and creative approaches. Irrespective of the amounts of money available for funding innovation, the challenging question for health care institutions is whether to invest in several large projects or many small projects. While there are no firm guidelines, many research grants have minimal amounts of approximately $50,000. The results of this program suggest that small amounts of money encouraged more applications from a greater number of applicants. Not only would large grants have resulted in much fewer projects, smaller grants may have encouraged applications from researchers discouraged by large grants.

We identified several ways to improve our program. First, a timeline to complete the proposed innovations needs to be established, and funding for incomplete projects returned. Second, a budget tracking template should be completed at least quarterly to ensure accountability and allow an opportunity for applicants to communicate difficulties they may be experiencing that would potentially require an extended deadline. Third, the decision not to fund was largely based on a determination that a project was “not innovative enough.” Applicants questioned the program’s lack of definition of innovation, suggesting that the definition should be more explicit.

In summary, the small grant innovation funding program at SickKids achieved its goal of allowing clinicians with innovative ideas to develop them by applying for grants where there were no other avenues for funding. For the cost of 1 “standard” principal investigator–led grant ($233,700) this program stimulated 26 investigators to explore innovation that had many diverse impacts across SickKids.

Affiliations: From the Royal College of Surgeons in Ireland, Dublin, Ireland (Orrell); the Division of Orthopaedics, Hospital for Sick Children, Toronto, Ont., (Yankanah); and the Department of Surgery, The Hospital for Sick Children, Toronto, Ont. (Heon, Wright).

Funding: The Hospital for Sick Children Foundation.

Competing interests: None declared.

Contributors: All authors contributed substantially to the conception, writing and revision of this commentary and approved the final version for publication.

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Are surgeons happy in practice? Examining a quarter-century of Alberta’s surgical graduates

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SUMMARY
Every year, hundreds of new surgeons graduate from residency programs across Canada. Much time and effort is spent on preparing these surgeons for independent practice, but there is little literature about the career trajectories of surgeons after they finish training and enter practice. We surveyed all surgeons graduating from the residency programs of a single Canadian medical school over 25 years (1985–2010). Most respondents rated their job satisfaction as high/very high and indicated they would still pursue a residency in surgery and/or their specialty if they had it to do over again. This commentary discusses important information about where our graduates go and what their careers are like, challenging existing stereotypes about careers in surgery. Our survey findings should be communicated to students interested in careers in surgery.

Much literature exists about the teaching of surgery in medical school and surgical residency. There is, however, a paucity of information about what happens to surgeons after they graduate from residency and go into independent practice. Little has been written about practising surgeons in terms of what their professional lives are like, and what provides them with satisfaction in their lives and careers. In popular culture, television dramas often present a stereotype of the practising surgeon as being overworked and unhappy and facing personal problems related to being “married to the job.” Negative stereotyping is not unique to surgery, but the image of the overworked and miserable surgeon may explain why many medical students do not consider a career in surgery.

The purpose of our project was to examine the professional lives of Canadian surgeons in practice. We chose a cohort of surgeons who had graduated from the residency programs of a single Canadian university over a 25-year period. We aimed to learn more about their lives and practice and to see whether stereotypes presented by popular culture were supported by data. We chose to focus specifically on physician job satisfaction, as this has been identified as an important factor in patient outcomes. We also hoped that gaining a better understanding of the opportunities and challenges faced by surgeons in practice might allow us to better prepare today’s graduates for their careers.

WHO RESPONDED?

All 389 surgery residents who graduated from the University of Alberta between January 1985 and December 2010 were identified. Of these, 7 were deceased and 13 could not be traced. We used an anonymous online mixed-methods survey to collect information. Questions were chosen based on a review of the literature and were a combination of selected response items, Likert scales, and open-ended constructed response.
items. We piloted a draft version of the survey with 5 local surgeons who provided feedback and suggested changes. The final version of the survey contained 44 items in 4 main areas: demographics, current surgical practice, job satisfaction and questions related to residency training.

Over the course of a month, 161 graduates completed the online questionnaire (42% response rate). The male:female ratio was 7:1. More than three-quarters of respondents were between 35 and 54 years old; only 12% were older than 54 years. Most (84%) respondents were married or living with a partner; 7.6% were divorced. The modal number of children was 2. More than half of respondents were located in Alberta, and almost three-quarters were located in Canada; other graduates were located in the United States (20%) and Saudi Arabia (7%). There was good representation of all surgical specialties (Table 1) and of all years sampled, with preponderance toward more recent graduates (55% graduating in 2001–2010 v. 25% in 1985–1995).

**WHAT DID THEY TELL US?**

The majority of respondents were in active practice in Canada. Most (93%) reported working in an urban location with a population of more than 50,000. Most respondents reported being in a group practice with other surgeons (54%). A majority described themselves as working in an academic setting (55%). Most respondents reported they had had “no difficulty” or “very little difficulty” finding a job once they finished their training (86%). The average graduate works 60 hours per week, with three-quarters of this time spent on clinical care; 2 days a week are spent in the operating room, and call accounts for about 6 nights per month.

Three-quarters of respondents rated their job satisfaction as high or very high. Three main themes were identified as important components of this satisfaction: job factors, patient factors and interpersonal factors. Three-quarters of our graduates described themselves as holding leadership positions. Most felt they had been well prepared for practice by residency and felt the most important lessons learned were related to surgical technique and clinical judgment. When asked whether they would choose to pursue a residency in surgery and/or their specialty again, more than 80% agreed or strongly agreed.

In 2008, Cyr-Taro and colleagues surveyed 34 general surgery graduates and found that 90% would choose their current job again. Konrad and colleagues identified 10 facets relating to physician job satisfaction. These included relationships with peers, patients, staff and community; autonomy; pay; resources; intrinsic satisfaction; free time away from work; and administrative support. Our graduates described most of these facets in their responses, focusing particularly on intrinsic satisfaction and on their relationships with patients and colleagues.

We were surprised that 86% of respondents reported little difficulty finding a job, especially with the current concern over the lack of positions in certain specialties. The Royal College of Physicians and Surgeons of

### Table 1. Demographic characteristics of survey respondents

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%)</th>
<th>Characteristic</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Current location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>87.5 (140)</td>
<td>Alberta</td>
<td>50.3 (77)</td>
</tr>
<tr>
<td>Female</td>
<td>12.5 (20)</td>
<td>Rest of Canada</td>
<td>21.6 (33)</td>
</tr>
<tr>
<td>Age, yr</td>
<td>United States</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25–34</td>
<td>5.7 (9)</td>
<td>Saudi Arabia</td>
<td>7.2 (11)</td>
</tr>
<tr>
<td>35–44</td>
<td>48.4 (77)</td>
<td>Other</td>
<td>0.7 (1)</td>
</tr>
<tr>
<td>45–54</td>
<td>34.0 (54)</td>
<td>Graduation year</td>
<td></td>
</tr>
<tr>
<td>55–64</td>
<td>11.9 (19)</td>
<td>1985–1990</td>
<td>14.2 (22)</td>
</tr>
<tr>
<td>≥65</td>
<td>0 (0)</td>
<td>1991–1995</td>
<td>11.0 (17)</td>
</tr>
<tr>
<td>Marital status</td>
<td>1996–2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>83.4 (131)</td>
<td>2001–2005</td>
<td>26.5 (41)</td>
</tr>
<tr>
<td>Divorced</td>
<td>7.6 (12)</td>
<td>2006–2010</td>
<td>29.0 (45)</td>
</tr>
<tr>
<td>Single</td>
<td>8.3 (13)</td>
<td>Specialty</td>
<td></td>
</tr>
<tr>
<td>Widowed</td>
<td>0.6 (1)</td>
<td>Cardiac surgery</td>
<td>6.5 (10)</td>
</tr>
<tr>
<td>No. of children</td>
<td>General surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>13.4 (21)</td>
<td>Neurosurgery</td>
<td>10.4 (16)</td>
</tr>
<tr>
<td>1–2</td>
<td>40.1 (63)</td>
<td>Otolaryngology</td>
<td>10.4 (16)</td>
</tr>
<tr>
<td>3–4</td>
<td>40.8 (64)</td>
<td>Orthopedic surgery</td>
<td>12.3 (19)</td>
</tr>
<tr>
<td>≥5</td>
<td>5.7 (9)</td>
<td>Plastic surgery</td>
<td>10.4 (16)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Urology</td>
<td>11.0 (17)</td>
</tr>
</tbody>
</table>
Canada has published a recent report focusing on unemployment among specialists. Our findings may relate to the fact that many of the respondents graduated before recent changes in the job market; it is likely that current graduates may report greater difficulty finding jobs.

Implications of our survey

Our survey was one of the largest of its type and, to our knowledge, it was the first to focus on multiple surgical specialties in a Canadian setting. Our findings may be limited by the possibility of nonresponse and recall bias as well as the lack of a validated tool for physician job satisfaction. We attempted to minimize this effect by keeping the survey as short as possible and by sending out multiple follow-ups and reminders to invite surgeons to participate. To avoid spurious comparisons among specialties, we did not perform subgroup analyses.

Surgeons graduating from the University of Alberta from 1985 to 2010 have achieved a high level of job satisfaction in a wide variety of practice settings. In contrast to the negative stereotypes found in popular media, we found that the surgeons who answered our survey were very satisfied with their jobs, in a stable relationship and working an average of fewer than 65 hours per week. Our findings challenge existing stereotypes about careers in surgery and should be communicated to students interested in careers in surgery.

Affiliations: All authors are from the Department of Surgery, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, Alta.

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Competing interests: None declared.

Contributors: All authors contributed substantially to the conception, writing and revision of this commentary and approved the final version for publication.

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Evaluating the reliability of surgical assessment methods in an orthopedic residency program

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Background: Orthopedic surgical education in Canada has seen major change in the last 15 years. Work hour restrictions and external influence have led to new approaches for surgical training. With a change toward competency-based educational models under the CanMEDS headings there is a need to ensure the validity of modern assessment methods. Our objective was to evaluate the reliability of a currently used surgical skill assessment tool within an orthopedic residency program, as measured by the Surgical Encounters Form.

Methods: A surgical assessment tool has previously been created at our institution that comprises 15 items spanning 4 of the CanMEDS competencies. Results were blinded to the primary investigator and coded by a third party. The assessments were collected, and we measured percent agreement using Cronbach’s $\alpha$ and Fleiss $\kappa$.

Results: Over a 5-month period 11 staff members assessed 10 residents. Eighty-eight assessments were completed in total. Weighted percent agreement was 90.9%. Cronbach’s $\alpha$ averaged 0.865 for the medical expert role, 0.920 for technical skills, 0.934 for the communicator role, 1.00 for the collaborator role and 1.00 for the health advocate role. The mean Fleiss $\kappa$ score was 0.147 (95% confidence interval –0.071 to 0.364), demonstrating low interrater reliability.

Conclusion: Despite the development of a validated assessment tool to evaluate surgical skills acquisition, interrater reliability results suggest low levels of agreement among assessors.

Contexte : L’enseignement de la chirurgie orthopédique au Canada a beaucoup évolué ces 15 dernières années. La diminution des heures de travail et les influences extérieures sont à l’origine des nouvelles approches pour la formation en chirurgie. Avec l’avènement des modèles de formation fondés sur les compétences et les rôles CanMEDS, il faut s’assurer de la validité des méthodes d’évaluation modernes. Notre objectif était d’évaluer la fiabilité d’un outil de vérification des habiletés chirurgicales actuellement utilisé par un programme de résidence en orthopédie, au moyen du Formulaire de rencontres chirurgicales.

Méthodes : Un outil d’évaluation chirurgicale existe déjà dans notre établissement et comporte 15 éléments qui se rattachent à 4 des rôles CanMEDS. Sur une période de 5 mois, 11 membres du personnel ont évalué 10 résidents. Les résultats étaient à l’insu de l’investigateur principal et encodés par une tierce partie. Les évaluations ont été colligées et nous avons mesuré le pourcentage de concordance à l’aide du coefficient $\alpha$ de Cronbach et du score $\kappa$ de Fleiss.

Résultats : Quatre-vingt-huit évaluations ont été effectuées au total. Le pourcentage de concordance pondéré a été de 90.9 %. Le coefficient $\alpha$ de Cronbach a été en moyenne de 0,865 pour le rôle d’expert médical, de 0,920 pour les habiletés techniques, de 0,934 pour le rôle de communicateur, de 1,00 pour le rôle de collaborateur et de 1,00 pour le rôle de promoteur de la santé. Le score $\kappa$ de Fleiss moyen a été de 0,147 (intervalle de confiance de 95 % –0,071 à 0,364), témoignant d’une faible fiabilité inter-évaluateurs.

Conclusion : Malgré la mise au point d’un outil d’évaluation validé pour mesurer l’acquisition des habiletés en chirurgie, les résultats au plan de la fiabilité inter-évaluateurs indiquent un faible degré de concordance entre les examinateurs.
By 2014, the training of orthopedic surgery residents in Canada will have undergone another fundamental change. The Royal College of Physicians and Surgeons of Canada (RCPSC) is adopting a competency-based training program that all medical training institutions will have to abide by. This will build on the CanMEDS competency framework that has been in place since 1993. The framework is a “common set of essential abilities that all physicians, regardless of specialty, need for optimal patient outcomes.” The 7 components of the framework are medical expert, communicator, collaborator, manager, health advocate, scholar and professional.

With increased public demand for accountability, government pressure, advancing technology, work hour restrictions and financial limitations there has been a shift toward defined, objective, competency-based training methods of surgical skill involves the Surgical Encounters Form (SEF; Appendix 1, available at canjsgurg.ca). This 15-item form incorporates 4 of the CanMEDS competencies — medical expert, communicator, collaborator and health advocate — as well as a section for technical skill in order to fully evaluate surgical competence. A consensus panel of staff surgeons created the SEF to fulfill the CanMEDS requirements for an orthopedic residency training program. The evaluation tool has been modified several times based on feedback from staff and residents. The SEF is completed at least once during every resident rotation.

It is crucial that assessment methods of surgical residents be valid. Validity is the concept of discerning if an assessment tool is actually measuring that which it purports to measure. There is conflicting literature on the requirements for demonstrating validity, but Cook and Beckman provide a modern, medically oriented definition that is suitable and understandable.

Validity can be broken down into 5 factors: content, response process, relationship to other variables, consequences and internal structure. The content of a tool should represent the entire construct it is evaluating. There should be no extraneous information or deviation from the spirit of the construct. The on the other hand, there should be no missing pertinent details. Second, the response process must demonstrate that a tool’s outcomes reflect the user’s thoughts during an assessment moment. Cook explains that if an evaluator or a student were to speak out loud and describe their thoughts during an assessment, the tool should adequately reflect these vital moments. If there is the possibility to be good, bad or ugly, the response process must reflect this. In essence, a valid tool must be built on foundations that reflect the mental process of the assessment. Next, any new assessment tool should be comparable to currently used methods and should most closely align with the gold standard. Similar evaluation methods should correlate with each other. The fourth factor in determining validity is the concept of consequence. Does the score make a difference? Can we take some amount of meaning from the result of the measure and take action based on the results? Ideally any type of resident evaluation tool would aid in academic advancement, job applications, guidance toward extra training and identifying areas of weakness. The final concept is the internal structure or reliability of the tool. Evaluation methods of similar items should yield similar results among users and over time. Each of the 5 components of validity is required to demonstrate the true value of a tool. Cook and Beckman recognized that the concept of validity is a fluid one. In any one instance of evaluation a tool may or may not fulfill the criteria for validity. A key component of this evaluation strategy is to build a large body of evidence in multiple situations to ensure that a reliable conclusion is being met. No single evaluation will confirm the validity of a tool.

Reliability is the concept that a measurement tool can achieve reproducible results among users and at different points in time. Terms often used synonymously with reliability are repeatability, precision and consistency. Errors in reliability can be either systematic or random and affect the validity of a study. Systematic errors occur in the same
way each time a measurement is performed. Random errors occur differently for each assessment. Reliability is an ideal surrogate measure of validity because it has defined mathematical values depending on which method of evaluation is used. If a study is not reliable, it is not valid. On the other hand if a study is reliable, it may be valid. The other components of validity are more qualitative and more difficult to demonstrate numerically.

We had previously attempted to determine the reliability of a non–medical expert, or intrinsic, CanMEDS role at our institution. Problems with feasibility, complex wording, lengthy assessment forms and poor staff compliance led to an inadequate number of responses and subsequently questionable results. Hulley and Cummings proposed 5 key steps to improve reliability measures of evaluations: standardize the measurement methods, train observers, refine instruments, automate instruments and take repeat measurements. Each of these recommendations was undertaken in preparation for this project.

By determining the reliability of evaluation methods created in the CanMEDS context we can move closer to determining the usefulness of this assessment scheme. The purpose of our study was to determine the reliability of a surgical assessment tool, broadly under the medical expert role, within an orthopedic surgery residency program.

**METHODS**

We performed a literature review in February 2013 and updated it in October 2014 using PubMed, EMBASE and Cochrane search engines and the terms [resident] + [evaluation] + [competence] + [CanMEDS] and [surgery]. We found 18 studies that address surgical assessment methods of residents (Fig. 1). The methods of assessment included objective structured assessment of technical skill (OSATS), structured technical skills assessment forms and individually created tools for the assessment of task-specific objectives. Each of the studies recognizes a void left in evaluation methods of technical skill and attempts to create reliable options for these assessment moments.

Our health research ethics board approved our study. In July of 2013, we held individual meetings with the staff orthopedic surgeons and the orthopedic residents. During these sessions, we explained the purpose of the study, answered questions and obtained consent. Staff surgeons were already familiar with the SEF. The 3-point grading scale was explained carefully. All comparisons were made to staff surgeons. A score of 3 reflects equivalent skill to that of a board-certified surgeon, 2 reflects capability but not quite the skill level of a staff surgeon, and 1 reflects insufficient skill. A fourth category was available for “not
observed.” The surgeons completed assessments during operating days for all orthopedics residents on service. Residents off service were excluded, as were off-service residents covering the orthopedics team. Residents ranged from postgraduate year (PGY)-1 to PGY-5. The staff surgeon and resident would agree on a case for assessment during each operating day. An electronic copy of the form, which could be completed on hand-held devices, was emailed to the staff surgeon, who was encouraged to complete the form as soon as possible after the operation. The form was submitted electronically to a third party (the program research coordinator). Upon completion of the study all assessments were coded to keep the principle investigator blinded to the study results.

Statistical analysis

Data were collected and analyzed for internal consistency using Cronbach’s $\alpha$ and for interrater reliability using percent agreement and Fleiss $\kappa$ scores. We used SPSS version 20 to evaluate internal consistency. The same data were entered into AgreeStats2013 version 2 to assess the percent agreement and Fleiss $\kappa$ scores for weighted data.

We used Cicchetti's method for ordinal data, in which the number of categories is squared and multiplied by 2, for the original sample size calculation. Thirty-six evaluations were required to adequately assess the interrater reliability of the tool through a weighted measurement of Fleiss $\kappa$.

RESULTS

Eleven staff members assessed 10 residents over a 5-month period. Eighty-eight evaluations were collected in total. One evaluation contained no resident identification and was discarded, leaving 87 evaluations for analysis (Table 1).

Cronbach’s $\alpha$ measures averaged 0.865 for the medical expert role, 0.920 for technical skills, 0.934 for the communicator role, 1.00 for the collaborator role and 1.00 for the health advocate role (Table 2).

The AgreeStats2013 linear weighting scale was applied, and the average weighted percentage agreement was 0.909. The mean Fleiss $\kappa$ score was 0.147 (95% confidence interval [CI] –0.071 to 0.364) for weighted data (Table 3).

DISCUSSION

The determination of reliability is a key prerequisite for the development of valid assessment tools. The RCPSC’s shift toward competency-based education will require the creation of valid assessment tools in order to uphold the fundamentals of this education strategy. Other areas of surgical practice have demanded similar scrutiny. In 2004 Furey determined that for 3 commonly used fracture classifications there was low to moderate reliability.

Table 1. Number of surgical assessments completed for each resident

<table>
<thead>
<tr>
<th>Resident</th>
<th>no. of evaluations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff 1</td>
<td>2</td>
</tr>
<tr>
<td>2 3 4 5</td>
<td>6 7 8 9 10</td>
</tr>
<tr>
<td>A — — — — — — 3 — — 3</td>
<td></td>
</tr>
<tr>
<td>B — — — — — — 4 — 2</td>
<td></td>
</tr>
<tr>
<td>C 2 — — — 6 2 — 1 —</td>
<td></td>
</tr>
<tr>
<td>D — — 4 — 1 3 — 1 2 —</td>
<td></td>
</tr>
<tr>
<td>E — — 1 — 5 4 — 1 —</td>
<td></td>
</tr>
<tr>
<td>F 1 — 2 — — 2 — 1 1</td>
<td></td>
</tr>
<tr>
<td>G 2 1 1 3 3 — 1 —</td>
<td></td>
</tr>
<tr>
<td>H — 1 1 — 4 2 — 1 —</td>
<td></td>
</tr>
<tr>
<td>I — — 1 — 1 — 1 —</td>
<td></td>
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<tr>
<td>J — — 1 — 1 — 1 —</td>
<td></td>
</tr>
<tr>
<td>K — — 2 — — 3 — 4 — 2</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Cronbach’s $\alpha$ scores for the surgical encounters form

<table>
<thead>
<tr>
<th>Competency; Cronbach’s $\alpha$</th>
<th>Resident</th>
<th>Medical expert</th>
<th>Technical skills</th>
<th>Communicator</th>
<th>Collaborator</th>
<th>Health advocate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.909</td>
<td>0.939</td>
<td>0.920</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>3</td>
<td>0.957</td>
<td>0.818</td>
<td>0.915</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>6</td>
<td>0.915</td>
<td>0.900</td>
<td>0.95</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>7</td>
<td>0.909</td>
<td>0.960</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>8</td>
<td>0.923</td>
<td>0.912</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>9</td>
<td>0.906</td>
<td>0.920</td>
<td>0.934</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Mean</td>
<td>0.965</td>
<td>0.920</td>
<td>0.934</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Table 3. Percent agreement, Fleiss $\kappa$ scores and 95% confidence intervals for surgical encounters form

<table>
<thead>
<tr>
<th>Weighted scores</th>
<th>Resident</th>
<th>% Agreement</th>
<th>$\kappa$ (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.674</td>
<td>0.188 (–0.27 to 0.645)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.714</td>
<td>0.142 (–0.627 to 0.913)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.916</td>
<td>0.433 (0.073 to 0.792)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.818</td>
<td>0.022 (–0.05 to 0.095)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.902</td>
<td>0.222 (0.982 to 0.361)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>0.939</td>
<td>–0.304 (–0.614 to 0.007)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>0.488</td>
<td>–0.097 (–0.195 to 0.002)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>0.948</td>
<td>0.111 (0.074 to 0.297)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>0.841</td>
<td>–0.095 (–0.189 to 0.003)</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.909</td>
<td>0.147 (0.071 to 0.364)</td>
<td></td>
</tr>
</tbody>
</table>

CI = confidence interval.
moderate interrater reliability. The purpose of the present project was to determine the reliability of an assessment method of the medical expert role within an orthopedic surgery residency program.

Our literature review revealed 2 modern studies that had demonstrated reliable instruments for the evaluation of surgical residents. Niitsu and colleagues\(^1\) assessed their residents’ technical skills using the OSATS tool over a 3-year period. They noted a positive correlation between training year and a higher OSATS score. Gofton and colleagues\(^2\) developed the Ottawa surgical competency operating room evaluation (O-Score) at the University of Ottawa. Over a 2-phase evaluation they developed a general assessment scheme that could be applied to any procedure. They demonstrated a correlation between resident training year and improved scores and came to the conclusion that the tool was reliable and practical.

Previous attempts by our group to evaluate assessment methods of orthopedic surgery residents were met with difficulty. A lack of interest, the perception of wasted time and overly complex assessment methods were the stated reasons for poor staff compliance. Before starting the evaluation of the medical expert role, steps were taken to improve feasibility and compliance. Staff members were trained on the correct definitions and uses of the SEF. Strict definitions of each category were used. Complex wording of categories was simplified and shortened. We created an online version of the instrument that could be completed on mobile devices immediately after the observed procedure, and in doing so removed some of the potential for losing assessments and for recall bias. The new electronic form was emailed to the staff each day they operated with a resident and took approximately 3 minutes to complete. Finally our study included 2 6-week evaluation periods to increase our total number of evaluations. A return of 87 assessments represents a vast improvement in response rates from our surgeons and gives our study strength when compared with the currently available literature. Low numbers and poor response rates often hamper studies. Though no formal survey was done to determine reasons for the increased compliance, the feasibility and ease of the online tool, specifically through mobile interfaces, was noted to be a vast improvement.

Our literature review yielded several studies that explored novel evaluation methods for surgical skills acquisition but none that examined currently used methods.\(^{18-21}\) Eighty-eight evaluations were completed in our study, 87 of which were suitable for analysis. Three statistical measures of reliability were used for this analysis. The first is Cronbach’s \(\alpha\). This measure seeks to determine if similar items within a matrix produce similar outcomes. The SEF uses 4 of the CAN-MEDS competencies to evaluate surgical competence. To ensure that heterogeneity did not falsely affect the results, each of the separate competencies’ \(\alpha\) scores was determined (Table 2). Significant numbers of “not observed” values and data that had no variability made some scores unattainable. The average \(\alpha\) score for the medical expert role was 0.865 and for the technical skills section was 0.920. The communicator, collaborator and health advocate roles had values of 0.934, 1.00 and 1.00, respectively. An \(\alpha\) of 0.865 represents almost perfect agreement (Table 4). Caution must be taken in analyzing the final 4 \(\alpha\) values. Such high scores likely represent a lack of variability within the tool and, though concordant, may not be reliable.\(^22\)

The percent agreement is simply the number of times different raters agreed on the measurement. The weighted percent agreement for this study was 91%, which supports a high interrater agreement but did not take chance into consideration. With a 3-point scale there is a 33% probability that evaluators will agree on chance alone. In order to assess this we used weighted Fleiss \(\kappa\) scores. The mean \(\kappa\) score was 0.147 (95% CI –0.071 to 0.364). This demonstrates slight agreement among users when chance is considered (Table 5).

Any measurement tool that demonstrates poor reliability will have questionable validity. The reliability of the SEF is questionable. High values of percent agreement and Cronbach’s \(\alpha\) would seem to support its reliability, but low weighted \(\kappa\) scores suggest a less robust measure of reliability.

The response rate during this study was greatly improved from our original evaluation of assessment measures. Staff members commented that the electronic form and a less wordy assessment scheme made the tool more feasible to complete. This led to a sample size more than double the size required.
Limitations

Despite the large sample size, there were still weaknesses in our study. First, although there was a high percent agreement among raters, the $\kappa$ scores were quite low. Feinstein and Cicchetti raised concerns about Cronbach’s $\alpha$ and $\kappa$ statistics as measures of reliability. This phenomenon is more likely to occur with narrow Likert scales. Only 3 response options were available on the SEF. Though this simplified the tool and improved feasibility, it may have harmed the objective measures of reliability and may not accurately reflect all the potential outcomes for a resident evaluation. A high agreement based on chance alone would be expected. Other statistical measures may be needed to address these issues. Future work will have to account for balance between feasibility and overly complex but more reliable tools. Second, no formal follow-up sessions were held with the staff and residents to address their qualitative concerns with the SEF. This could be added in the future as we seek to build evidence for the validity of our institution’s assessment tools. Hulley and Cummings methods for improvement of reliability scores should be applied again for future studies.

CONCLUSION

The SEF demonstrates questionable reliability for assessing the medical expert role in an orthopaedic residency program. Further modifications need to be made before it can be reliably applied to a competency-based education system. This project is valuable in that it builds on the evidence that is needed to support the validity of our assessment methods. We have also explored successful options for overcoming some of the pitfalls that may be encountered during the evaluation of assessment methods within surgical training programs.

Affiliations: From the Department of Surgery (Smith), the Faculty of Medicine, Health Sciences Centre, (Harnett) and the Department of Orthopaedic Traumatology (Furey), Memorial University of Newfoundland, St. John’s, NL.

Competing interests: None declared.

Contributors: N. Smith and A. Furey designed the study. N. Smith acquired the data, which all authors analyzed. N. Smith wrote the article, which all authors reviewed and approved for publication.

References

Diagnosis of VTE postdischarge for major abdominal and pelvic oncologic surgery: implications for a change in practice

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Carly Leggett, MPH  
Pascal Lambert, MSc  
Jason Park, MD, MEd  
David Hochman, MD  
Debrah Wirtzfeld, MD  
Andrew McKay, MD, MSc

Background: Extended thromboprophylaxis after hospital discharge following cancer surgery has been shown to reduce the incidence of venous thromboembolism (VTE); however, this practice has not been universally adopted. We conducted a population-based analysis to determine the proportion of patients with symptomatic VTE diagnosed within 90 days after initial discharge following major abdominopelvic cancer surgery who might have benefited from extended thromboprophylaxis.

Methods: We used the Manitoba Cancer Registry to identify patients who underwent major abdominopelvic cancer surgery between 2004 and 2009. The proportion in whom VTE was diagnosed during the initial hospital stay was determined by accessing the Hospital Separations Abstracts. The proportion in whom VTE was diagnosed after discharge was determined by examining repeat admissions within 90 days and by accessing Drug Programs Information Network records for newly prescribed anticoagulants. Detailed tumour and treatment-specific data allowed calculation of VTE predictors.

Results: Of 6612 patients identified, 106 (1.60%) had VTE diagnosed during the initial stay and 96 (1.45%) presented with VTE after discharge. Among patients in whom VTE developed after discharge, 33.3% had a pulmonary embolus, 24% had deep vein thrombosis, and 6.3% had both. Predictors of presenting with VTE after discharge within 90 days following surgery included advanced disease, presence of other complications, increased hospital resource utilization, primary tumours of non-colorectal gastrointestinal origin and age younger than 45 years. The development of VTE was an independent predictor of decreased 5-year overall survival.

Conclusion: The cumulative incidence of VTE within 90 days following major abdominopelvic oncologic surgery was 3.01%, with about half (1.45%) having been diagnosed within 90 days after discharge.

Contexte : La thromboprophylaxie prolongée après le congé hospitalier suite à une chirurgie pour cancer a permis de réduire l'incidence de la thrombo-embolie veineuse (TEV); or, cette pratique n’a pas été universellement adoptée. Nous avons procédé à une analyse de population afin de déterminer la proportion de patients qui ont reçu un diagnostic de TEV symptomatique dans les 90 jours suivant leur congé à la suite d’une chirurgie majeure pour cancer abdomino-pelvien et qui auraient pu bénéficier d’une thromboprophylaxie prolongée.

Méthodes : Nous avons utilisé le registre du cancer du Manitoba pour recenser les patients ayant souscrit une chirurgie majeure pour cancer abdomino-pelvien entre 2004 et 2009. La proportion de patients chez qui une TEV a été diagnostiquée au cours du séjour hospitalier initial a été calculée à partir des sommaires d’hospitalisation préparés au congé du patient. La proportion de patients chez qui la TEV a été diagnostiquée après le congé provient de l’examen des dossiers de réadmission dans les 90 jours et du réseau provincial d’information sur les programmes de médicaments pour les anticoagulants nouvellement prescrits. L’analyse des données détaillées sur les tumeurs et les traitements a permis d’établir les prédicteurs de la TEV.

Résultats : Sur 6612 patients recensés, 106 (1,60 %) ont reçu un diagnostic de TEV durant leur séjour initial et 96 (1,45 %), après leur congé. Parmi les patients chez qui la TEV est survenue après le congé, 33,3 % ont souffert d’une embolie pulmonaire, 24 %, d’une thrombose veineuse profonde et 6,3 %, des deux. Les prédicteurs de la TEV consécutives au congé hospitalier dans les 90 jours suivant une chirurgie incluaient : maladie avancée, présence d’autres complications, utilisation accrue des ressources hospitalières, tumeur primitive d’origine gastro-intestinale non colorectale et âge < 45 ans. La TEV s’est révélée être un prédicteur indépendant d’une plus brève survie globale à 5 ans.

Conclusion : L’incidence cumulative des TEV dans les 90 jours suivant une chirurgie majeure pour cancer abdomino-pelvien a été de 3,01 %, environ la moitié des cas (1,45 %) ayant été diagnostiqués dans les 90 jours suivant le congé.
Major abdominal cancer surgery is a risk factor for venous thromboembolism (VTE). The risk persists after hospital discharge and after discontinuation of the usual perioperative thromboprophylaxis. Only a few studies have evaluated the efficacy and safety of prolonged thromboprophylaxis with low molecular weight heparin (LMWH) after discharge from hospital in patients undergoing surgery for abdominal or pelvic cancer. In both the FAME and ENOXACAN II trials, substantial numbers of patients were left unaccounted for. Much of the benefit in the ENOXACAN II study was seen in distal deep vein thromboses (DVT) picked up on routine venography. A third study failed to show a protective effect of prolonged thromboprophylaxis with LMWH. A recent Cochrane meta-analysis, however, did show a benefit of extended prophylaxis in terms of both proximal and symptomatic VTE.

Despite these trials, the practice of providing extended thromboprophylaxis after major abdominal oncologic surgery has not been universally adopted. There is still controversy regarding the clinical significance of an occult, radiographically detected DVT and the additional cost of extended thromboprophylaxis.

The primary objective of our study was to determine the proportion of patients who underwent major abdominal or pelvic surgery for cancer and in whom VTE was subsequently diagnosed postdischarge within 3 months of surgery. These patients presenting with late VTEs after their initial hospital stay are presumably the population that could benefit most from extended prophylaxis. A significant number would lend justification to adopting the practice of extended thromboprophylaxis. Secondary objectives included determining the characteristics and predictors of VTE.

**Methods**

**Study design**

This study was a population-based review of the incidence of VTE up to 3 months postdischarge for patients who underwent major abdominal or pelvic surgery for cancer between January 2004 and December 2009. We used administrative data from Manitoba Health, the government agency responsible for providing universal health insurance for all citizens living in the province of Manitoba, Canada. The University of Manitoba’s Health Research Ethics Board approved our study.

**Population**

All adult patients who underwent major abdominal or pelvic surgery for cancer in the Province of Manitoba between January 2004 and December 2009 were considered eligible. The starting year 2004 was chosen because this was the first year that the Manitoba Cancer Registry (MCR) began to collect detailed tumour-node-metastasis (TNM) staging for each entry in the registry. Patients were included if the surgery was done under general anesthetic and the length of hospital stay (LOS) was at least 2 days. Only patients with solid-organ cancers were included. Patients with bloodborne malignancies, such as leukemia and lymphomas, were excluded from the analysis.

**Procedure**

Patient-specific information was retrieved using several administrative databases maintained by Manitoba Health.

**Manitoba Cancer Registry**

The MCR is maintained by CancerCare Manitoba (CCMB), the provincially mandated central cancer agency to which patients are referred for consideration of chemotherapy or radiation therapy. The MCR receives reports on all cases of cancer in Manitoba, whether the patients are treated at CCMB or not. Using this registry, we identified patients and collected detailed demographic data, including age, sex and postal codes of the patients’ home addresses. The MCR data sources provided detailed tumour-specific information, including the histological diagnosis and the TNM status at the time of diagnosis.

**Medical Claims (Physician Billing) Database and Hospital Separations Abstracts**

The Medical Claims and Hospital Separations Abstracts databases contain patient-specific information about contacts with the health care system. We used the Medical Claims Database to obtain information about consultations and services provided to patients both in and out of hospital. We used these records to identify the health care provider, location and type and date of surgery. It also provided detailed information regarding subsequent contacts with the health care system because of subsequent diagnoses of VTE. In addition, the Hospital Separations Abstracts provided admission dates, discharge dates and information on up to 16 diagnoses (ICD-9-CM) and 12 procedures (ICD-9-CM). From these data, we calculated patient comorbidity according to the Charlson score, which allowed this variable to be controlled in the analyses. This also allowed us to determine in-hospital mortality associated with VTE.

**Manitoba Health Registry**

The Manitoba Health Registry contains information on every Manitoban covered by the province’s health care insurance plan. This provided up-to-date vital statistics for each patient, including information on the last date of coverage and the reason for cancellation (e.g., moved or died). Also, it provided further information regarding the mortality associated with VTE.

**Drug Program Information Network (DPIN) Registry**

The DPIN is an online point-of-sale prescription drug system that connects Manitoba Health and pharmacies in the...
province and generates complete drug profiles for each client. From this registry, patients with new outpatient prescriptions for LMWH were identified and included since there was a high probability that these prescriptions were for VTE. New prescriptions for warfarin or other anticoagulants without an initial period of heparinization with LMWH were not included, since such prescriptions were unlikely to be for VTE and more likely for other indications, such as atrial fibrillation.

From these data, we determined the proportion of patients who underwent major abdominal or pelvic surgery for cancer and in whom VTE was subsequently diagnosed within 90 days after discharge from hospital. We assessed the characteristics of the VTEs and LOS; specific predictors analyzed included age, sex, type of cancer, anatomic location, TNM stage, surgical procedure (laparoscopic, open, or laparoscopic converted to open), the presence of neoadjuvant chemotherapy and/or radiation therapy, the presence of other postsurgical complications, preoperative morbidity as measured by the Charlson comorbidity index,15 hospital volume, surgeon volume and resource utilization band (RUB). An RUB is defined as a variable measuring the expected utilization of health resources, rated on a scale from none to very high, derived from the Johns Hopkins Adjusted Clinical Group (ACG) system.16

Statistical analysis

We analyzed continuous variables using the Mann–Whitney U test and categorical variables using a χ² or Fisher exact test. Variables found to be significantly associated with morbidity or mortality on univariate analysis were analyzed using logistic regression. Rates of VTE over time were calculated using the Kaplan–Meier method, and we compared groups using the log rank test. We considered results to be significant at p < 0.05.

The sample population was one for convenience. We estimated that incidence of VTE after discharge would be about 1%,8,12,14 in order to be 95% confident that the true incidence is within ± 1%, 381 patients needed to be included in the sample. Therefore our study had more than enough power to reach its primary objective.

RESULTS

There were 6612 patients in the Province of Manitoba who had major abdominal or pelvic surgery for solid-organ cancers between 2004 and 2009. The overall patient characteristics of this cohort are shown in Table 1. Of those 6612 patients, 202 (3.05%) had VTE within 90 days of surgery, either during or after the initial hospital stay. A VTE was diagnosed during the initial hospital stay in 106 patients (1.60%) and after discharge in 96 (1.45%) patients. Of these 96 patients, 64 were readmitted to hospital with a principal diagnosis of a new VTE within 90 days of surgery, and 32 patients received a new prescription for LMWH in the outpatient setting within 90 days of surgery. These latter patients were assumed to have had a VTE treated outside of hospital.

Among the 106 patients in whom VTE was diagnosed during the initial hospital stay, 50 patients (46.7%) had a DVT, 50 patients (46.7%) had a pulmonary embolus (PE), and 6 patients (6.5%) had both. Among the 96 patients diagnosed with VTE after discharge, 23 patients (24.0%) had DVT, 32 patients (33.3%) had PE, and 6 patients (6.3%) had both. For the remaining 35 patients (36.5%), the site could not be determined.

The median LOS for patients without VTE was 7 (range 4–11) days. For patients who had VTE in hospital, the median LOS was 19 (range 10–34) days. The median LOS for subsequent readmissions with VTE was 9 (range 6–13) days.

Predictors of postdischarge VTE on univariate analysis are shown in Table 2. Predictors were age, American Joint Committee on Cancer (AJCC) stage,17 the development of complications, noncolorectal gastrointestinal cancer, and high resource utilization band (RUB). Rectal cancer was associated with a higher risk of VTE than colon cancer. Other predictors, such as sex, cancer grade, cell type, surgery type and previous treatment, were not associated with VTE.

Predictors of postdischarge VTE on multivariate analysis are also shown in Table 2. Independent predictors were stage, RUB, development of complications, primary site of cancer and age.

The development of VTE was associated with reduced 5-year survival (Fig. 1). The 5-year survival for those without VTE was 69.41%, whereas that for patients with VTE was 53.88% (p < 0.001).

DISCUSSION

In the present study the cumulative incidence of VTE was 3.01% (1.60% during the initial hospital stay and 1.45% after discharge), which is similar to that in other reports.18,19 Another finding of our study was the decreased 5-year overall survival associated with the development of VTE. This result has been found by others,18 but does not prove causation as it is possible that more biologically aggressive tumours that would be expected to have a poorer prognosis anyway were also associated with VTE formation.

The existing literature has some limitations that may be partly responsible for the practice of extended thromboprophylaxis not having been uniformly adopted. The ENOXACAN II study12 found a relative risk reduction of 60% (p = 0.02); however, the benefit of extended treatment was predominantly in the reduction of asymptomatic distal DVT, which is of questionable significance. Another major limitation was that only about half of the patients recruited for the study were accounted for in the outcome assessment. The presence of a few additional events among the
lost patients in either group could have had dramatic effects on the results either way. The FAME study\textsuperscript{8} found a relative risk reduction of 55\%, but again the number of patients who dropped out was significant. In a third study, the number of patients who were included in the outcome assessment was only one-third of the total.\textsuperscript{13} The study did not demonstrate a statistically significant benefit.

Recently, the Cochrane Collaboration published a meta-analysis of trials evaluating prolonged thromboprophylaxis for abdominal or pelvic surgery.\textsuperscript{14} This meta-analysis included the 3 trials listed above\textsuperscript{8,12,13} plus a fourth study that was published only as an abstract.\textsuperscript{20} By combining the studies, the meta-analysis demonstrated a significant reduction in overall episodes of VTE (14.3\% in the control

<table>
<thead>
<tr>
<th>Table 1. Demographic and predictor characteristics of cohort by VTE status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristic*†</td>
</tr>
<tr>
<td>Age, yr</td>
</tr>
<tr>
<td>Sex</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>AJCC stage</td>
</tr>
<tr>
<td>I</td>
</tr>
<tr>
<td>II</td>
</tr>
<tr>
<td>III</td>
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<tr>
<td>IV</td>
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<tr>
<td>Missing</td>
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<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>Not available</td>
</tr>
<tr>
<td>Cancer type</td>
</tr>
<tr>
<td>Nonadenocarcinoma</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
</tr>
<tr>
<td>Other complications</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>Surgery type</td>
</tr>
<tr>
<td>Open</td>
</tr>
<tr>
<td>Laparoscopic</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Primary site</td>
</tr>
<tr>
<td>Colon</td>
</tr>
<tr>
<td>Rectum</td>
</tr>
<tr>
<td>Other gastrointestinal</td>
</tr>
<tr>
<td>Female genital</td>
</tr>
<tr>
<td>Male genital</td>
</tr>
<tr>
<td>Urinary system</td>
</tr>
<tr>
<td>Treatment before surgery</td>
</tr>
<tr>
<td>Chemotherapy and radiation</td>
</tr>
<tr>
<td>Chemotherapy</td>
</tr>
<tr>
<td>Radiation</td>
</tr>
<tr>
<td>Neither</td>
</tr>
<tr>
<td>RUB</td>
</tr>
<tr>
<td>Very high</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>Low/moderate</td>
</tr>
</tbody>
</table>

AJCC = American Joint Committee on Cancer; RUB = resource utilization band; SD = standard deviation; VTE = venous thromboembolism.

*Accounts for multiple VTE diagnoses.
†Denominators for tumour-specific variables are based on total number of tumours.
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group v. 6.1% in the treatment group, OR 0.41, 95% confidence interval [CI] 0.26–0.63). There was also a significant decrease in proximal DVT, with an incidence of 5.1% in the control group compared with 1.1% in the treatment group (OR 0.27, 95% CI 0.13–0.57). Importantly, the Cochrane review did find a significant decrease in symptomatic VTE. The incidence of symptomatic VTE in the control group was 1.8% (8 of 455 patients) compared with 0.22% (1 of 446 patients) in the treatment group (OR 0.27, 95% CI 0.13–0.57). Still, this must be interpreted cautiously because owing to the large number of patients lost to follow-up in the studies and the low number of symptomatic VTEs, only a few additional events in either group could have resulted in quite different conclusions.

Our study found that 1.45% of patients undergoing major abdominal or pelvic oncologic surgery had a VTE diagnosed after discharge and could have potentially benefitted from extended VTE prophylaxis. Assuming the same risk reduction as the Cochrane review,14 a number needed to treat of 117 can be calculated.

One of the biggest unresolved dilemmas is how much of a reduction would justify introducing thromboprophylaxis for up to 28 days and whether the risks outweigh the benefits. However, the existing literature has not reported an increased bleeding risk,8,12–14,21 and the consequences of VTE can be lethal. In the Cochrane meta-analysis,14 the rate of bleeding events in the treatment group was 4.1% (25 of 614 patients) compared with 3.7% (23 of 628 patients) in the control group. This risk was not significant (p = 0.73), although it is possible that there is a very small risk of bleeding for which the existing trials and meta-analyses were underpowered to detect.

Another dilemma is determining which patients might derive the greatest benefit from extended thromboprophylaxis in order to guide treatment decisions. All patients undergoing major abdominal or pelvic surgery for cancer are considered to be at high risk for VTE.22 We found that patients with noncolorectal gastrointestinal cancers, advanced stage of disease and postoperative complications and those requiring a higher intensity of nursing care were at even higher risk for VTE. Other studies have identified additional risk factors, such as advanced age, higher Charlson comorbidity score, prior VTE, sepsis and longer LOS.23–25 Unlike others, we did not find an association between older age and VTE; in fact, younger age was associated with increased odds of presenting with VTE after discharge. The reason for this result is not clear. It may be that younger patients underwent more extensive surgical procedures, which was not fully controlled for in the multivariate analysis. Also, we assumed that all patients received VTE prophylaxis with heparin in the postoperative period, but perhaps some younger patients were deemed to be at lower risk and did not receive heparin.

### Table 2. Univariable and multivariable analysis between predictors and VTE developing postdischarge

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Univariate analysis</th>
<th>Multivariate analysis</th>
<th>p value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>p value</td>
<td>OR (95% CI)</td>
<td>p value</td>
</tr>
<tr>
<td>Age, yr</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 70</td>
<td>0.454 (0.228–0.906)</td>
<td>0.028</td>
<td>0.325 (0.158–0.666)</td>
<td>0.047</td>
</tr>
<tr>
<td>60–69</td>
<td>0.617 (0.311–1.226)</td>
<td>0.539 (0.269–1.083)</td>
<td></td>
<td></td>
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<tr>
<td>46–59</td>
<td>0.501 (0.243–1.031)</td>
<td>0.455 (0.219–0.945)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–45</td>
<td>1.000</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AJCC stage</td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Missing</td>
<td>2.963 (1.046–8.390)</td>
<td>2.100 (0.708–6.228)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>3.838 (1.912–7.708)</td>
<td>3.248 (1.583–6.663)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>3.352 (1.802–6.236)</td>
<td>3.033 (1.600–5.751)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>1.098 (0.541–2.229)</td>
<td>1.070 (0.521–2.195)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
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<tr>
<td>Other complications</td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
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<td>Yes</td>
<td>2.039 (1.369–3.037)</td>
<td>1.748 (1.110–2.752)</td>
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<tr>
<td>No</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
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<tr>
<td>Primary ste</td>
<td></td>
<td></td>
<td>0.002</td>
<td>0.004</td>
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<tr>
<td>Other</td>
<td>0.705 (0.429–1.158)</td>
<td>0.843 (0.494–1.438)</td>
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<tr>
<td>Other gastrointestinal</td>
<td>2.171 (1.179–3.999)</td>
<td>1.895 (0.994–3.613)</td>
<td></td>
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<tr>
<td>Rectum</td>
<td>1.731 (1.010–2.965)</td>
<td>1.586 (0.92–2.736)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colon</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>RUB</td>
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<td>&lt; 0.001</td>
<td>0.002</td>
<td>0.004</td>
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<tr>
<td>Very high</td>
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<td>1.204 (0.762–1.901)</td>
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<td>Low/moderate/high</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
</tbody>
</table>

AJCC = American Joint Committee on Cancer; CI = confidence interval; OR = odds ratio; RUB = resource utilization band; VTE = venous thromboembolism.
Limitations

This study has several important limitations. First, we assumed that patients received appropriate VTE prophylaxis during their initial postoperative stay. This would have consisted of a single preoperative dose of unfractionated heparin (UFH) or LMWH continuing with subcutaneous doses postoperatively.26 Others have shown that VTE prophylaxis is underutilized in patients undergoing oncologic surgery.27 Second, we assumed that new outpatient prescriptions for LMWH were for newly diagnosed VTEs that did not require hospitalization. It is possible that some of these prescriptions were for other indications and the true number of postdischarge VTEs was overestimated. Third, the proportion of DVTs related to central venous catheters could not be determined from the available data. A fourth limitation of the study is the inability to determine whether the surgical procedures were done with a curative or palliative goal, or if they were done in an elective or emergency setting. These factors may have important implications in the decision whether or not to offer extended thromboprophylaxis, but we could not determine their influence on the incidence of VTE.

Perhaps the biggest limitation of this study is that the true proportion of how many of these VTEs diagnosed within 90 days of hospital discharge could have been prevented is not known. It is not known whether the same risk reduction seen in the Cochrane review14 would have been found in these patients. Some of the VTEs diagnosed after discharge may have formed before discharge while patients were still receiving standard prophylaxis and may not have been preventable with longer prophylaxis. In addition, we used a cut off of 90 days from discharge to determine VTEs that might have been preventable with extended prophylaxis. This arbitrary cut-off was chosen to capture patients in whom a VTE might have developed within 28 days of surgery, but were not diagnosed until later and may have resulted in an overestimate.

This study was designed to determine the number of patients who might have had a preventable VTE. It makes the assumption that most of the 1.45% of patients with postdischarge VTE could have benefited. Although the percentage who might benefit is small, the majority of these patients might benefit, extended prophylaxis should be considered, especially in high-risk patients. This remains an area where further research is needed and is ongoing.28,29

CONCLUSION

The cumulative incidence of VTE within 90 days of major abdominopelvic oncologic surgery was 3.01%; of those patients 1.45% had VTE diagnosed within 90 days after hospital discharge. Predictors of VTE after discharge were advanced AJCC stage, the development of postoperative complications, a high RUB, noncolorectal gastrointestinal cancer, and age 45 years or younger. The development of VTE was associated with longer LOS and reduced overall survival. Presumably, the patients (1.45%) in whom VTE was diagnosed after discharge may have benefited most from extended thromboprophylaxis for 28 days after hospital discharge. Although the benefit is small, extended prophylaxis should be considered, especially in high-risk patients.

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Competing interests: None declared.

Contributors: H. Alsubaie, D. Hochman and A. McKay designed the study. H. Alsubaie, C. Leggett, P. Lambert and A. McKay acquired the data, which all authors analyzed. H. Alsubaie and A. McKay wrote the article, which all authors reviewed and approved for publication.

References


13. Commentaries and Discussions are subject to a publication fee of $500, payable on acceptance in Canadian funds.

14. Accepted Research, Review and Continuing Medical Education articles are subject to a publication fee of $700, and CJS sponsors.


Perioperative factors predicting poor outcome in elderly patients following emergency general surgery: a multivariate regression analysis

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Shaheed Merani, MD, PhD  
Keerit Tauh, MD  
Rachel G. Khadaroo, MD, PhD

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Background: Older adults (≥ 65 yr) are the fastest growing population and are presenting in increasing numbers for acute surgical care. Emergency surgery is frequently life threatening for older patients. Our objective was to identify predictors of mortality and poor outcome among elderly patients undergoing emergency general surgery.

Methods: We conducted a retrospective cohort study of patients aged 65–80 years undergoing emergency general surgery between 2009 and 2010 at a tertiary care centre. Demographics, comorbidities, in-hospital complications, mortality and disposition characteristics of patients were collected. Logistic regression analysis was used to identify covariate-adjusted predictors of in-hospital mortality and discharge of patients home.

Results: Our analysis included 257 patients with a mean age of 72 years; 52% were men. In-hospital mortality was 12%. Mortality was associated with patients who had higher American Society of Anesthesiologists (ASA) class (odds ratio [OR] 3.85, 95% confidence interval [CI] 1.43–10.33, \( p = 0.008 \)) and in-hospital complications (OR 1.93, 95% CI 1.32–2.83, \( p = 0.001 \)). Nearly two-thirds of patients discharged home were younger (OR 0.92, 95% CI 0.85–0.99, \( p = 0.036 \)), had lower ASA class (OR 0.45, 95% CI 0.27–0.74, \( p = 0.002 \)) and fewer in-hospital complications (OR 0.69, 95% CI 0.53–0.90, \( p = 0.007 \)).

Conclusion: American Society of Anesthesiologists class and in-hospital complications are perioperative predictors of mortality and disposition in the older surgical population. Understanding the predictors of poor outcome and the importance of preventing in-hospital complications in older patients will have important clinical utility in terms of preoperative counselling, improving health care and discharging patients home.

Contexte : La population qui connaît la croissance la plus rapide est celle des adultes âgés (≥ 65 ans). Ces personnes nécessitent un nombre croissant d’interventions chirurgicales urgentes. Or, la chirurgie d’urgence comporte souvent un risque de décès pour les patients âgés. Notre objectif était d’identifier les prédicteurs de la mortalité et d’une issue négative chez les patients âgés soumis à une chirurgie générale d’urgence.


Résultats : Notre analyse a regroupé 257 patients âgés en moyenne de 72 ans; 52 % étaient des hommes. La mortalité perhospitalière a été de 12 %. La mortalité a été associée à des patients qui se classaient dans une catégorie ASA (American Society of Anesthesiologists) plus élevée (rapport des cotes [RC] 3.85, intervalle de confiance [IC] de 95 % 1.43–10.33, \( p = 0.008 \)) et présentaient plus de complications perhospitalières (RC 1.93, IC de 95 % 1.32–2.83, \( p = 0.001 \)). Près des deux tiers des patients qui ont reçu leur congé pour retourner à la maison étaient plus jeunes (RC 0.92, IC de 95 % 0.85–0.99, \( p = 0.036 \)), se classaient dans une catégorie ASA moins élevée (RC 0.45, IC de 95 % 0.27–0.74, \( p = 0.002 \)) et avaient connu moins de complications perhospitalières (RC 0.69, IC de 95 % 0.53–0.90, \( p = 0.007 \)).

Conclusion : La catégorie ASA et les complications perhospitalières sont des prédicteurs péríopératoires de mortalité et d’état général de santé dans la population âgée soumise à la chirurgie. Comprendre les prédicteurs d’une issue négative et l’importance de prévenir les complications perhospitalières chez les patients âgés aura une importante utilité clinique pour les consultations préopératoires, l’amélioration des soins de santé et le retour des patients à la maison.

DOI: 10.1503/cjs.011614
With the expected increase of the elderly population to more than 20% in 2030, a better understanding of their special needs and outcomes while undergoing emergency surgery is required. Correspondingly, in 2010 approximately 33% of hospital stays and 41% of hospital costs were attributed to patients older than 65 years. With these statistics in mind, the demand for acute surgical care of elderly patients has also been increasing.

There have been a very limited number of studies investigating the perioperative risk factors associated with emergent general surgery in patients between 65 and 80 years old. Seniors are a unique subset of patients with their own problems and vulnerabilities including the cumulative loss of physiologic reserve in almost every organ system, otherwise known as frailty. Recent studies involving patients older than 80 years demonstrated that age and number of comorbidities did not accurately predict poor surgical outcomes, and further studies have suggested that frailty measures are better overall predictors.

The purpose of the present study was to characterize the subset of patients aged 65–80 years who underwent emergency general surgery and to examine their surgical outcomes, including in-hospital mortality and morbidity. We also examined factors associated with the ability to discharge patients back home without the need for in-patient rehabilitation or transfer to long-term care.

**METHODS**

**Study design and setting**

The University of Alberta Human Research Ethics Board approved this research. We conducted a retrospective cohort study involving patients aged 65–80 years undergoing emergency general surgery at the University of Alberta Hospital, a tertiary care academic hospital in Edmonton, Alta., between 2009 and 2010. Data were collected from an extensive retrospective chart review. This study followed the STROBE guideline for reported retrospective cohort studies.

**Patients, variables and outcome measures**

We included patients who had at least 1 emergency general surgical procedure during admission. Patient demographic characteristics, including age, sex, weight, height, prehospitalization medication use and comorbidities, were collected. Additionally, operative data, including anesthesiologist-assigned American Society of Anesthesiologists (ASA) class, operative procedure performed and surgical diagnoses, were collected. Clinical outcomes measured included in-hospital complications, length of hospital stay (LOS), in-hospital mortality and discharge disposition.

**Statistical analysis**

Data were collected using a Microsoft Access database, and we performed the statistical analysis using SPSS version 17.0. Frequencies and percentages were tabulated for categorical and ordinal variables; means and standard deviations were calculated for continuous variables. We used logistic regression analysis to identify covariate-adjusted factors associated with in-hospital mortality, complications and discharge of patients home. Age, sex, body mass index (BMI), number of prehospitalization medications, comorbidities, ASA class and number of in-hospital complications were chosen as covariates. We considered a p value < 0.05 to be evidence of an association not attributable to chance, therefore indicating statistical significance.

**RESULTS**

**Patient demographics, diagnoses and operative procedures**

From 2009 to 2010 there were 257 patients between the ages of 65 and 80 years who underwent emergency general surgery at the University of Alberta Hospital. Mean age was 71.5 years, 52% were men, and the average BMI was 27.7 (Table 1). Comorbid illness was present in almost 95% of the included patients, with hypertension, coronary artery disease and diabetes being the most common (Table 1). In total, 93% of patients were on at least 1 medication before admission. Bowel obstruction (12.1%), cholecystitis (10.5%) and intestinal ischemia (8.6%) were the most common diagnoses (Table 3).

**Complications**

More than half of our patients (53%) experienced 1 or more complications during hospital admission. Surgical site infections (20.6%), cardiac events (20.2%), sepsis (12.1%) and postoperative bleeding (9.7%) were the most frequent complications (Table 4). Cardiac events included cardiac arrest (6.6%), myocardial infarction (5.8%) and arrhythmias (7.8%). Postoperative bleeding included the need for transfusion or operative intervention. Repeat visits to the operating room were required for 9 of the 25 patients with postoperative bleeding (3.5%). Other frequent complications identified were delirium (7.0%); pneumonia, including hospital-acquired pneumonia and aspiration (7.0%); and acute kidney injury, including any creatinine change resulting in concern by the attending physician or the need for renal replacement therapy (6.2%). Other complications, such as urinary tract infections, wound dehiscence, thromboembolic events and strokes, were less frequent.
In-hospital mortality

The overall in-hospital mortality was 12%. Patients with intestinal ischemia or gastric ulceration had the highest mortality (Fig. 1). We used logistic regression analysis to identify factors associated with in-hospital mortality (Table 5). The ASA class (odds ratio [OR] 3.85, 95% confidence interval [CI] 1.43–10.33, \( p = 0.008 \)) and the number of complications (OR 1.93, 95% CI 1.32–2.83, \( p = 0.001 \)) were significantly

| Table 1. Patient demographic characteristics \((n = 257)^*\) |
|-----------------|------------------|
| Characteristic  | No. (%).         |
| Age, yr         |                  |
| 65–69           | 102 (39.7)       |
| 70–75           | 96 (37.3)        |
| 76–80           | 59 (22.9)        |
| Male sex        | 134 (52.1)       |
| BMI \((n = 246)\) |                  |
| Underweight     | 9 (3.5)          |
| Healthy         | 74 (28.8)        |
| Overweight      | 91 (35.4)        |
| Class I obesity | 44 (17.1)        |
| Class II obesity| 16 (6.2)         |
| Class III obesity| 12 (4.7)       |

BMI = body mass index.

*Unless otherwise indicated.

| Table 2. Patient clinical characteristics — comorbidities and medication use |
|-----------------|------------------|
| Characteristic  | No. (%)          |
| No. of comorbidities |              |
| None            | 14 (5.4)         |
| 1–2             | 75 (29.2)        |
| 3–5             | 127 (49.4)       |
| > 5             | 41 (15.9)        |
| Type of comorbidity |              |
| Hypertension    | 153 (59.5)       |
| Coronary artery disease | 75 (29.2) |
| Diabetes        | 58 (22.6)        |
| Thyroid disease | 53 (20.6)        |
| Respiratory disease (including COPD) | 53 (20.6) |
| GERD            | 49 (19.1)        |
| Smoking history | 36 (14.0)        |
| No. of home medications |              |
| None            | 18 (7.0)         |
| 1–2             | 43 (16.7)        |
| 3–5             | 103 (40.1)       |
| > 5             | 93 (36.1)        |
| Home medication use |              |
| Statin          | 100 (38.9)       |
| Diuretic        | 95 (37.0)        |
| Proton pump inhibitor | 90 (35.0) |
| Anti-platelet   | 82 (31.9)        |
| ACE inhibitors  | 82 (31.9)        |
| β-blockers      | 79 (30.7)        |
| ASA class       |                  |
| 1               | 4 (1.5)          |
| 2               | 50 (19.3)        |
| 3               | 96 (37.1)        |
| 4               | 86 (33.2)        |
| 5               | 10 (3.9)         |

ACE = angiotensin-converting enzyme; COPD = chronic obstructive pulmonary disease; GERD = gastroesophageal reflux disease.

| Table 3. Patient clinical characteristics — most common diagnoses and procedures performed |
|-----------------|------------------|
| Characteristic  | No. (%)          |
| Primary diagnosis |              |
| Bowel obstruction | 31 (12.1)     |
| Cholecystitis    | 27 (10.5)       |
| Soft tissue infection | 22 (8.6) |
| Colorectal cancer | 22 (8.6)      |
| Intestinal ischemia | 22 (8.6)  |
| Other            | 27 (10.5)       |
| Operative procedure |              |
| Cholecystectomy  | 31 (12.1)       |
| Colon resection with primary anastomosis | 26 (10.1) |
| Colon resection with ostomy | 23 (8.9) |
| Gastric resection/gastrostomy | 18 (7.3) |
| Hemiorrhaphy     | 17 (6.6)        |
| Exporatory laparotomy | 15 (5.8) |
| Other            | 35 (13.6)       |

| Table 4. Patient outcomes — complications following surgery |
|-----------------|------------------|
| Outcome         | No. (%)          |
| No. of complications |              |
| None            | 121 (47.1)       |
| 1–2             | 78 (30.4)        |
| 3–5             | 52 (20.2)        |
| > 5             | 6 (2.3)          |
| Type of complication |              |
| Surgical site infections | 53 (20.6) |
| Superficial incisional | 16 (6.2)     |
| Deep incisional  | 9 (3.5)          |
| Organ/space     | 18 (7.0)         |
| Anastomtic leak | 10 (3.9)         |
| Cardiac         | 52 (20.2)        |
| Cardiac arrest  | 17 (6.6)         |
| Myocardial infarction | 15 (5.8) |
| Cardiac arrhythmia | 20 (7.8)      |
| Sepsis          | 31 (12.1)        |
| Postoperative bleeding | 25 (9.7) |
| Observation     | 2 (0.8)          |
| Transfusion     | 14 (5.4)         |
| Repeat operation| 9 (3.5)          |
| Delirium        | 18 (7.0)         |
| Pneumonia (including aspiration) | 18 (7.0) |
| Acute kidney injury | 16 (6.2)    |
| UTI             | 15 (5.8)         |
| Wound dehiscence| 13 (5.0)         |
| DVT/PE          | 6 (2.3)          |
| Stroke          | 3 (1.2)          |

DVT = deep vein thrombosis; PE = pulmonary embolus; UTI = urinary tract infection.
associated with mortality. The operative diagnoses of intestinal ischemia and peptic ulcer disease were highly associated with mortality, but were not statistically significant on regression analysis (OR 1.14, 95% CI 0.99–1.31, \( p = 0.06 \)). Importantly, chronologic age alone or the number of comorbidities did not correspond with mortality.

**Length of stay and disposition**

The median LOS was 13 days, with almost one-quarter of patients spending more than 30 days in hospital (Table 6). Nearly two-thirds of patients required additional support upon discharge, including home care services (24.4%), transfer to subacute hospitals or rehabilitation centres (23.3%) and advancement of care to assisted living or nursing home placement (2.7%; Table 6). To determine which patients were at risk of not returning home after admission, we performed a multivariate logistic regression analysis (Table 7). After controlling for confounding factors, ASA (OR 0.45, 95% CI 0.27–0.74, \( p = 0.002 \)), advanced age (OR 0.92, 95% CI 0.85–0.99, \( p = 0.036 \)) and the development of in-hospital complications (OR 0.69, 95% CI 0.53–0.90, \( p = 0.007 \)) were associated with the inability to return home.

**Discussion**

Acute care surgery is being performed more frequently in frail elderly patients and can result in clinical, cognitive and functional deterioration. Our study shows that 95% of older patients present to hospital with 1 or more pre-existing comorbid illnesses. Mortality was 12%, and more than 50% of patients experienced an in-hospital complication — a very important finding since the number of in-hospital complications was significantly associated with mortality. Interestingly, chronologic age or the number of comorbidities did not correspond with mortality. More than two-thirds of the patients required additional resources on discharge from hospital. Some of the predictors associated with the inability to return home were advanced age, ASA class and the development of in-hospital complications. This knowledge can enhance perioperative counselling of patients and families about expected outcomes and assist with appropriate resource planning for patients.
Similar to other studies, we found that complications resulting from emergent surgeries can lead to worsened clinical status, additional hospital costs and, perhaps more importantly, decline in functional status requiring additional support or alternate level of care when leaving hospital. A recent study by Sheetz and colleagues reported a poor correlation between complications and mortality, but failure to rescue patients from in-hospital complications was significantly associated with mortality, and this association was greater in patients older than 75 years. In our study the most common complications were cardiac events, surgical infection/sepsis and postoperative bleeding. Cardiac events occurred in 1 of every 5 patients, which is a substantial number and suggests further studies are required to examine the use of postoperative telemetry in high-risk elderly patients. Delirium was documented in only 7% of patients in this study. However, we feel this event is significantly underreported owing to lack of recognition of delirium, particularly identification of hypoactive delirium states, and poor understanding of the importance of the diagnosis. Delirium has been found in other studies to be a common postoperative complication in older patients and is associated with important adverse outcomes, such as increased LOS, higher postoperative complication rates, falls, discharge to long-term care and death. These and other complications are potentially preventable, and attention to these is paramount. Our study supports that a focus on preventing complications postoperatively can significantly impact outcomes in elderly patients.

A large proportion of the older patients in our study stayed more than 30 days in hospital and required additional support on discharge. Unfortunately, acute care models rarely take into account the special needs of this population; for example, proactive planning of services, such as rehabilitation, is seldom done. Acute hospitals continue to be geared to provide care for those with single acute illnesses rather than those with multiple acute and chronic conditions. This can result in poor postsurgical outcomes, an increased requirement for care, reduced quality of life, increased dependency and increased health care resource utilization. Our centre will be exploring how to improve outcomes by examining new care models, such as acute care for the elderly (ACE) units applied to a surgical setting where there is a focus on screening for early identification of geriatric syndromes, family and caregiver involvement at all stages of care, interdisciplinary assessments and an environment supportive of discharge planning and community services.

Our study reinforces that higher ASA class is associated with mortality following emergency general surgery in elderly patients. It should be mentioned that despite being a statistically significant variable, the ASA class had a wide CI, likely associated with our relatively small data set, and therefore we cannot accurately describe the direct magnitude of its effect on mortality. Three of the more common scoring systems to predict outcome are the Reported Edmonton Frail Scale (REFS), the Acute Physiology and Chronic Health Evaluation II (APACHE II) and the Physiologic and Operative Severity Score for the enUmeration of Morbidity and mortality (POSSUM). There are several reasons these are often not used in the acute surgical setting; the APACHE II score requires an extensive workup often not conducive to acute surgical situations, the POSSUM scoring system may overestimate mortality in low-risk patients while underestimating the risk in elderly patients or those undergoing emergency surgery, and the REFS scale uses more comprehensive subjective geriatric measures (v. physiologic), which are not always possible to obtain quickly preoperatively. By contrast, ASA class can be quickly determined on admission. While anesthesiologists often use this score, our study demonstrates the value of surgeons using ASA class for preoperative risk stratification and discussions.

Limitations

Our study is limited by its retrospective single-centre design and small sample size. Our statistical analysis did not take into account the severity of certain comorbidities, therefore it might be worthwhile to incorporate the Charlson Comorbidity Index instead of the total number of comorbidities in future studies. In addition, this study focused on the elderly patients who underwent an operation but did not examine outcomes of the patients who had nonoperative management. For example, some patients may have been treated nonoperatively (i.e., medical management for acute cholecystitis) or as per end-of-life care goals or personal wishes to avoid surgery. This is an important cohort of patients who would benefit from studies in the future.

Conclusion

Older patients undergoing emergency surgery are at very high risk for in-hospital complications. The ASA class and the development of an in-hospital complication are independent predictors of mortality; these factors were associated with the inability to return home. Understanding the perioperative factors associated with adverse outcomes can allow for identification of at-risk patients to allow for development of tailored preventative strategies and resource planning to improve the outcome in elderly emergency surgical patients.

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Competing interests: None declared.
Contributors: R. Khadaroo designed the study. M. Lees, S. Merani and K. Tauh acquired the data, which all authors analyzed. All authors wrote and reviewed the article and approved the final version for publication.

References


Correction

In the article “Medical mentorship in Afghanistan: How are military mentors perceived by Afghan health care providers?” by Beckett et al. (Can J Surg. 2015;58(3 Suppl 3): S98–S103. doi: 10.1503/cjs.012214), the author Neill K.J. Adhikari’s name was spelled incorrectly. We apologize for this error.
Intraoperative ultrasonography and surgical strategy in hepatic resection: What difference does it make?

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Shiva Jayaraman, MD, MESc

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Background: With modern advancements in preoperative imaging for liver surgery, intraoperative ultrasonography (IOUS) may be perceived as superfluous. Our aim was to determine if IOUS provides new information that changes surgical strategy in hepatic resection.

Methods: We retrospectively analyzed 121 consecutive liver resections performed at a single institution. Preoperative computed tomography and/or magnetic resonance imaging determined the initial surgical strategy. The size, location and number of lesions were compared between IOUS and preoperative imaging. Reviewing the operative report helped determine if new IOUS findings led to changes in surgical strategy. Pathology reports were analyzed for margins.

Results: Of 121 procedures analyzed, IOUS was used in 88. It changed the surgical plan in 15 (17%) cases. Additional tumours were detected in 10 (11%) patients. A change in tumour size and location were detected in 2 (2%) and 3 (4%) patients, respectively. Surgical plans were altered in 7 (8%) cases for reasons not related to IOUS. There was no significant difference ($p = 0.74$) in average margin length between the IOUS and non-IOUS groups (1.09 ± 1.18 cm vs. 1.18 ± 1.05 cm).

Conclusion: Surgical strategy was altered owing to IOUS results in a substantial number of cases, and IOUS-guided resection planes resulted in R0 resections in nearly all procedures. The best operative plan in hepatic resection includes IOUS.


Méthodes : Nous avons analysé rétrospectivement 121 résections hépatiques consécutives réalisées dans un même établissement. La tomographie par ordinateur ou l’imagerie par résonance magnétique préopératoires ont été utilisées pour choisir la stratégie chirurgicale initiale. La taille et la position des tumeurs détectées ainsi que leur nombre ont été comparés selon la méthode utilisée : échographie peropératoire ou imagerie préopératoire. Nous avons étudié les rapports opératoires pour déterminer si l’échographie peropératoire avait entraîné un changement de stratégie chirurgicale et avons examiné les rapports de pathologie pour connaître les résultats de l’analyse des contours.

Résultats : L’échographie peropératoire a été utilisée dans 88 des 121 interventions étudiées. Elle a influé sur la stratégie chirurgicale dans 15 cas (17 %). De nouvelles tumeurs ont été détectées chez 10 patients (11 %), et un changement dans la taille ou la position de la tumeur a été détecté chez 2 (2 %) et 3 patients (4 %), respectivement. Dans 7 cas (8 %), la stratégie chirurgicale a été modifiée, mais pour des raisons indépendantes des résultats de l’échographie. Nous n’avons pas observé de différence significative ($p = 0.74$) entre la taille moyenne des contours pour les 2 groupes de patients, soit ceux qui ont été soumis à l’échographie peropératoire et ceux qui ne l’ont pas été (1,09 ± 1,18 cm par rapport à 1,18 ± 1,05 cm).

Conclusion : La stratégie chirurgicale a été modifiée en fonction des résultats de l’échographie peropératoire dans un nombre important de cas, et dans presque tous les cas, l’échographie peropératoire a donné lieu à une résection complète. La meilleure approche lors d’une résection hépatique inclut donc l’échographie peropératoire.
Since its inception in the late 1980s, intraoperative ultrasonography (IOUS) has been an important adjunct in hepatic resection. It can reveal new tumours not seen on preoperative imaging that would change surgical planning. Furthermore, IOUS provides new information about lesions and their association with vital anatomical structures to help guide resection planes. Studies in the 1990s showed that new information from IOUS altered surgical strategy in up to 53% of cases. Contemporary studies demonstrate rates closer to 20%. The decline in rates could be attributed to important advances in preoperative imaging. In particular, computed tomography (CT) and magnetic resonance imaging (MRI) with bespoke liver protocols enhance preoperative image accuracy and quality. Given these imaging advances, it is necessary to ask whether IOUS still plays a role in modern hepatic resections.

The primary outcome of our study was to determine whether the use of IOUS leads to changes in surgical strategy and the reason for those changes. Our secondary outcome was to determine whether the use of IOUS impacts resection margins.

**Methods**

**Study design**

We performed a single-institution retrospective study on 111 consecutive patients who underwent 121 operative procedures. The operations took place between February 2011 and July 2013 and were performed by 2 hepatobiliary surgeons. Both benign and malignant disease were included. In all resections, a preoperative CT or MRI scan was performed a mean of 45.3 ± 46.4 (range 1–424) days before the planned operation. Excluding 3 major outliers (1 patient with primary sclerosing cholangitis and 2 with metastatic breast cancer), preoperative imaging was performed a mean of 39.4 ± 25.8 (range 1–117) days before the operation. Diagnostic laparoscopy was used in all cases with an incidental finding of gallbladder cancer from previous cholecystectomy. Similarly, diagnostic laparoscopy was used in any patient with a high risk of peritoneal disease. Inspection via bimanual palpation through a small incision was used before every other open procedure.

The planned operation was documented in the last clinic note before the procedure. The operative note recorded the actual procedure performed. In cases that included IOUS, the staff radiologist or surgeon reported on the ultrasound findings. Staff radiologists compared these findings with preoperative imaging reports. We recorded any differences in number, size or location of lesions and whether these findings led to a change in operative plan.

We further stratified our procedures by diagnosis and type and analyzed whether these groupings impacted changes to surgical strategy. Given the small sample size in this study, we stratified procedures broadly in 3 ways: malignant versus benign, laparoscopic versus open and minor (≤ 3 liver segments) versus major (> 3 liver segments) planned resection.

As a secondary outcome, we compared IOUS and nonIOUS groups for differences in resection margins. Using the final pathology report, the closest parenchymal margin out of all lesions was documented.

A single researcher gathered and entered all the data into a spreadsheet. The St. Joseph Health Centre research ethics board approved this study.

**Statistical analysis**

Descriptive statistics are reported as frequencies and means. We compared continuous variables using parametric t tests and categorical variables using the chi-squared test for independence. We considered results to be significant at p < 0.05. Analyses were performed using SAS software version 9.3 (SAS Institute Inc.).

**Results**

Table 1 shows the patient demographic characteristics, diagnoses and types of imaging used in the IOUS and nonIOUS groups; 88 of the 121 procedures used IOUS and 33 did not. There was no significant difference in patient age, sex or diagnoses between the groups. A substantially greater percentage of patients in the nonIOUS group than in the IOUS group underwent preoperative MRI (70% v. 48%).

In the nonIOUS group, the preoperative plan was changed in 11 patients (Table 2). Carcinomatosis or advanced metastases on inspection led to an abortion in 8 cases. One case was aborted owing to portal vein and hepatic artery invasion. An extended bowel resection due to locally advanced tumour was required in 1 case. A misdiagnosed infection requiring abscess drainage instead of a hepatectomy and severe adhesions leading to a conversion changed the plan in 1 case each.

The surgical plan in the IOUS group changed in 7 (8%) cases for reasons not directly related to IOUS findings (Table 3). Additional tumours were found on inspection in

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total (n = 121)</th>
<th>IOUS (n = 88)</th>
<th>Non-IOUS (n = 33)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD, yr</td>
<td>59.5 ± 13.3</td>
<td>58.5 ± 13.0</td>
<td>62.1 ± 13.7</td>
<td>0.19</td>
</tr>
<tr>
<td>Female sex</td>
<td>55 (45)</td>
<td>38 (43)</td>
<td>17 (52)</td>
<td>0.41</td>
</tr>
<tr>
<td>Preoperative imaging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT (≥ 1)</td>
<td>77 (64)</td>
<td>62 (70)</td>
<td>15 (45)</td>
<td>0.011</td>
</tr>
<tr>
<td>MRI</td>
<td>65 (54)</td>
<td>42 (48)</td>
<td>23 (70)</td>
<td>0.031</td>
</tr>
<tr>
<td>Ultrasonography</td>
<td>17 (14)</td>
<td>13 (15)</td>
<td>4 (12)</td>
<td>0.71</td>
</tr>
<tr>
<td>Postoperative diagnosis (malignant)</td>
<td>101 (83)</td>
<td>76 (86)</td>
<td>25 (76)</td>
<td>0.16</td>
</tr>
</tbody>
</table>

CT = computed tomography; IOUS = intraoperative ultrasonography; MRI = magnetic resonance imaging; SD = standard deviation.

*Unless otherwise indicated.

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4 patients. Three of them underwent extended resection. The remaining patient was changed to a much smaller resection owing to inadequate residual volumes. Liver conditions changed the operation in 3 patients. An unexpectedly cirrhotic liver led to a conversion from a laparoscopic to an open procedure in 1 patient and to a much smaller resection in another patient. Significant bleeding led to a conversion in the remaining case.

Conversely, IOUS directly led to a change in surgical plan in 15 (17%) cases (Table 3). Additional tumours were found in 10 patients. A more extensive resection was performed in 8 of them, and the remaining 2 cases were aborted. A significant change in tumour size and tumour location leading to an alteration in surgical plan was found in 2 and 3 cases, respectively. All 3 instances with shifts in location led to a more limited resection, as the tumour was confirmed to be away from critical adjacent structures. In 1 case where the tumour size changed the procedure was aborted owing to new vascular involvement, and in the other case an extended resection was planned, but was ultimately aborted owing to a positive celiac lymph node. The diagnoses in patients whose surgical plans were changed due to IOUS are outlined in Table 4.

The time interval between imaging and the operation did not impact changes in surgical strategy. The comparison of change versus no change in surgical strategy between the IOUS (p = 0.82) and non-IOUS (p = 0.15) groups was not significant. Similarly, within the IOUS group the comparison of changes due to IOUS, changes not due to IOUS and no changes in surgical strategy was not significant (p = 0.85).

### Table 2. Changes in surgical plan in the non-IOUS group (n = 33)

<table>
<thead>
<tr>
<th>Reason for change</th>
<th>No. (%) of changes, n = 11</th>
<th>No. (%) of changes not owing to IOUS, n = 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abort (carcinomatosis)</td>
<td>7 (21.2)</td>
<td></td>
</tr>
<tr>
<td>Abort (locally advanced tumour)</td>
<td>1 (3.0)</td>
<td></td>
</tr>
<tr>
<td>Conversion (adhesions)</td>
<td>1 (3.0)</td>
<td></td>
</tr>
<tr>
<td>Infection</td>
<td>1 (3.0)</td>
<td></td>
</tr>
<tr>
<td>Locally advanced tumour (extended resection)</td>
<td>1 (3.0)</td>
<td></td>
</tr>
<tr>
<td>IOUS = intraoperative ultrasonography.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3. Changes in surgical plan in the IOUS group (n = 88)

<table>
<thead>
<tr>
<th>Reason for change</th>
<th>No. (%) of changes owing to IOUS, n = 15</th>
<th>No. (%) of changes not owing to IOUS, n = 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional tumour(s) found via IOUS</td>
<td>10 (11.4)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Additional tumour(s) found via inspection</td>
<td>0 (0)</td>
<td>4 (4.5)</td>
</tr>
<tr>
<td>Liver conditions</td>
<td>0 (0)</td>
<td>3 (3.4)</td>
</tr>
<tr>
<td>Tumour location</td>
<td>3 (3.4)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Tumour size</td>
<td>2 (2.3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>IOUS = intraoperative ultrasonography.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 4. Diagnoses in operative plans changed due to IOUS

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. (%) of changes owing to IOUS, n = 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gallbladder adenoma</td>
<td>1 (6.7)</td>
</tr>
<tr>
<td>Gallbladder cancer</td>
<td>1 (6.7)</td>
</tr>
<tr>
<td>Hepatocellular carcinoma</td>
<td>1 (6.7)</td>
</tr>
<tr>
<td>Cholangiocarcinoma</td>
<td>1 (6.7)</td>
</tr>
<tr>
<td>Metastatic colorectal cancer</td>
<td>10 (66.7)</td>
</tr>
<tr>
<td>Focal nodular hyperplasia</td>
<td>1 (6.7)</td>
</tr>
</tbody>
</table>

### Table 5. Secondary outcome analysis

<table>
<thead>
<tr>
<th>Factor</th>
<th>IOUS, mean ± SD, cm</th>
<th>Non-IOUS, mean ± SD, cm</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Margin length</td>
<td>1.09 ± 1.18</td>
<td>1.18 ± 1.05</td>
<td>0.74</td>
</tr>
<tr>
<td>R1 resection rate, no. (%)</td>
<td>3 (3.4)</td>
<td>2 (6.0)</td>
<td>0.61</td>
</tr>
</tbody>
</table>

IOUS = intraoperative ultrasonography; SD = standard deviation.

Stratification of the IOUS group did not produce any significant findings when analyzing impact on surgical change. A χ² test analyzed the stratification categories to surgical changes due to IOUS, changes not due to IOUS and no surgical change. Laparoscopic versus open (p = 0.24), benign versus malignant disease (p = 0.61) and major versus minor planned procedure (p = 0.14) were all nonsignificant.

Our secondary outcome was differences in margins between the IOUS and non-IOUS groups. There were no significant differences in margin length or R1 resection rate between the 2 groups (Table 5).

### Discussion

The major finding of our study shows that IOUS directly altered surgical plans in 17% of cases. The most recent study on IOUS, published in 2011, reported a 16.5% change in surgical strategy in operations for malignancies. Previous series published in the 2000s reported rates between 11.5% and 22.8%. These rates of change are decreasing; earlier studies published in the 1990s reported that surgical strategy was affected in 19%–53% of cases. While there was a historical decrease in rates between decades, our study results confirm that the impact of IOUS has plateaued over the last decade despite further advances in preoperative imaging. With the current rates of change in surgical strategy, it appears that modern preoperative imaging alone does not preclude the use of IOUS.

Our data show that in patients who did not undergo IOUS, 33% of cases had a surgical change. At first glance, this may suggest that this group experienced more surgical changes than the IOUS group (17%); however, 8 of the 11 cases in the non-IOUS group for which the surgical plan changed were aborted after initial inspection and before IOUS could be used owing to carcinomatosis or cirrhotic liver.
tumour extension. None of the cases in the IOUS group for which the surgical plan changed were aborted owing to readily visible metastases, which precluded resection. As such, it would be reasonable to exclude the 8 aborted cases in the non-IOUS group when assessing the difference in surgical change between the 2 groups. The non-IOUS group would then have experienced a change in surgical plan for 3 of 33 (9%) cases, which is less than the 17% of change due to IOUS. The IOUS subset supports this finding, as 8% of cases in this group experienced a change in surgical plan that was unrelated to IOUS findings.

An unexpected finding of our study was that there was no difference in resection margins between the IOUS and non-IOUS groups. A major function of IOUS has been to help surgeons define surgical planes. In 4 of our 15 cases that changed due to IOUS findings, the relationship of lesions to vascular structures played a major role in operative management. In the remaining IOUS cases, the surgeons noted that IOUS guided their planned resection. To our knowledge, no recent studies compare margin sizes between non-IOUS and IOUS groups. Continued refinement in modern surgical technique is a possible explanation for this finding. Further, perhaps consulting preoperative imaging intraoperatively is as sensitive as IOUS in defining margin planes when the tumour location is known.

In our full cohort, 33 of the 121 procedures did not involve IOUS. The type of preoperative imaging used likely impacted the preoperative decision making to not perform IOUS. A substantially greater percentage of patients ($p = 0.031$) in the non-IOUS group had preoperative MRIs. Multiple studies5,15,19,20 have shown that MRI has a much higher sensitivity than CT in detecting both malignant and non-malignant lesions. Sahani and colleagues31 compared the sensitivities of IOUS and MRI and reported that out of 159 histopathology-confirmed lesions analyzed, 12 (7.5%) lesions were seen only with IOUS. However, this finding did not achieve statistical significance, and the authors concluded that MRI was as sensitive as IOUS in detecting liver lesions. Despite this evidence, it should be noted that 8 of 15 patients whose procedures had a change in surgical plan owing to IOUS findings had a preoperative MRI. Experienced judgment must be carefully applied if one decides to forgo IOUS based on the presence of a preoperative MRI alone.

Apart from type of imaging, the surgeons at our institution agree that other factors influencing their decision to use IOUS include the method and extent of resection. However, there was there was no objective difference between the groups in laparoscopic cases ($p = 0.29$) or the number of major planned resections ($p = 0.27$). Eight of the 33 patients in the non-IOUS group had their procedures aborted before they could undergo IOUS. Excluding these patients, 21% of the cohort did not undergo IOUS. Ultimately, subjective surgical judgment by the primary surgeon determined whether or not to use IOUS. Hopefully, studies such as ours can help standardized decision making in the use of IOUS.

There is heterogeneity within the subset of patients whose surgical plans changed owing to IOUS findings. Two different benign and 4 different malignant diseases are represented in this cohort (Table 4). The dominant diagnosis was metastatic colorectal cancer (67%). This is relatively proportional to the number of patients in our full cohort with this diagnosis (49%). While our sample size is too small to make any significant conclusions, these findings suggest that IOUS is useful in all liver surgery regardless of the diagnosis.

**Limitations**

A small sample size with a high degree of heterogeneity is one of the limitations of this study. We were unable to generate any meaningful conclusions on the impact of IOUS after stratifying our procedures by diagnosis and procedure. The retrospective nature of the study and lack of adequate control group also limit our findings. The person performing IOUS was not the same for all procedures, nor were these individuals blinded to the preoperative imaging results. Lack of blinding was for both logistical and ethical reasons and was a potential sources of bias. In future, a prospective randomized trial with a larger number of patients with each diagnosis would provide more definitive evidence for the use of IOUS.

**Conclusion**

We found that IOUS directly altered the preoperative surgical plan in 17% of cases. There was no significant difference in positive margins between the IOUS and non-IOUS groups. However, surgical planes were more easily defined with IOUS. Despite the modernization of preoperative imaging modalities, the best operative plan in hepatic resections still includes the use of IOUS.

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**Competing interests**: None declared.

**Contributors**: R. Jrearz and S. Jayaraman designed the study. All authors acquired the data, which R. Jrearz and S. Jayaraman analyzed. R. Jrearz and S. Jayaraman wrote the article, which all authors reviewed and approved for publication.

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Patient views on financial relationships between surgeons and surgical device manufacturers

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Background: Over the past decade, revelations of inappropriate financial relationships between surgeons and surgical device manufacturers have challenged the presumption that surgeons can collaborate with surgical device manufacturers without damaging public trust in the surgical profession. We explored postoperative Canadian patients’ knowledge and opinions about financial relationships between surgeons and surgical device manufacturers.

Methods: This complex issue was explored using qualitative methods. We conducted semistructured face-to-face interviews with postoperative patients in follow-up arthroplasty clinics at an academic hospital in Toronto, Canada. Interviews were audiotaped, transcribed and analyzed. Patient-derived concepts and themes were uncovered.

Results: We interviewed 33 patients. Five major themes emerged: 1) many patients are unaware of the existence of financial relationships between surgeons and surgical device manufacturers; 2) patients approve of financial relationships that support innovation and research but are opposed to relationships that involve financial incentives that benefit only the surgeon and the manufacturer; 3) patients do not support disclosure of financial relationships during the consent process as it may shift focus away from the more important risks; 4) patients support oversight at the professional level but reject the idea of government involvement in oversight; and 5) patients entrust their surgeons to make appropriate patient-centred choices.

Conclusion: This qualitative study deepens our understanding of financial relationships between surgeons and industry. Patients support relationships with industry that provide potential benefit to current or future patients. They trust our ability to self-regulate. Disclosure combined with appropriate oversight will strengthen public trust in professional collaboration with industry.

Contexte : Ces 10 dernières années, la mise en lumière de relations financières inappropriées entre des chirurgiens et des fabricants de matériel chirurgical a remis en doute la capacité des chirurgiens à collaborer avec les fabricants et ébranlé la confiance du public en la profession. Nous avons étudié ce que les patients canadiens ayant récemment été opérés pensent et connaissent des relations financières entre les chirurgiens et les fabricants de matériel chirurgical.

Méthodes : Nous avons mené une étude qualitative portant sur cette question complexe au moyen d’entrevues semi-dirigées effectuées en personne avec des patients qui assistaient, dans un hôpital universitaire de Toronto (Canada), à des rencontres postopératoires à la suite d’une arthroplastie. Les entrevues ont été enregistrées, transcrites, puis analysées, ce qui a mis au jour des notions et des thèmes issus des patients.

Résultats : Nous avons interrogé 33 patients et dégagé 5 grandes conclusions : 1) de nombreux patients ignorent l’existence de relations financières entre les chirurgiens et les fabricants de matériel chirurgical; 2) les patients acceptent les relations financières qui soutiennent l’innovation et la recherche, mais rejettent celles qui ne profitent qu’aux chirurgiens et aux fabricants; 3) les patients ne veulent pas que les relations financières soient divulguées pendant le processus de consentement, car une telle divulgation pourrait détourner l’attention des risques plus importants; 4) les patients sont d’accord pour qu’une surveillance soit exercée par l’ordre professionnel, mais pas par le gouvernement; 5) les patients font confiance aux chirurgiens et croient qu’ils font des choix axés sur leurs patients.

Conclusion : Cette étude qualitative approfondit notre compréhension des relations financières entre les chirurgiens et les autres acteurs du domaine. Les patients soutiennent ce type de relations pourvu qu’elles puissent profiter aux patients actuels et futurs, et croient en notre capacité d’autoréglementation. Ensemble, la divulgation de ces relations et une surveillance appropriée renforceront la confiance du public en la collaboration entre les professionnels et les entreprises.
A

s Plato said, “If you are making flutes, you’d better talk to the flutist.”

— Arthroplasty patient

Owing to increasing costs of publicly funded joint replacement surgery, the U.S. Department of Justice (DOJ) launched an investigation in March 2005 into financial relationships between the 5 largest hip and knee implant manufacturers (Biomet, DePuy, Smith & Nephew, Stryker and Zimmer) and orthopedic surgeons.1

The DOJ alleged that these manufacturers provided unethical financial incentives for orthopedic surgeons to use their products.2 The financial relationships in question included consulting agreements for questionable work, contracts paying royalties without any actual transfer of intellectual property, payments for continuing medical education at exclusive resorts, expensive meals disguised as medical lectures, inappropriate gifts and even direct payments to surgeons for using specific hip or knee implants.1

After 2 years of investigation, the DOJ filed a criminal complaint on Sept. 27, 2007, against 4 of the manufacturers (Zimmer, DePuy, Biomet and Smith and Nephew) for “knowingly and willfully combining, conspiring, confederating and agreeing with others to commit an offense against the United States by violating the Anti-Kickback Statute.”2 This statute prohibits the exchange of anything of value with the purpose of increasing reimbursement from a federal health program (e.g., Medicare).2 The complaint was settled through deferred prosecution agreements, which included financial settlements that totalled US$311 million.2 Although the number of financial relationships between surgeons and manufacturers decreased from 939 to 526 in the year following this settlement, the amount of payments increased from a total of US$198 million to US$228 million.3 However, this settlement provided the impetus for the Patient Protection and Affordable Care Act (i.e., Sunshine Act), which aims to manage financial relationships between physicians and industry through public disclosure.4 Central to this U.S. legislation is the requirement that payments of more than $100 made from industry to a physician must be disclosed on a public website.4

More recently, surgeon–manufacturer financial relationships have been under scrutiny following the worldwide recall of the DePuy ASRTM Hip5,6 and the subsequent class action lawsuits.7 Evidence from the Australian Orthopaedic Association National Joint Replacement Registry indicated that the DePuy ASRTM Hip Resurfacing System had a 5-year revision rate of 10.9% compared with 4% for other prostheses.8 Initial registry data that suggested this unacceptably high rate of revision were dismissed by the device manufacturer and the surgeon-designers who incorrectly blamed errors in the surgical technique of low volume surgeons as opposed to problems with the implant design.5,8

The ASRTM recall provides a potential example of actual patient harm due to bias resulting from financial relationships between a device manufacturer and surgeons.5,7 The 2 surgeon-designers were named as defend-
or revision hip or knee arthroplasty. Participants from 2 surgeons’ arthroplasty follow-up clinics at Mount Sinai Hospital, Toronto, Ont., were invited to participate. Mount Sinai Hospital is a tertiary care hospital within a medical system that has a single provincially run medical insurance program. These surgeons’ clinics treat a broad spectrum of patients, including those requiring complex revision arthroplasty as well as young adults requiring arthroplasty. Initial interviews were from a convenience sample of patients, but as is common practice with qualitative studies, purposive recruiting began once concepts and themes emerged from data analysis.

We excluded patients who had undergone surgery within 3 months, those who were unable to communicate in English and those who were unable to provide informed consent. Patients were recruited over a 3-month period from January to March 2010. They were enrolled until “saturation” — a theoretical point beyond which no new concepts arise as a result of further interviews — was reached.

Data collection

All interviews were conducted by the first author (M.W.C), who had no therapeutic relationship with the participants, using an interview guide that was developed from a review of the relevant literature. As is customary in qualitative research, the interview guide was iteratively altered based on patient-derived concepts and themes brought out in previous interviews. Interviews lasted 20–45 minutes. They were audiotaped, and demographic information was collected from each participant. All interviews were transcribed verbatim by a professional transcriptionist and were checked for accuracy by M.W.C. Transcriptions were imported into MAXQDA 10 software (Udo Kuckartz) for analysis. This software allows qualitative researchers to organize and code content. Importantly, codes and themes are generated by the researcher, not by the software.

Data analysis

Data were analyzed using qualitative content analysis techniques that included coding in 3 phases. The first phase involved labelling segments of text with conceptual codes derived from the data (e.g., “patient too concerned with pain to deal with other issues”). The second phase involved grouping similar concepts into categories (e.g., “concerns regarding disclosure”). The third phase involved grouping associated categories into identifiable overarching themes (e.g., patients approve of financial relationships that support education and research, but are opposed to relationships that provide benefit solely to the surgeon or manufacturer). Themes described broad concepts that ran throughout the majority of the interviews. Data analysis occurred in parallel to data collection and began after the first interview. As analysis progressed, newly derived codes were defined, linked with other related codes and then applied systematically across previously analyzed data.

In order to verify the trustworthiness of our findings we used several techniques. We confirmed our understanding of participants’ statements by paraphrasing and summarizing participant responses to ensure accuracy. By maintaining audiotapes, professionally transcribed interviews and electronically stored data analysis and using verbatim quotes in our results, we created an audit trail that would enable other researchers to follow our decision trail. Although the primary analysis of the transcripts was conducted by M.W.C, this analysis was frequently subjected to critical discussion by the research team and 2 qualitative researchers at the University of Toronto not involved with the study. On 4 occasions, sections of transcripts and analysis were presented to interdisciplinary groups of scholars in law, philosophy, bioethics, medicine, nursing and surgery at the Joint Centre of Bioethics at the University of Toronto. We used the feedback from these groups to develop our analysis.

Ethical considerations

The Research Ethics Board at Mount Sinai Hospital approved our study, and we obtained informed consent from each participant. To ensure confidentiality and privacy, audiotapes were destroyed after transcription. Interview transcripts were rendered anonymous by removing all identifiable information, including the names of surgeons and hospitals, and saved on a password-protected and encrypted computer. Patients were reimbursed $10 for parking. There were otherwise no clinical or material incentives for participation.

Results

Participant information

We interviewed 33 patients before reaching saturation. Participant demographic data are summarized in Table 1.

Qualitative description

Qualitative analysis of the patient interviews yielded 5 patient-derived themes. These themes are described below with verbatim quotes from patient interviews.

Many patients are unaware that financial relationships between surgeons and surgical device manufacturers exist

Despite the publicity in the lay media regarding financial relationships between surgeons and industry, the vast majority of patients interviewed were unaware that relationships existed between surgeons and surgical device manufacturers:
“I wouldn’t even have thought about that… It wouldn’t even have occurred to me.” However, more than half of the patients were aware that financial relationships existed between physicians and the pharmaceutical industry: “I’ve heard somewhere, you know, doctors are paid to promote certain drugs, generally drugs. I have never heard of hip replacements or knee replacements, but definitely drugs.”

Patients approve of financial relationships that support innovation and research, but are opposed to relationships that involve financial incentives

Most patients thought that surgeon input is a necessary ingredient for improvement and innovation of surgical devices: “As Plato said, “if you are making flutes, you’d better talk to the flutist.”

Regarding educating other health care providers about a company’s product, patients felt that this too was a positive relationship: “If that surgeon is helping to teach other surgeons how to use it properly, it’s … a good, positive thing, and not a problem.”

Many patients treated health care like any other business where financial relationships are essential in advancing the field: I don’t see there is any difference than in any other industry where practitioners and manufacturers work together. I mean, I don’t know how else you are going to end up with better products.

Although most of the patients felt that it is appropriate for surgeons to be reimbursed for their expertise, patients were more discerning when considering relationships that involved providing benefit solely to the surgeon or manufacturer. Importantly, patients disapproved of financial relationships in which there were no foreseeable benefits for current or future patients:

If he gets paid to educate other surgeons, I think that’s in one category…there is something a little hazy about getting a night on the town or free dinners…it doesn’t seem like it is in the same category. It seems like it’s a step in the other direction...

Most of the patients interviewed judged kickbacks to be inappropriate: “You know, if it is just being used as … a kickback to the surgeon, then I wouldn’t agree.” Patients were particularly concerned about the prospect of receiving an inferior product because of a relationship based on kickbacks with a particular company:

If it is for an educational purpose, then… it’s productive and if it's really related to work, that’s a healthy relationship. But if it’s almost like a bribe, or an incentive, that’s inappropriate. That would make me uncomfortable, because then it’s: ‘I am not necessarily going with the best company, I am going with who’s spoiling me’.

Patients do not support disclosure of financial relationships during the consent process as it may shift focus away from the more important risks

Most of the patients interviewed do not view disclosure of financial relationships to patients as beneficial. Most patients felt that disclosure would take away focus from other more important preoperative issues:

I don’t think we are knowledgeable enough to know whether it matters. You would just be more confused… you get enough information when you are having something like this done for the first time. I mean, it just clouds the issue. I would rather have not known, to tell you the truth.

Many patients felt that disclosure would merely add to their anxiety: “I don’t think they need to have more stress in the decision they are trying to make.” Some felt that too much information preoperatively would overwhelm them: “There is too much clutter out there now, there is too much information out there now, and you are just going to confuse people.”

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<th>Table 1: Participant demographic data</th>
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Many patients felt that a surgeon’s business with a device manufacturer should not involve the patient as it would not influence their decision making before surgery: “It’s useless information for me, it’s not going to help my decision whether to have surgery or not.” Many felt that they would have difficulty understanding the complexities of financial relationships between surgeons and industry: “You are into areas where people don’t have enough intrinsic training in the field to make use of that information.”

**Patients support oversight at the professional level but reject the idea of government involvement in oversight**

Although they disapproved of disclosure to patients as a method to manage financial relationships, most patients felt oversight was warranted:

I think it should be looked at…ultimately, it affects the patient, but there is not much the patient can do about [surgeon–industry relationships]. The [professional regulatory bodies] should be the ones that intervene.

Patients felt that the hospital and professional bodies should oversee financial relationships between surgeons and industry:

I think there has to be really clear conflict of interest policies in the hospitals that cover all departments and they should cover, you know, research practice and any kind of [industry] remuneration in any way for anything, including gifts.

Although all the patients were within a medical system that has a single provincially run medical insurer, patients were against government oversight of financial relationships between surgeons and industry: “I think the government should just stay out of this as much as possible.”

**Patients’ entrust their surgeon to make appropriate patient-centred choices**

Patients want decisions regarding the appropriateness of financial relationships with industry to be made by their surgeon. They expect surgeons to make these decisions while holding patients’ interests paramount:

[The surgeon] is the expert, he’s probably experimented, he sees which one he thinks works best in individual circumstances and I would think he would use his judgment to pick the one that was most appropriate for my own circumstances.

Regardless of whether they approved of a financial relationship between their surgeon and a device manufacturer, most patients felt that they had little other choice than to trust that their surgeon would place patients’ interests above personal financial interests: “But the truth of the matter is…you have to have faith in the person when they cut you open.”

**Discussion**

The results of this study provide needed patient insight and guidance on how surgeons should manage their relationships with industry. Although patients are unaware of relationships between surgeons and industry, more than half of those interviewed were aware of financial relationships between physicians and the pharmaceutical industry. Similar results were found in a survey of Canadian and American hip and knee arthroplasty patients. There are 2 reasons for this phenomenon. The majority of interactions between industry representatives and surgeons do not occur in the vicinity of the conscious patient, whereas interactions between pharmaceutical company detailers and physicians can be noticed by patients in a doctor’s office. There has also been a greater emphasis in the lay media on pharmaceutical companies’ indiscretions than on those of surgical device manufacturers.

Patients support relationships with industry that provide potential benefit to current or future patients. The patients interviewed in this study did not paint all relationships between surgeons and industry with the same brush. They viewed relationships in which a surgeon’s knowledge and experience is required for product innovation and education differently from those that offer no potential benefit to current or future patients. Patients acknowledged that surgeon input is vital in the development and improvement of surgical treatments. They supported surgeon engagement and reimbursement by device manufacturers for their expertise.

These findings are consistent with those of quantitative research examining patient views on surgeons as industry consultants and physician–industry relationships. In an effort to manage financial relationships between surgeons and device manufacturers, the U.S. Patient Protection and Affordable Care Act mandated public reporting of financial relationships between physicians and pharmaceutical companies and device manufacturers. It is unclear how this information will be used by individual patients. The patients we interviewed felt that financial relationships were difficult to comprehend and that they would distract from the surgical risks outlined during the consent discussion. As Weinburg and colleagues found in their 2008 study, conflicts of interest rank low on patients’ decision-making priority lists. Our findings are in contrast to the results of a review of quantitative studies that reported a strong patient desire for disclosure. This review included studies that did not examine vulnerable patients facing major surgical risks as a component of their decision-making process. Most of the studies reviewed used potential patients, potential research participants or members of the general public, who had few, if any, competing worries. Patients in our study had an outlook similar to those of more vulnerable research participants surveyed in cancer research trials. Vulnerable research participants often rejected the idea of disclosure, as they felt it did
not help them in the decision to participate, and it added an extra burden that they would rather not deal with. Our study patients endorsed this view. Like cancer trial participants, surgical patients have limited options and are the least likely to use information regarding their surgeon’s financial relationships with industry in their preoperative decision making.33

Though our study participants supported oversight of financial relationships between surgeons and industry, they rejected government involvement. Our data are consistent with previously published data using quantitative methods, suggesting that patients feel that professional self-regulation is appropriate and that the profession can be trusted with the management of members’ conflicts of interests.21

Ultimately, patients trust their surgeons to make decisions that prioritize patients’ interests. Regardless of whether they wanted disclosure or approved of financial relationships, patients in our study expected their surgeons to manage conflicts of interests appropriately and ethically. Patients do not want their relationships with their surgeons to dissolve into a “buyer beware” model. They expect their surgeons to make decisions regarding conflicts of interest based on the surgeons’ knowledge, integrity and virtue. The data derived from this qualitative analysis are consistent with peer-reviewed published quantitative analyses.22

Limitations

Our study has several limitations. As we interviewed a single surgeon’s patients from a single urban academic hospital within a medical system that has a single provincially run medical insurer, the views provided may not be generalizable to patients in other settings. Patients who agreed to participate may have divergent views from those who did not participate. Postoperative patients’ trust in their surgeon may have influenced their responses, and patients may have been biased by their positive outcomes. However, we excluded patients who had experienced complications or poor outcomes. We excluded preoperative patients to minimize the risk of inducing worry and mistrust that might be caused by discussing this topic preoperatively. Although the interviewer had no professional relationships with the patients interviewed, he was an orthopedic trainee at the time of the interviews while concurrently completing a Master of Science in bioethics. This potential source of bias was mitigated by having 2 qualitative researchers at the University of Toronto critically examine the data analysis. In addition, on 4 separate occasions, sections of transcripts and analysis were presented to interdisciplinary groups of scholars in law, philosophy, bioethics, medicine, nursing and surgery at the Joint Centre of Bioethics at the University of Toronto. Feedback from these groups was used to develop our analysis.

CONCLUSION

This qualitative study deepens our understanding of financial relationships between surgeons and industry. Patients support relationships with industry that provide potential benefit to current or future patients. They trust our ability to self-regulate. Disclosure is a necessary but insufficient strategy to manage conflicts of interest. Disclosure combined with appropriate oversight will strengthen public trust in professional collaboration with industry.

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Competing interests: None declared.

Contributors: All authors designed the study. M. Camp acquired and analyzed the data, which M. McKneally also analyzed. M. Camp and M. McKneally wrote the article, which all authors reviewed and approved for publication.

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Endoscopy services and training: a national survey of general surgeons

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Background: Delivering high-quality endoscopy services depends largely on the competence of endoscopists. General surgery residency training in endoscopy and the associated quality of endoscopy services being delivered by general surgeons have been the subject of considerable controversy. In conjunction with the Canadian Association of General Surgeons (CAGS) executive board, we formulated a survey to evaluate the general state of endoscopy practice and training among general surgeons in Canada.

Methods: The study was designed as a cross-sectional survey. General surgeons who are members of CAGS were selected to participate in the study and were emailed a link to the online questionnaire regarding the importance of endoscopy. They were asked to compare their training to resident training today.

Results: Sixty-nine surveys were completed. The majority of general surgeons (95.7%) indicated that endoscopy was an important skill to possess, and more than 85.5% used endoscopy in their own practices. However, nearly half (46.4%) felt that general surgery endoscopy training in Canada is currently inadequate to produce competent endoscopists. The main qualitative themes emerging from the survey were the inadequacy of current postgraduate endoscopy training (37.5%) and the absence of standardization in training (25.0%).

Conclusion: Endoscopy is considered integral to academic and community general surgeons’ practices; however, the adequacy of training seems to be questioned. Postgraduate training in endoscopy needs to be formalized and standardized, with a greater emphasis placed on teaching endoscopy.


Méthodes : L’étude s’est effectuée sous forme de sondage transversal. Des chirurgiens généraux membres de l’ACCG ont été choisis pour participer à l’étude et ont reçu par courriel un lien vers le questionnaire en ligne sur l’importance de l’endoscopie. On leur a demandé de comparer leur formation à celle que reçoivent maintenant les médecins résidents.

Résultats : En tout, 69 questionnaires ont été remplis. Les chirurgiens généraux ont indiqué en majorité (95,7 %) que l’endoscopie constituait une importante technique à maîtriser, et plus de 85,5 % l’utilisent dans leur pratique. Presque la moitié (46,4 %) étaient toutefois d’avis que la formation actuelle en endoscopie en chirurgie générale au Canada ne peut produire des endoscopistes compétents. Les principaux thèmes qualitatifs que dégage le sondage portent sur la déficience de la formation en endoscopie que reçoivent actuellement les résidents (37,5 %) et sur le manque de normalisation de la formation (25,0 %).

Conclusion : On considère que l’endoscopie fait partie intégrante des pratiques universitaires et communautaires des chirurgiens généraux, mais on semble douter que la formation soit adéquate. Il faut structurer et normaliser la formation en endoscopie que reçoivent les résidents et insister davantage sur son enseignement.
Endoscopy is an integral component of the Canadian health care system in the diagnosis and treatment of gastrointestinal (GI) disease, particularly colorectal cancer (CRC). The demand for endoscopy has steadily increased, and in 2012–13 more than 1.7 million GI endoscopic procedures were performed in Canada alone. Endoscopic services in Canada are mainly delivered by general surgeons and gastroenterologists. General surgeons perform about 50% of all procedures. Service delivery is disparate in Canada. Gastroenterologists almost exclusively provide endoscopic services in academic centres, whereas general surgeons provide the majority of these services at community sites.

Recent reports have called into question the quality of endoscopy services in Canada. An editorial by Rabeneck, the Vice President of Prevention and Cancer Control for Cancer Care Ontario (CCO), stated that overall, gastroenterologists are more competent at colonoscopy than other endoscopists, including general surgeons.

A competent endoscopist must be able to view the entirety of the colon, assess suspicious lesions and obtain pathology specimens while maximizing patient safety and comfort. Competence has been defined as a greater than 90% success rate of cecal intubation in all cases (>95% of screening colonoscopies). To deliver high-quality endoscopy services, CCO guidelines published in 2014 recommend performance of a minimum of 200 colonoscopies per year before being granted access to the endosuite.

The Canadian Association of General Surgeons (CAGS) is committed to providing quality endoscopic services and training across the entire country. We invited all general surgeons in Canada to provide their opinions as to the importance of endoscopy in general surgical practice today and to comment further on their competence as endoscopists, their own training and the competence of current trainees.

**Methods**

**Questionnaire**

The questionnaire comprised 6 multiple-choice questions and 1 open discussion question. The questionnaire was designed and then pretested by members of the CAGS Executive (n = 6) and revised accordingly.

**Survey design and population**

The survey was attached in 2 consecutive monthly general surgery newsletters emailed to all CAGS members. Respondents had to click a link to the web-based version of the questionnaire. The survey was conducted between Dec. 1, 2013, and Feb. 1, 2014. To participate in the survey, respondents had to be active CAGS members with a valid email address.

**Qualitative data analysis**

Qualitative survey responses were analyzed using grounded theory. Data were coded, written into memos and finally formulated into 4 themes.

**Results**

Sixty-nine surveys were completed and received over 8 weeks, for a response rate of less than 5%. We received 32 optional qualitative comments.

The largest respondent group was general surgeons practising for more than 10 years (56.5%), while the smallest group (7.6%) had practised for less than 1 year (Table 1). Surgeons practising for 1–5 years and 5–10 years made up 15.9% and 20.3% of respondents, respectively.

Surgeons practising in academic centres provided 40.6% of survey responses. All other responses (59.4%) were obtained from community-based surgeons serving populations ranging from fewer than 50 000 to more than 100 000 people. Community surgeons serving populations of fewer than 50 000 people made up the largest subset of community-based respondents (27.5%). Surgeons who served populations of between 50 000 and 100 000 people made up the smallest community-based subset (10.1%).

### Table 1. Quantitative survey responses

<table>
<thead>
<tr>
<th>Question</th>
<th>Response rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>How long have you been a practising general surgeon?</td>
<td></td>
</tr>
<tr>
<td>&lt; 1 yr</td>
<td>7.2</td>
</tr>
<tr>
<td>1–5 yr</td>
<td>15.9</td>
</tr>
<tr>
<td>5–10 yr</td>
<td>20.3</td>
</tr>
<tr>
<td>&gt; 10 yr</td>
<td>56.5</td>
</tr>
<tr>
<td>What type of hospital do you serve?</td>
<td></td>
</tr>
<tr>
<td>&lt; 50 000 community hospital</td>
<td>27.5</td>
</tr>
<tr>
<td>50 000–100 000 community hospital</td>
<td>10.1</td>
</tr>
<tr>
<td>&gt; 100 000 community hospital</td>
<td>21.7</td>
</tr>
<tr>
<td>Academic hospital</td>
<td>40.6</td>
</tr>
<tr>
<td>Do you think endoscopy is an important skill for today’s general surgeon?</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>95.7</td>
</tr>
<tr>
<td>No</td>
<td>4.3</td>
</tr>
<tr>
<td>Is endoscopy a part of your practice?</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>85.5</td>
</tr>
<tr>
<td>No</td>
<td>14.5</td>
</tr>
<tr>
<td>Do you feel that you have received adequate training to be a competent, practising endoscopist?</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>88.4</td>
</tr>
<tr>
<td>No</td>
<td>11.6</td>
</tr>
<tr>
<td>Do you feel that general surgery residents today receive adequate training to be a competent, practising endoscopist?</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>53.6</td>
</tr>
<tr>
<td>No</td>
<td>46.4</td>
</tr>
</tbody>
</table>
Most surgeons (95.7%) believed that endoscopy is an important skill for general surgeons to possess. In addition, 85.5% of surgeons reported using endoscopy in their practices, with 88.4% feeling that they received adequate training during their residencies to perform competent endoscopy. However, nearly half the surgeons (46.4%) felt that current endoscopy training is inadequate to produce competent surgical endoscopists.

Four qualitative themes emerged from the survey. Illustrative comments of each theme can be found in Table 2. The most prevalent theme was that current postgraduate endoscopy training is inadequate and fails to consistently produce competent endoscopists (37.5%). The second theme showed that surgeons reported an absence of standardization in surgical endoscopy training (25.0%), citing variable endoscopy experiences across centres and the absence of a formal accreditation program as examples. Poor interest among surgery residents to become competent endoscopists was the third theme (15.6%). Finally, respondents also highlighted that limited access to the endoscopy suite (15.6%) affects resident learning experiences, as privileges are shared with gastroenterology.

**Discussion**

Endoscopy has remained an essential component of general surgery for more than 3 decades.8 The majority (95.7%) of surgeons in our survey considered endoscopy to be an important skill, and many (85.5%) still actively use endoscopy in their practices. Our results are similar to those of previous studies that found that 89%–97% of general surgeons reported endoscopy as a necessary skill for practice.9,10 Endoscopy is the fourth most common procedure performed by urban general surgeons and, on average, comprises 46% of all rural general surgery cases.11 Considering the rapid expansion of endoscopic technology and growing indications for therapeutic intervention, endoscopy continues to be an active tool in general surgical practice and comprises a significant portion of procedural billings.

In our study 88.4% of surgeons believed that they had received adequate endoscopy training and could perform endoscopy competently. However, whether general surgeons are objectively competent endoscopists is controversial, and the data are mixed. Studies have reported that general surgeons have higher rates of missed CRC, are more likely to require the assistance of anesthesiologists for colonoscopy and incorrectly perform surveillance colonoscopy at shorter intervals than current guidelines recommend.12–17 While the strength of these studies can be debated, the criticism toward general surgeons needs to be addressed, and this begins by critically analyzing general surgery residency training programs.

Surgical training has been criticized for its inability to adequately prepare surgical endoscopists for practice. Roughly half (47%) of the surgeons we surveyed reported that current postgraduate surgical endoscopy training is inadequate. This notion was also reinforced in 35% of the qualitative comments. Surgical residents themselves have previously indicated shortcomings in

| Table 2: Qualitative themes isolated from the comments sections of completed surveys |
|--------------------------------|-------------------------------|
| **Theme**                        | **Response rate, %**       |
| Current endoscopy training is inadequate | 37.5 |
| Absence of standardization       | 25.0 |
| Poor resident interest           | 15.6 |
| Limited access to the endoscopy suite | 15.6 |

<table>
<thead>
<tr>
<th>Representative comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Three months of endoscopy as an R2 or R3 is inadequate.&quot;</td>
</tr>
<tr>
<td>&quot;[Residents] feel that after their 1–2 month GI rotation in their PGY3 year they are capable endoscopists and fail to keep up their skills throughout their residency.&quot;</td>
</tr>
<tr>
<td>&quot;Basic endoscopic skills are inadequate in new surgeons (…).&quot;</td>
</tr>
<tr>
<td>&quot;Our residency training program has inadequate exposure to justify accreditation for endoscopy at the completion of training.&quot;</td>
</tr>
<tr>
<td>&quot;It seems that [training] is not standard across the country and certainly some centres are not providing the same amount of training.&quot;</td>
</tr>
<tr>
<td>&quot;We should make sure our residents are surpassing well-defined quality standards prior to passing them.&quot;</td>
</tr>
<tr>
<td>&quot;(…) there is a variable endoscopy experience for current surgical residents among the programs.&quot;</td>
</tr>
<tr>
<td>&quot;Those [students] motivated to learn and be competent are able to do so, while others probably do not reach adequate skill to perform quality colonoscopy.&quot;</td>
</tr>
<tr>
<td>&quot;Major lack of interest in endoscopy.&quot;</td>
</tr>
<tr>
<td>&quot;Gastroenterology is restricting surgery residents opportunities to learn endoscopy.&quot;</td>
</tr>
<tr>
<td>&quot;Unfortunately the turf war between GI and surgery is ever present.&quot;</td>
</tr>
<tr>
<td>&quot;Gastroenterologists are reluctant to teach [endoscopic skills] to our surgical residents and are squeezing the rotations down to numbers of scopes, which they will soon be able to say that our residents did not do enough volume to be competent…&quot;</td>
</tr>
</tbody>
</table>

GI = gastrointestinal/gastroenterology; PGY = postgraduate year; R = residency.
Surgical endoscopy training.\textsuperscript{18} Most recently, an unpublished study by the CAGS Residents Committee found that 39% of graduating surgery residents in Canada felt unprepared to perform endoscopy because of inadequate training.

The most obvious explanation for the underpreparedness of general surgery residents is the lack of sufficient training time and exposure to endoscopy within residency training. General surgery residents generally receive approximately 0.5–4 months of formal endoscopy education during the second or third year of residency,\textsuperscript{1,10,19} with additional, if somewhat limited, exposure throughout the remainder of their training. During this time, they are expected to achieve the minimum threshold number of colonoscopies (50) and upper GI endoscopies (35), as per the requirements of the American Board of Surgery.\textsuperscript{18} On the other hand, gastroenterology fellows receive 18 months of formal training in endoscopy, with fellowship training programs requiring a minimum of 140 colonoscopies and 130 upper GI endoscopies for minimal competence.\textsuperscript{20} Yet, even this threshold has been shown to be too low to achieve competence in colonoscopy, as Spier and colleagues\textsuperscript{20} have shown that GI fellows need 500 cases to achieve competency thresholds. One Canadian study found that merely 17% of surgery residents were able to attain the minimum number of 140 colonoscopies required by the American Society for Gastrointestinal Endoscopy (ASGE).\textsuperscript{1} Another study revealed that only 21% of surgical residents had performed more than 100 colonoscopies during their training.\textsuperscript{19} Accordingly, surgical endoscopy training suffers from insufficient endoscopy volume.

Potential solutions exist. The introduction of a longitudinal endoscopy curriculum — one that encompasses the entire duration of a surgical residency program — may be a way to improve inadequate endoscopy exposure. For example, 4 years after the implementation of a dedicated longitudinal endoscopy training program, Morales and colleagues\textsuperscript{21} were able to increase endoscopy procedural volumes nearly 10-fold, with graduating residents performing 161 endoscopies on average.

The Fundamentals of Endoscopic Surgery (FES) program created by the Society of American Gastrointestinal and Endoscopic Surgeons offers a promising option to introduce a quality standardized endoscopy training program. In conjunction with sufficient clinical experience within postgraduate training the FES program could prove to be an answer to the inconsistent numerical competency targets that currently drive endoscopy training.\textsuperscript{22,23}

A lack of resident interest in endoscopy is another factor considered to be associated with inadequate endoscopy training. Similarly, Spier and colleagues\textsuperscript{18} found that only 43% of residents from an urban tertiary care hospital were considering using endoscopy in their practices following graduation. Interestingly, the argument has been raised that as general surgeons continue to subspecialize (e.g., aspiring breast and endocrine surgeons), it may not be necessary that all surgery residents receive training in endoscopy. In this case, residents choosing to specialize in areas where endoscopy is integral to their practices would have to complete an endoscopy training program and perform the minimum number of recommended endoscopies before graduating.

The absence of standardized endoscopy training programs in Canada may also explain poor endoscopy performance. No standards currently exist for surgical endoscopy training,\textsuperscript{22} and in some cases a dedicated endoscopy curriculum has only been reported in 50% of residency programs.\textsuperscript{10,19} A standardized certified endoscopic training curriculum from the Royal College of Physicians and Surgeons of Canada mandating completion by residents before completion of final certification exams is clearly needed.

Limited access to the endoscopy suite further exacerbates this issue and was identified by our survey as a potential problem. The proposed turf war over endoscopy resources between general surgery and gastroenterology has been documented in the past, with studies reporting that gastroenterology holds monopolies over endoscopy services at most tertiary centres.\textsuperscript{9,24} Although the question of whether the turf war affects surgical endoscopy training is controversial, it is known that gastroenterologists provide training to surgical residents.\textsuperscript{10,21} Therefore, it is important to not focus on a turf war, but rather work together among specialists to ensure the preparedness of all trainees for clinical practice.

Limitations

Our study is not without limitations. First, our findings are limited by the subjective nature of our survey-based data. We did not carry out an official thematic analysis on qualitative survey data. We are also affected by poor response rate. While the exact number of active CAGS members is variable, achieving a response rate lower than 5% is not ideal. Low response rates can potentially lead to marked sampling bias, but studies have supported the validity of low-response survey studies.\textsuperscript{26} Email could have been a poor vehicle for gathering survey results. As personal email volume increases it is often difficult to find time to complete a survey beyond regular duties. The response rate also raises the question of whether there is a lack of interest in endoscopy among general surgeons in Canada.

An opinion-based questionnaire submits itself to inherit biases. There is a natural tendency for the introduction of the “Lake Wobegon,” or above-average effect. In this case, surgeons seem to overestimate their own
abilities and downgrade the abilities of the trainee when they feel there is a comparison directly to themselves.\(^{27}\)

Overall, further investigation into endoscopy training in Canada and how it may be improved is needed to ensure the quality of future endoscopy service in Canada.

**CONCLUSION**

Endoscopy remains an important skill for general surgeons to possess, and current surgical endoscopy training needs to be readdressed. The absence of a standardized endoscopy curriculum, poor resident interest in endoscopy and limited access to the endoscopy suite contribute to the issue of inadequate endoscopy training for surgical trainees. Although both the training and competence of surgical endoscopy has previously been questioned, our study proposes and synthesizes novel ideas as to why surgical endoscopy training may be inadequate. As medical and surgical training moves toward competency-based training,\(^{23,28}\) CAGS needs to be committed to efforts to ensure high-quality training in endoscopy.

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**Competing interests:** None declared.

**Contributors:** All authors designed the study. D. Skubleny and N. Switzer acquired the data, which N. Switzer analyzed. D. Skubleny and N. Switzer wrote the article, which all authors reviewed and approved for publication.

**References**


Impact of the age of stored blood on trauma patient mortality: a systematic review

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Patrick C. Froese, CCP
Mete Erdogan, PhD
Robert S. Green, MD

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Background: The impact of the age of stored red blood cells on mortality in patients sustaining traumatic injuries requiring transfusion of blood products is unknown. The objective of this systematic review was to identify and describe the available literature on the use of older versus newer blood in trauma patient populations.

Methods: We searched PubMed, Embase, Lilac and the Cochrane Database for published studies comparing the transfusion of newer versus older red blood cells in adult patients sustaining traumatic injuries. Studies included for review reported on trauma patients receiving transfusions of packed red blood cells, identified the age of stored blood that was transfused and reported patient mortality as an end point. We extracted data using a standardized form and assessed study quality using the Newcastle–Ottawa Scale.

Results: Seven studies were identified (6780 patients) from 3936 initial search results. Four studies reported that transfusion of older blood was independently associated with increased mortality in trauma patients, while 3 studies did not observe any increase in patient mortality with the use of older versus newer blood. Three studies associated the transfusion of older blood with adverse patient outcomes, including longer stay in the intensive care unit, complicated sepsis, pneumonia and renal dysfunction. Studies varied considerably in design, volumes of blood transfused and definitions applied for old and new blood.

Conclusion: The impact of the age of stored packed red blood cells on mortality in trauma patients is inconclusive. Future investigations are warranted.
The transfusion of packed red blood cells (pRBCs) is considered a cornerstone principle for the management of traumatically injured patients. In cases of both blunt and penetrating trauma, the loss of intravascular blood volume is a common occurrence — so much so that any degree of hemodynamic instability is assumed to reflect hemorrhage. Although crystalloid intravenous fluids are often used in these patients to establish hemodynamic stability, the early administration of pRBCs has also been advocated. However, the use of donor blood products is not without risk of complication. Recent investigations in cardiac surgery, interventional cardiology and critical care have determined that the transfusion of older pRBCs is associated with increased adverse events, including increased mortality. Although the exact mechanism responsible for this is unknown, it is thought that structural, biochemical and immunologic changes occur within RBCs during their storage (also known as “storage lesion”) and that these changes limit the benefits of pRBC transfusions.

Previous studies investigating the age of transfused blood in patients with traumatic injury have yielded inconsistent results. To our knowledge, no systematic review currently exists that exclusively examines the impact of the age of transfused RBCs on mortality in the trauma patient population, although other patient populations have been investigated. The objective of this review was to assess the available evidence for the impact of the age of stored RBCs given as transfusions in the trauma population on patient mortality.

Methods

Literature search

A systematic search of PubMed (1966 to February 2014), Embase (1974 to February 2014), Cochrane and Lilac databases was executed in February 2013 and updated in February 2014. We examined all articles describing the transfusion of stored pRBCs in a trauma patient population and reporting on the age of the blood transfused or the duration for which it was stored. Our a priori outcome was all-cause mortality, although this was not specified in the original search parameters in order to conduct a broad and exhaustive search that identified all relevant investigations. A university librarian assisted with the development of the search strategy. Our specific research question was the following: In patients sustaining traumatic injuries presenting to an emergency department or trauma centre and requiring transfusion of pRBCs during their initial management, does the age of the transfused blood products subsequently have an impact on patient mortality? Search terms (medical subject headings, Emtree headings and free text words) related to trauma patients, age of stored blood, transfusion of pRBCs and patient mortality were used with Boolean logic to identify all potentially relevant articles. No language restrictions were applied.

Study eligibility criteria were determined a priori and used to review citations for relevant studies. Criteria for inclusion were the following: the study was specific to blunt and/or penetrating trauma population, the study population received a transfusion of RBCs, the age of the transfused blood products was described and the study included the end point of patient mortality. All citations were reviewed in accordance with these criteria. As pRBCs are the most frequently transfused blood product in the trauma population, we limited our search to studies that examined the storage age of RBCs; studies that focused on the transfusion of other blood products, such as platelets or plasma, were excluded.

A single author (N.S.) initially reviewed the titles of all studies identified using the search strategy. Studies that were not relevant and any duplicate articles were excluded. Two of us (N.S. and P.F.) independently reviewed the abstract and/or full text of publications related to both the trauma population and the receipt of blood products. Studies that met all of the eligibility criteria were then reviewed by a third author (R.G.) for inclusion. Any discrepancies regarding the selection of articles for inclusion were resolved by consensus among the study authors.

Study selection

Our study population was trauma patients of any age who received a transfusion of RBCs at an emergency department or trauma centre. We included any randomized controlled trial, case-control series or cohort study that met the eligibility criteria. In addition, previously published review papers or meta-analyses related to RBC storage lesions including but not specific to the trauma population were reviewed to identify additional studies.

Our primary outcome of interest was patient mortality. Secondary outcomes included intensive care unit (ICU) admission and length of stay, renal failure, severe sepsis and multiorgan failure, deep vein thrombosis (DVT) and any other complications that were reported. Since a standard definition for the age of stored blood does not currently exist, we also extracted the definition that was used for the age of stored blood from each included study.

Critical appraisal of included studies

The quality of all included studies was assessed independently by a single blinded author (M.E.) using the Newcastle–Ottawa Quality Assessment Scale for cohort studies. Studies were evaluated based on their selection of study groups, their comparability and their assessment of the outcome of interest. A score was calculated for each study, with a maximum score of 9 representing the highest methodological quality.
**Data extraction**

Data elements were evaluated for all publications independently by a single nonblinded author (N.S.) using a standardized data collection form. Extracted information included the year and country of publication, patient age and sex, inclusion and exclusion criteria, primary and secondary outcomes, definitions of old versus new blood, injury severity scores (ISS), blunt and penetrating trauma population distribution and strength of association (odds ratios [OR], relative risks [RR]) between the age of transfused blood and outcomes of interest. Our intent was to perform a meta-analysis of previous studies. Only data explicitly stated in the manuscript of included studies were extracted. Study authors were contacted when clarification of data was required.

**RESULTS**

Seven studies met all of our selection criteria (Fig. 1). We excluded 289 studies because they did not report the age of

---

**Fig. 1.** Study selection.
transfused blood or storage lesion \( (n = 256) \), they were review articles or meta-analyses \( (n = 7) \), they were not specific to the trauma population \( (n = 18) \), they lacked reporting of mortality as an end point \( (n = 7) \), or the study was prematurely terminated owing to logistical issues at the investigation site \( (n = 1) \). Three of these studies that are relevant in the trauma literature on this subject were excluded because the primary outcome measured was not mortality.\(^{17,26,27}\) We identified 2 additional studies through bibliographic review of included studies,\(^{28,29}\) neither was included for analysis (bringing the total number of excluded studies to 291) because 1 was a review article and 1 a feasibility study. Our search strategy is shown in Figure 2.

**Study characteristics and design**

Table 1 summarizes the characteristics and design of the 7 included studies,\(^{10–16}\) representing a total of 6780 patients. All included studies were single-centre retrospective cohort studies performed at trauma centres in the United States and published between the years 2005 and 2010. Studies were limited to adult patients, a majority of whom had incurred blunt trauma (range 74.4%–100%). All studies reported all-cause in-hospital mortality as a primary outcome. The mean ISS varied between 14.4 and 26.3,\(^{10,12–14}\) and the median ISS varied between 18 and 29,\(^{11,15,16}\) Overall mortality ranged from 2.7% to 20.3%.

---

**Table 1. Study and patient characteristics**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Hassan et al.(^{31})</th>
<th>Murrell et al.(^{36})</th>
<th>Phelan et al.(^{35})</th>
<th>Spinella et al.(^{32})</th>
<th>Weinberg et al.(^{33})</th>
<th>Weinberg et al.(^{30})</th>
<th>Weinberg et al.(^{34})</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>820</td>
<td>275</td>
<td>399</td>
<td>202</td>
<td>1813</td>
<td>1624</td>
<td>1647</td>
</tr>
<tr>
<td>Male sex, %</td>
<td>67</td>
<td>67</td>
<td>78.2 [72–84]</td>
<td>74.8 [65–81]</td>
<td>70.6 [65–75]</td>
<td>66.7 [65–77]</td>
<td>67.7 [60–71]</td>
</tr>
<tr>
<td>Blunt mechanism, %</td>
<td>89</td>
<td>89</td>
<td>NR</td>
<td>92.6 [76–98]</td>
<td>76</td>
<td>100 [95–100]</td>
<td>74.4 [72–77]</td>
</tr>
<tr>
<td>Inclusion criteria</td>
<td>Transfusion in ICU within 24 hr</td>
<td>Transfusion ≥ 0.5 pRBC, surviving 48 hr</td>
<td>Transfusion ≥ 0.5 pRBC, surviving 48 hr</td>
<td>Transfusion ≥ 0.5 pRBC, ICU admission</td>
<td>Transfusion ≥ 0.5 pRBC, ICU admission</td>
<td>Transfusion ≥ 0.5 pRBC, ICU admission</td>
<td>Transfusion ≥ 0.5 pRBC, ICU admission</td>
</tr>
<tr>
<td>Exclusion criteria</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>New blood definition, d in storage</td>
<td>≤ 14 Variable</td>
<td>Mean 14 &lt; 28 &lt; 14 &lt; 14 &lt; 14 &lt; 14</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Old blood definition, d in storage</td>
<td>&gt; 14 Variable</td>
<td>Mean 21 &gt; 28 &gt; 14 &gt; 14 &gt; 14 &gt; 14</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Total pRBC units transfused, mean ± SD, mean (range) or median [IQR]</td>
<td>6 [4–11]</td>
<td>3 [2–6]</td>
<td>16.5 ± 16.3</td>
<td>9 [6–12.5]</td>
<td>4.9 (NR)</td>
<td>5.2 [1–104]</td>
<td>3.2 ± 1.8</td>
</tr>
</tbody>
</table>

C = cohort; ED = emergency department; ICU = intensive care unit; ISS = injury severity score; IQR = interquartile range; NR = not reported; pRBC = packed red blood cells; R = retrospective; SC = single centre; SD = standard deviation; u = units.

---

**Fig. 2. Search strategy for PubMed.**
Definitions for the age of stored blood varied among the 7 studies. Blood was considered old if it was in storage 14 days or longer,\textsuperscript{30,33,34} longer than 14 days,\textsuperscript{31} or 28 days or longer.\textsuperscript{32} One study\textsuperscript{35} used the mean age of all units received within 14 days to define new blood and the mean age of all units stored 21 days or longer to define old blood, and 1 study\textsuperscript{36} developed a composite variable that was defined by the proportionate age of each blood unit averaged over all units transfused and then multiplied by the total number of units transfused. The 7 studies also differed considerably in their eligibility criteria and the volume of pRBCs transfused. Owing to the heterogeneity in study design and populations, it was not possible to perform a meta-analysis. All studies were of high quality based on the Newcastle–Ottawa Scale, scoring at least 7 out of a possible 9 points (Table 2).

**Age of transfused blood and trauma patient outcomes**

The age of transfused blood and its association with trauma patient outcomes is summarized in Table 3. Evidence for an association between the age of blood and inhospital mortality was conflicting, as 4 studies\textsuperscript{10,32–34} found transfusion of older blood to be associated with increased mortality in trauma patients, while 3 studies\textsuperscript{31,35,36} reported no increase in mortality associated with older versus newer blood. Two studies transfused RBCs that had been leukoreduced before storage; 1 study\textsuperscript{35} reported no increased risk of death associated with transfusion of prestorage leukoreduced RBCs but could not determine whether the effect on mortality was neutral or protective, and another study\textsuperscript{33} reported increased mortality associated with transfusion of older blood despite universal leukoreduction.

In addition to the outcome of mortality, some studies investigated additional patient outcomes and their association with the age of transfused blood. One study\textsuperscript{31} examined the incidence of complicated sepsis and reported that after controlling for age, sex, ISS and total pRBC units transfused, the administration of older blood was significantly associated with the development of complicated sepsis (OR 1.9, 95% confidence interval [CI] 1.1–3.4). Another study\textsuperscript{32} looked at the incidence of DVT and found it to be higher in patients transfused with older blood than in patients receiving newer blood (17 of 39 [43.6%] v. 7 of 44 [15.9%], \( p = 0.006 \)). A third study\textsuperscript{36} examined patient length of stay in the ICU and the requirement for ICU care and reported that patients receiving older blood had significantly longer ICU stays than patients receiving newer blood (RR 1.15, 95% CI 1.11–1.20) but did not have significantly greater need for ICU care. One of the included studies\textsuperscript{30} focused on outcomes in less severely injured patients and reported that the transfusion of older blood was associated with renal dysfunction (OR 1.12, 95% CI 1.02–1.23) and pneumonia (OR 1.10, 95% CI 1.04–1.17) but was not significantly associated with acute respiratory distress syndrome.

**Discussion**

We have conducted, to our knowledge, the first systematic review examining the impact of the age of transfused RBCs on trauma patient mortality. Our broad search strategy identified 7 studies from the published literature involving a total of 6780 patients. Within these 7 studies, there was substantial heterogeneity in the applied definitions for old versus new blood. The storage time after which new blood was defined as old

<table>
<thead>
<tr>
<th>Table 2. Quality assessment of included studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study*</td>
</tr>
<tr>
<td>Factor</td>
</tr>
<tr>
<td>Hassan et al.\textsuperscript{21}</td>
</tr>
<tr>
<td>Selection</td>
</tr>
<tr>
<td>Representativeness of the exposed cohort</td>
</tr>
<tr>
<td>Selection of the nonexposed cohort</td>
</tr>
<tr>
<td>Ascertainment of exposure</td>
</tr>
<tr>
<td>Demonstration the outcome of interest not present at start of study</td>
</tr>
<tr>
<td>Comparability</td>
</tr>
<tr>
<td>Comparability of cohorts on basis of design or analysis</td>
</tr>
<tr>
<td>Outcome</td>
</tr>
<tr>
<td>Assessment of outcome</td>
</tr>
<tr>
<td>Was follow-up long enough for outcomes to occur</td>
</tr>
<tr>
<td>Adequacy of follow up of cohorts</td>
</tr>
<tr>
<td>Total score</td>
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</tbody>
</table>

*Based on the Newcastle-Ottawa Quality Assessment Scale for cohort studies, each study was awarded a maximum of 1 star for each item within the Selection and Outcome categories, and a maximum of 2 stars for the Comparability category. Total scores for each study were calculated by adding 1 point for each star awarded, with a maximum possible score of 9.
blood ranged from 14 to 28 days. Studies also varied in the volume of blood transfused, ranging from 1 to 6 units. Conclusions drawn from individual studies on the impact of the age of stored blood on patient mortality ranged from neutral to negative. Overall, the results of the 7 studies included in this review are inconclusive with regards to the effect of the age of stored RBCs on trauma patient mortality.

The early transfusion of blood products, often as part of a massive transfusion protocol, and the avoidance of large volume crystalloid resuscitations has become the standard of care in critically ill patients.37 Research into the impact of the age of stored RBCs in a variety of patient populations has evolved over the past decade. Studies from the cardiac surgery literature have generally shown mixed results; however, several large retrospective studies have demonstrated increased mortality in patients transfused with older blood.6,7 Recently, 2 large studies in cardiology patients, including 1 study of patients undergoing percutaneous coronary intervention (PCI), demonstrated increased mortality in patients receiving transfusions of older blood.18,19

Within the critical care literature, there are a number of smaller retrospective studies that have been performed, some of which included trauma patients and reported mixed results regarding the impact of older blood on patient mortality. In a multicentre observational study of 757 ICU patients, an increase in mortality was observed for patients who were transfused with older blood.10 The age of blood evaluation (ABLE) study is a double-blind, multicentre, parallel randomized controlled clinical trial of 2510 critically ill adults that is currently underway in 3 countries (Canada, France, United Kingdom) to test if transfusion with RBCs stored for 7 days or less is associated with lower 90-day mortality than transfusion with standard-issue RBCs (2–42 days of storage).41 If a difference is found, the results of the ABLE study will be applicable to critically ill adults but not to other patients.

In Canada, the supply of red blood cells is based on public donation through hospital-based or national organizations, such as Canadian Blood Services. Current practice in Canada is to transfuse older blood first to avoid waste. However, once blood donation has occurred it must be stored, and RBCs are known to undergo a series of physical and biochemical changes during storage, which are collectively known as “storage lesion.”13–15 These changes include degradation of erythrocytic 2,3-diphosphoglycerate (2,3-DPG), which diminishes the binding affinity of RBCs for oxygen.14 Storage lesion also includes depletion of cellular adenosine triphosphate (ATP) stores, which reduces the ability of sodium–potassium

<p>| Table 3. Association between the age of transfused blood and trauma patient outcomes |</p>
<table>
<thead>
<tr>
<th>Study</th>
<th>Age of blood transfused* (quantity)</th>
<th>Outcome</th>
<th>OR (95% CI)</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hasson et al.31</td>
<td>Old (≥ 7u)</td>
<td>Mortality</td>
<td>NS</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Old (≥ 7u)</td>
<td>Complicated sepsis</td>
<td>1.9 (1.1–3.4)</td>
<td>—</td>
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<tr>
<td>Murrell et al.36</td>
<td>Old</td>
<td>In-hospital mortality</td>
<td>NS</td>
<td>—</td>
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<tr>
<td></td>
<td>Old</td>
<td>Need for ICU care</td>
<td>NS</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Old</td>
<td>Longer ICU stay</td>
<td>—</td>
<td>1.15 (1.11 – 1.20)</td>
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<tr>
<td>Phelan et al.35</td>
<td>Mean 14 d</td>
<td>Mortality</td>
<td>0.426 (0.182 – 0.998)</td>
<td>—</td>
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<tr>
<td></td>
<td>Mean 21 d</td>
<td>Mortality</td>
<td>0.439 (0.225 – 0.857)</td>
<td>—</td>
</tr>
<tr>
<td>Spinella et al.32</td>
<td>Old (≥ 5u)</td>
<td>In-hospital mortality</td>
<td>4.0 (1.34 – 11.61)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Old (≥ 10u)</td>
<td>In-hospital mortality</td>
<td>8.9 (2 – 40)</td>
<td>—</td>
</tr>
<tr>
<td>Weinberg et al.33</td>
<td>Old (overall)</td>
<td>Mortality</td>
<td>NS</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Old (1–2u)</td>
<td>Mortality</td>
<td>NS</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Old (≥ 3u)</td>
<td>Mortality</td>
<td>2.18 (1.00 – 4.97)</td>
<td>—</td>
</tr>
<tr>
<td>Weinberg et al.30</td>
<td>New</td>
<td>Mortality</td>
<td>NS</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Old</td>
<td>Mortality</td>
<td>1.12 (1.02 – 1.23)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>New</td>
<td>Renal dysfunction</td>
<td>NS</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Old</td>
<td>Renal dysfunction</td>
<td>1.18 (1.07 – 1.29)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>New</td>
<td>Pneumonia</td>
<td>NS</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Old</td>
<td>Pneumonia</td>
<td>1.10 (1.04 – 1.17)</td>
<td>—</td>
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<tr>
<td></td>
<td>New</td>
<td>ARDS</td>
<td>NS</td>
<td>—</td>
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<tr>
<td></td>
<td>Old</td>
<td>ARDS</td>
<td>NS</td>
<td>—</td>
</tr>
<tr>
<td>Weinberg et al.34</td>
<td>1–2u old v. new</td>
<td>In-hospital mortality</td>
<td>—</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>≥ 3u old v. new</td>
<td>In-hospital mortality</td>
<td>—</td>
<td>1.57 (1.14 – 2.15)</td>
</tr>
</tbody>
</table>

ARDS = acute respiratory distress syndrome; CI = confidence interval; ICU = intensive care unit; OR = odds ratio; NS = not significant; RR = relative risk; u = units.

*Based on individual study definitions for old and new blood.
channels, glucose transport and oxidative stress defence mechanisms to function.\textsuperscript{32,41} Additionally, the shape of the RBC degrades in a linear fashion from typical biconcave discs to spiculated echinocytes, increasing viscosity, reducing the ability to transverse small capillary beds, and increasing cell aggregation and potentially thrombus formation, as well as proinflammatory and prothrombotic effects of free heme from hemolysis of stored RBCs.\textsuperscript{43} These changes are thought to have adverse effects on or limit cell survival in patients who receive transfusions of older blood. Historically, donor leukocyte contamination was thought to illicit adverse responses from the recipient’s immune system; however, since pretransfusion leukoreduction is now standard practice, this risk has largely been negated.\textsuperscript{14}

In the trauma patient population, we identified 4 single-centre retrospective studies examining the impact of storage lesion using a cutoff of 14 days to denote old blood. While studies have varied in their inclusion criteria, particularly the number of units transfused, there is a trend toward studies reporting an increase in adverse patient outcomes following transfusion of older blood, including multiorgan failure,\textsuperscript{26} longer ICU/hospital length of stay,\textsuperscript{27} pneumonia\textsuperscript{44} and other major infections\textsuperscript{17,41} and all-cause mortality.\textsuperscript{10,12–14} Trauma patients who receive large volumes of blood as part of massive transfusion protocols may have an increased risk of death compared with those who receive smaller total volumes of old blood, suggesting that a dose effect of older blood may exist for various outcomes.\textsuperscript{28} Three of the studies\textsuperscript{32–34} included in our review suggested that an increased overall mortality does not exist. The most commonly used cutoff reported in published studies is 14 days, which dichotomizes all transfused pRBCs into 1 of 2 treatment arms. This cutoff is derived from several biochemical laboratory studies demonstrating that physiologic changes occur within stored blood, and that after 14 days in storage these changes may have a negative impact in transfusion recipients.\textsuperscript{43} We identified only 1 study\textsuperscript{35} that analyzed the mean age of blood as a continuous variable. Within our included studies, there was considerable variability among the definitions used for the age of blood in storage, making it difficult to compare studies since blood considered to be old in one study would be considered new in another. Examining the age of transfused blood as a continuous variable may help to identify whether or not a transition age between new and old actually exists. Consistency of a clear definition for the age of stored blood is paramount for further research within the field.

**Limitations**

It is important to note that 3 of the included studies\textsuperscript{10,11,14} accounted for the majority of patients (5084 of 6780) and were all performed at the same institution and using the same database. After discussion with the lead investigator of these 3 studies, it is likely that some patients were included in multiple studies. However, because the inclusion criteria were different and there was not substantial overlap of patients, we chose to include all patients from these 3 studies in our review.

As with all systematic reviews, the quality of our study is based on the quality of our initial literature search. To avoid missing any potentially appropriate studies during our search, we purposefully kept our search terms broad in order to generate wide search results, which were then reviewed. For example, we did not require any specifics regarding trauma as a search term. We were not specific in our initial search for age of blood or storage lesion, as these are not universally used terms; instead, we manually selected studies with those terms during the search. Furthermore, there was substantial heterogeneity in study design, eligibility criteria, volumes of transfused blood and definitions used for old and new blood across all 7 studies. These limitations draw into question the generalizability of these study results and reinforce the need to establish standard definitions for the age of stored blood.

**Clinical relevance**

Transfusion of RBCs is a key management principle in the traumatically injured patient. Previous findings suggest the transfusion of older RBCs is associated with adverse effects. If the transfusion of older blood in trauma patients is associated with poor patient outcomes, it may promote the use of newer blood in this high-risk patient population. Several studies have shown that the negative effects of transfusing older blood are more significant when larger volumes of blood are transfused, although the true effect is currently unknown. However, should a properly conducted clinical investigation demonstrate that the transfusion of older blood negatively impacts patient outcomes, transfusion strategies targeting the use of new blood in trauma patients would represent an important shift in clinical practice.

**CONCLUSION**

The literature on the impact of the age of transfused blood on the mortality of trauma patients is inconclusive at present. The few studies available differ considerably in design and in their definitions for the age of stored blood. Agreement on a consensus definition for old and new blood is a crucial step toward better understanding the association between the age of transfused blood and poor patient outcomes.

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**Competing interests:** None declared.
References

Assessing personal contributions in global surgery: By whose yardstick?

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Robert Taylor, MD

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Summary

Over the past 2 decades, interest and involvement in global surgery as an evolving discipline have increased among practitioners and trainees. A demand for formal evaluation of global surgery projects has also increased with demands for outcomes and impact. However, there has been little or no encouragement or requirement for participants to formally assess their personal contribution either to a project or to the discipline itself owing to the volunteer-based nature of those involved. Though participant contribution cannot be easily measured, the experience can be used to foster professional development. We propose that this neglected opportunity be addressed and suggest a framework of intentional reflection and mentorship that can be applied as an integral part of the global surgery experience, from participant selection through debriefing after the experience.

For more than a century, surgeons with long-term or lifetime commitment to global surgery were the only ones involved in this activity. Over the past 2 decades this picture has changed dramatically. Interest and direct involvement have sharply increased, particularly among trainees. Similarly, the number of surgical care projects has risen exponentially.

Increasingly, sponsors of global health projects are demanding an accounting of outcomes and impact, usually tied to a cost analysis. Project evaluation is important, but assessment of individual contribution is often overlooked. How do individuals who participate in this work, many on a volunteer basis, assess their contribution to global surgery projects?

Why assess personal contribution?

Global surgery activities involve personal contributions and provide personal benefits. Literature examining benefits from participation in global health activities is limited, and focuses on the medical student or resident level. Benefits identified for trainees include an increased likelihood that they will care for underserved populations, have increased interest in humanitarianism and remain more generalist in clinical practice.

Benefits to practising surgeons are more speculative, but mesh with self-awareness and professional development. Professionalism is a core competency and reflective learning is at the heart of professional development. This is true at undergraduate, postgraduate and continuing education levels.

Intentional reflection is the process of analyzing and reframing experiences for the purpose of deeper learning and meaning (reflective learning) and a process through which personal experience informs and improves practice (reflective practice). Reflective learning can improve professionalism, and reflective practice can contribute to better management of patients and health systems. Repeating the same activity without reflection is simply repeating the same experience over and over again.
Enhancement of behaviours and practice through reflection is rooted in the opportunity to have assumptions challenged. Effective reflection requires time, effort and a willingness to question actions and underlying beliefs and values and to solicit different viewpoints. It is not a solitary activity. Surgeons can gain insight into their personal contribution within global surgery through intentional reflection upon their experience and discussion with others.

**Framework for personal contribution assessment**

Many methods, including journaling, field notes, blogs, portfolios, reflective narratives or storytelling, audio recordings or group discussion, can encourage reflection. There are no data to suggest the superiority or inferiority of any approach. Methods for reflection must be individualized.

Reflection creates a better understanding of ourselves and our global work so that future actions can be informed by this understanding. It is an essential part of professional development, but process is critical. Authors agree that reflection is iterative, but not intuitive. Reflection needs fostering. Many frameworks for reflection are described in the literature. Although somewhat different in content, each framework identifies questions that serve as prompts for reflection. Table 1 summarizes 2 models (Borton and Gibbs) for reflection with specific questions to promote reflective thinking.

However, self-assessment is often inaccurate; shared reflection is better than individual reflection. Others typically see things the reflector cannot see. When done well, feedback provides multiple perspectives, supports integration of emotions and cognitive experience, and discourages uncritical acceptance of the experience. Colleagues with experience in reflection can help foster skills for reflection.

**Timing of personal contribution assessment**

Recognizing the iterative nature of reflection and the responsibility of global surgery to encourage maturation of individuals involved, reflection should be applied throughout the experience. The focus of reflection and the persons involved in the reflective process will differ among the project phases.

**Selection and preparation phase**

Self-selection is the primary selection mode in global surgery, because the work is primarily volunteer-based. Obviously, when the work involves an actual contract and salary, competency benchmarks and key field performance indicators are more clearly articulated.

At the trainee level, predeparture training is mandated or encouraged. It begs the question why such standards are not established for practitioners. All too often there is little or no formal selection or preparation process.

It is a joint responsibility of interested individuals and those directing global projects to encourage such reflection. What information is or should be available to would-be recruits or volunteers? How much effort is put into orientation or predeparture discussions to establish expectations and provide information about the host community?

**Integration and performance appraisal phase**

Reflection is an iterative process and is most successful when we incorporate insights from others. Reflection should involve other expatriate team members and the host community.

Global projects need regular team meetings among expatriate participants to air concerns. Dialogue with host colleagues is equally essential. Feedback from both greatly facilitates integration and reduces tension and confusion.

Even though formal performance appraisals are standard throughout the workforce, they are frequently absent in global surgical care activity because of the volunteer nature of much of this work. Such appraisals are best conducted as a combination of self-assessment, project leader assessment and host assessment with an ensuing open discussion. These assessments should have a defined format and relate to

<table>
<thead>
<tr>
<th>Table 1. Examples of questions for intentional reflection</th>
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<tbody>
<tr>
<td><strong>Reflection model</strong></td>
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<tr>
<td><strong>Borton</strong></td>
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<tr>
<td><strong>Gibbs</strong></td>
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specific tasks and behaviours that are specified in project goals and known to all participants. The final appraisal may be verbal but ideally ought to be written and available to both the individual and the evaluator. This exercise helps to close loose ends or dissipate unsubstantiated impressions.

**Debriefing phase**

Once a project has finished and individuals have returned home they should participate in broader reflection or debriefing of their experience. Debriefing encourages individuals to articulate both positive (satisfaction) and negative emotions (tension) to an experienced listener to gain a broader perspective. This period can occur weeks or months later as an individual reflects on the personal meaning of the experience. One may ask him or herself, “Did this experience whet my appetite for future global surgery involvement?” “Have I become an advocate for global surgery, or have I lost interest in it?”

This is an important phase of the reflection process. There is usually an informal aspect to this phase as individuals relive and share common experiences. Seldom, however, is there a formal debriefing session with an experienced mentor. This is unfortunate because opportunities are missed to consolidate learning experiences and to correct misconceptions. It brings personal closure to the project, informs future involvement in global surgery and raises insights into how a participant may behave or do things differently in the future.

**WHO SHOULD PARTICIPATE IN PERSONAL CONTRIBUTION ASSESSMENT?**

Persons involved or considering involvement in global surgery are encouraged to reflect in each phase of their experience and involve others as much as possible in seeking a more robust and realistic perspective. Mentors can be critical in the process. Three types of mentorship are described. One type of mentor answers questions and gives advice. In this model, knowledge transfer is the focus, with the mentor controlling much of the meeting content and the mentee having a more passive role as listener and spectator. Another type of mentorship model involves the mentor sharing experiences. This is a more reciprocal relationship. The third type of mentorship focuses on listening and stimulating reflection. In this type, the mentee is the focus of attention and the mentor is the listener. The mentor seeks to understand the mentee’s situation and experience and attempts to widen perspective by promoting reflective learning. The mentor seeks to be an “authentic voice.”

We would suggest that, in the context of assessing personal contribution in global surgery by encouraging reflection, the third type of mentor is the most applicable.

The realities of mentorship are such that it is generally a scarce commodity in global surgery. It can be time consuming and it requires commitment and genuine interest. But, as we have described, mentoring and role-modelling are critical components toward improving reflective capacity, and improving reflective capacity enhances professional development in global surgery.

The individual participant needs to play the key role in reflection in each phase of his/her involvement. Other participants may vary depending upon the phase (Table 2).

**CONCLUSION**

Assessing personal contribution in global surgery projects is an important but largely neglected area. Many surgeons consider themselves experts and, as such, even if they have not done previous work in global surgery, consider their expertise and skill set sufficient to do effective global work. They wrongly assume that as a professional and medical expert, they will automatically have a positive impact as a participant in global surgery.

Assessing one’s contribution is complex, and no consistent metric can be applied — just like professionalism cannot be easily defined or measured. Teaching reflective principles and applying mentorship models are increasingly being applied at the trainee level as the model for encouraging professional competency. This may also be the best model within the discipline of global surgery for both trainees and surgical practitioners.

We encourage participants in global surgery to intentionally reflect in all phases of their involvement, from their decision to participate through to the debriefing phase after completing a project. Reflection is also something that project leaders should encourage by setting expectations and defining roles and, in conjunction with host colleagues, by providing meaningful feedback during and after a project. Those who are very active in global surgery should also reflect on what it means to be a mentor to new participants and work toward being better equipped to meet this role.

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**Competing interests:** None declared.

**Contributors:** Both authors contributed substantially to writing and/or revising and to the conception and design of the manuscript and approved the final version for publication.
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CJS’s top viewed articles*

1. Research questions, hypotheses and objectives
   Farrugia et al.
   *Can J Surg* 2010;53(4):278-81

2. Complications associated with laparoscopic sleeve gastrectomy for morbid obesity: a surgeon’s guide
   Sarkhosh et al.
   *Can J Surg* 2013;56(5):347-52

   Sahle Griffith et al.

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   Engels et al.
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9. The reliability of differentiating neurogenic claudication from vascular claudication based on symptomatic presentation
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   *Can J Surg* 2013;56(6):372-7

10. Defining medical error
    Grober and Bohnen

*Based on page views on PubMed Central of research, reviews, commentaries and discussions in surgery. Updated Sept. 9, 2015.
Bougie dilators: simple, safe and cost-effective treatment for Crohn’s-related fibrotic anal strictures

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Anal strictures with fibrotic induration have been shown to develop in up to 50% of all patients with Crohn’s disease (CD) with anal ulceration. We evaluate the technical feasibility, safety and long-term efficacy of bougie dilation for a subgroup of patients with symptomatic Crohn’s-related fibrotic anal strictures. Bougie dilation is simple to perform, relatively inexpensive and has a low risk of complications.

Summary

Anal strictures with fibrotic induration have been shown to develop in up to 50% of all patients with Crohn’s disease (CD) with anal ulceration. Clinically significant strictures occur in about 5% of patients with perianal CD. With reduced stool consistency due to the CD, symptoms are often minimal, and the stricture is discovered at examination. When present, the stricture-related symptoms are overflow diarrhea, perineal pain, constipation and/or fecal incontinence.

In the past, dilation was digital or with Hegar dilators. More recently, balloon dilation has become the choice for many, entailing a considerable long-term cost. To the best of our knowledge, there are no published case series of bougie dilation of CD anal strictures. This discussion demonstrates the technical feasibility, safety, long-term efficacy and cost-effectiveness of bougienage for a subgroup of patients with CD-related fibrotic anal strictures.

Ten patients with CD at a single university teaching hospital who had symptomatic fibrotic anal strictures and failure of digital dilation and were treated between 1988 and 2013 were all perceived to have irreversible fibrotic anal strictures (Cardiff classification S2a). They all had symptoms, such as narrowing stools, abdominal distension and overflow diarrhea. All were further characterized by the inability of a single experienced clinician to insert the distal interphalangeal joint of the examining index finger through the stricture. All strictures were 2 cm long or less, except in 1 patient who opted for colostomy.

Bougie dilation technique

With the patient in the left lateral position and without any prior bowel preparation, stricture dilation was performed using generously lubricated silicone bougies with a tapered Maloney tip (M-Flex, Medovations). Intravenous sedation with fentanyl and diazepam was given. Despite an initial estimated stricture diameter of 5–6 mm in all patients, the procedure was initiated with a # 40- to 44-French bougie. The usual number of bougies per session was 4–5, starting with a #40- or #44-French, and going by double sizes to #56- or #60-French (i.e., #40, #44, #48, #52, #56, #60). Ultimately, dilation up to the biggest bougie (#60-French) was achieved in all patients. With the passage of a bougie through a stricture there is often a sensation of it giving way; once this is felt, one knows that the maximum diameter of the bougie has been passed through the stricture. All procedures were performed by a single experienced physician in an endoscopy suite. A total of 308 procedures were performed. Treatment intervals varied according to patient demand.

The median age of patients at first therapy was 42 (interquartile range 25–50) years with a median follow-up of 10 (range 6–25) years. Dilation was
DISCUSSIONS EN CHIRURGIE

successful in all patients, allowing the full extent of the index finger to be easily passed through the strictures. Bleeding was minimal. All patients reported an immediate improvement in symptoms. Six patients continue to have serial bougienage until 2013. The treatment interval for these patients increased during follow-up; the median number of dilations dropped from 11 in the first 5 years of treatment to 4.5 in the last 5 years ($p = 0.04$). Of 3 patients who have had surgery, 2 did so for unrelated refractory CD and had proctocolectomy and ileostomy. One patient opted for a diverting sigmoid loop colostomy in preference to monthly bougienage. One patient died from an unrelated cause (Table 1).

**Potential complications**

There are inherent risks to performing anal stricture dilation, with potential bacteremia or exacerbation of a perirectal fistula. Three patients experienced transient fever within hours of bougienage. Subsequent antibiotic prophylaxis (ciprofloxacin and metronidazole [500 mg of each orally 3–4 hours before and 6–12 hours after the procedure]) has prevented any recurrence. No other complications were noted. No patients reported subsequent fecal incontinence.

Perhaps the greatest concern with blind bougie dilation is the risk of perforation. We minimized the risk by using highly flexible silicone bougies with a tapered Maloney tip and applying caution with the depth of device insertion. The tactile feedback during insertion of a bougienage provides a further advantage when compared with balloon dilation. No perforations were observed in our patients in a total number of 308 procedures. Furthermore, we have had no instances of new perianal disease or exacerbation of pre-existing disease.

**Table 1. Characteristics of bougienage therapy**

<table>
<thead>
<tr>
<th>Patient</th>
<th>No. total procedures</th>
<th>Follow-up</th>
<th>First 5 yr</th>
<th>Last 5 yr</th>
<th>Current status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16</td>
<td>1993–2013</td>
<td>6</td>
<td>3</td>
<td>Ongoing dilation</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>2003–2013</td>
<td>11</td>
<td>3</td>
<td>Ongoing dilation</td>
</tr>
<tr>
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<td>16</td>
<td>2003–2013</td>
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<td>5</td>
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<tr>
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<td>31</td>
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<td>10</td>
<td>22</td>
<td>1996–2007</td>
<td>14</td>
<td>8</td>
<td>Died in 2007 (stroke)</td>
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</table>

**Conclusion**

To our knowledge, this is the first published case series of bougie dilation for the treatment of irreversible fibrotic anal strictures in CD. Over time, the intervals between dilations have lengthened, perhaps owing to a change in the biology of the collagen in the strictures.4

Bougie dilators have some advantages over other methods. They provide tactile feedback, allowing estimation of the amount of resistance to the passage of the dilator, with avoidance of overdilation and perforation. Another important consideration is cost, as balloon dilators are not reusable and cost CAN $340 each (CRE Wire Guided Balloon Dilators, Boston Scientific plus Inflation System; Alliance Inflation Handle and Syringe). In contrast, bougie dilators are reusable; a set costs CAN $3600 (M-Flex Blue Silicone Bougies) and lasts for many years. Another group has shown that bougie dilators are more cost-effective than endoscopic dilators for postoperative benign rectal strictures as well as being equally safe and efficacious.5

All patients in this report had colonic CD. Since beginning anti–tumour necrosis factor therapy, 3 of 4 patients require stricture dilation much less frequently. Our experience demonstrates that bougie dilation can be used for the treatment of fibrotic anal strictures due to CD. This therapy is simple to perform, relatively inexpensive and has a low risk of complications. Furthermore, it is the senior author’s experience that some of these patients request a repeat dilation because of increasing perianal fistula drainage and report amelioration of the drainage following the procedure. The end result of this form of therapy is not only improved bowel function but, ultimately, avoidance of surgery. Finally, this method can be used in place of balloon dilation, with significant cost savings.

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**References**

Users’ guide to the surgical literature: how to perform a high-quality literature search

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SUMMARY

The article “Users’ guide to the surgical literature: how to perform a literature search” was published in 2003, but the continuing technological developments in databases and search filters have rendered that guide out of date. The present guide fills an existing gap in this area; it provides the reader with strategies for developing a searchable clinical question, creating an efficient search strategy, accessing appropriate databases, and skillfully retrieving the best evidence to address the research question.

Surgical must always ensure that the care they provide is rooted in the best available evidence. Finding the best evidence, one of the cornerstones of evidenced-based medicine (EBM), however, can be a difficult task for a practising surgeon, who often faces a high volume of potential sources from which to extract answers. Without the proper skills and approach, performing an effective literature search can be an arduous and time-consuming task that may not yield the best quality of evidence.

Literature searches have become a prerequisite for providing the most effective surgical care. With the monumental advancements in electronic database searching, a once resource-intensive and difficult process can now be done easily and expeditiously.

The article “Users’ guide to the surgical literature: how to perform a literature search” by Birch and colleagues was published in the Canadian Journal of Surgery in 2003, but the continuing technological developments in databases and search filters have rendered that guide out of date. The present guide fills an existing gap in this area; it provides the reader with strategies for developing a searchable clinical question, creating an efficient search strategy, accessing appropriate databases, and skillfully retrieving the best evidence to address the research question. Table 1 outlines these steps. As in previous users’ guide articles, we provide clinical scenarios to illustrate the concepts.

We caution readers that the purpose of the present guide is not to accept the validity of the articles discussed in our examples, which should be appraised using the techniques published in earlier users’ guides.

Clinical scenario

One hour after undergoing bilateral prophylactic simple mastectomy for breast cancer and Stage I breast reconstruction with insertion of tissue expanders in both breasts, a 40-year-old patient is returned to the operating room (OR) to evacuate a hematoma from the left breast. The surgical team was not aware that just before extubation in the OR the anesthesiologist gave the patient ketorolac to provide postoperative pain control. You are the surgeon involved with the case, and you believe the ketorolac is the cause of the hematoma. The anesthesiologist was not aware of the potential association. You promise to review the literature to determine if ketorolac was the culprit. You are unsure, however, how best to go about the search.
FORMING A RESEARCH QUESTION

It is important to ensure that your research question is well defined, as it will provide the foundation for the literature search. A well-designed research question addresses several components of the clinical scenario, conveniently summarized as PICO(T): incorporating the patient population (P), the intervention (I), any comparative interventions (C), the outcome of interest (O), and the time period for data collection (T). Note that a time period is not always necessary for a research question, such as in cases where you do not wish to restrict your observations to a specific point in care. Once all components of the PICO(T) have been addressed, you should be able to synthesize it into your research question, from which you can ultimately derive keywords.

From the clinical scenario, we format the PICO(T) with its components, as depicted in Table 2. Using the components of our PICO(T) formulation, we then pose a searchable research question: In surgical patients, does the use of ketorolac compared with other postoperative pain control agents cause postoperative hematoma?

DEVELOPING A SEARCH STRATEGY

Keeping in mind that surgeons are likely at different levels in their literature searching skills, this section emphasizes basic principles for developing a search strategy. The resulting strategy attempts to ensure that key articles are not missed owing to varying vocabularies and that all results are relevant. However, surgeons who are comfortable with these principles wishing to further decrease the time required to complete a search can use a simpler organization of search terms and proceed to the section on choosing appropriate databases.

A search strategy is a list of discrete search terms, which can be arranged into groups of related search terms or so-called concepts. Each of these concepts will represent a component of your PICO(T). You can determine the keywords in your clinical question and use them as your initial concepts. For example, it might not be necessary to include an all-encompassing list of pain medications used to treat acute pain postsurgery unless you are interested in specific comparators. Moreover, it is important to avoid the use of too many words for a single search term, opting instead to use more direct terms to designate your search. For example, instead of using “patients who are having surgery” in the population concept, simply specifying “surgery” or “operation” provides an appropriate and sufficient setting in which the population would belong. Multiple-word phrases threaten to limit your search inappropriately, as the indexed terms from most search engines or the direct wording from the article text may differ.

Ultimately, you want to limit the number of irrelevant articles while ensuring that your strategy does not restrict potentially relevant ones. Notice that in Table 3, additional terms have been added below the original search terms, which were considered based on the research question. Consider any synonyms or related terms germane to each concept that may also contribute to your search strategy. You do not need to exhaust the list of similar terms in order to develop a comprehensive search; the example in Table 3 is a good starting point. The initial search may determine whether you need to expand your search vocabulary with additional terms, thus increasing the number of articles returned, or vice versa. For our clinical scenario, the keywords can be selected as illustrated in Table 3.

Truncation/wildcard operators

You may want to ensure that your keywords include all appropriate variations of the root word (e.g., bleed, bleeds, bleeding), if applicable. Instead of including every variation of a keyword under each concept, you can expedite the search by adding an asterisk (*) at the end of the root (e.g., bleed*); the asterisk is known as a wildcard operator. Be mindful that truncations on roots with too many variations may produce an overwhelming search of many inappropriate articles. For example, using “surg***” instead of “surgery” or “surgical” would include thousands of additional terms, many of which would be irrelevant to the intended topic. Adding wildcard operators can ease the process of choosing search terms, but they must be used with caution in the case of broader search terms.
**Boolean operators**

Boolean operators can be used with most database search engines to organize and connect each key search term appropriately. The primary Boolean operators are AND, OR, NOT and parentheses. AND will narrow your search by ensuring that the articles extracted contain all of the terms connected by this operator. OR will broaden your search by including articles that use any 1 or more of the search terms connected by this operator. NOT will narrow your search by making sure that no article extracted contains the term following this operator. Finally, parentheses allow you to group individual terms together, so that all of those terms can be connected to additional terms using an operator.

**Search field tags**

Search field tags can be added at the end of each search term to specify where you want the database to search for it. These tags are also helpful for filtering your search and will be discussed in greater detail in the section of this guide on effectively filtering your search. Each search engine has its own format for tags, which can be found under the help section of the respective search interfaces. For convenience, the popular tags and their function with PubMed are included in Appendix 1, available at canjsurg.ca.

After developing the search strategy for the clinical scenario, you produce a text version ready to be used in database search engines consisting of the following:

(Surgery OR Surgical OR operation OR operative) AND Toradol OR Ketorolac) AND (Hematoma OR Bleed* OR Hemorrhage) AND (Postoperative OR Post-surgery OR Following surgery OR After surgery).

Figure 1 explains how this search strategy operates as an organized grouping of concepts. Notice that in our case, terms belonging to the same concept were connected via the OR operator to allow the search to include any combination of these terms. Also, each set of terms belonging to a concept were grouped together via parentheses, with each concept being connected to each other via AND to ensure that all 4 concepts are included in the articles extracted by the search engine.

**Text words versus controlled vocabulary**

Although text word searches should be a familiar concept, it is important to be aware of any “controlled vocabulary” used by a search engine and to understand its attributes and limitations. Text words intuitively search for those specific words in the text of the article, whereas controlled vocabulary encompasses standardized subject terms that have been assigned by indexers for each article based on relevant topics and keywords. Controlled vocabulary can include synonyms and associated subjects central to your original search terms. MEDLINE and EMBASE have employed medical subject headings (MeSH) and EMTREE vocabulary thesauri, respectively, each of which have their own distinct index. Controlled vocabulary terms are organized hierarchically, from broad to more detailed topics. Each article added to the database is assigned a series of appropriate controlled vocabulary terms. Both in PubMed and the Cochrane database, search terms are automatically searched as both a text word and a MeSH; putting quotation marks around a term will search only for the text word.

The caveat with these terms is that each article available in MEDLINE or the Cochrane database needs to be indexed within the relevant categories. As such, you risk missing articles if they haven’t been indexed appropriately.

In PubMed, the MeSH database can be accessed under “more resources” on the advanced search page or at www.nlm.nih.gov/mesh. Observing the terms involved in the MeSH tree associated with a term may help you choose additional search terms. For example, searching the term “bleed” from the third concept in the clinical scenario will yield “hemorrhage” as the first result. By clicking on that result and navigating to the MeSH tree at the bottom of the page, you will see a full hierarchy of vocabulary associated with this concept. Note that the terms provided in Table 3 are all included in this tree. Searching a term on this page will yield a list of different MeSH terms, which, if indexed, should be relevant to your search term. You
can choose to include an exclusively MeSH-searched term by appending the term with [mh]. Omitting text word searching for a term can act as a filter to include only articles that were specifically indexed under that term.

CHOOSING APPROPRIATE DATABASES

The search strategy discussed previously can now be used in a database search engine to extract relevant articles. The following guidelines focus on databases relevant to a surgical practice. The databases discussed in this guide consist of both unfiltered and filtered sources.

Unfiltered and filtered sources

For surgeons or any physician, 2 of the most common databases for conducting routine literature searches are MEDLINE and EMBASE. These are examples of unfiltered sources. The articles indexed here may have gone through a peer-review process, but this does not guarantee high quality. Filtered databases, on the other hand, include articles that have been preappraised by experts in health research methods. Thus, it is up to surgeons to recognize entries of lesser quality or relevance to their research questions.

Although MEDLINE and EMBASE are unfiltered databases, for most surgical queries, they are still very useful; we have found that most surgical interventions have not been preappraised to the same degree as medical interventions. Despite EMBASE containing a more exhaustive number of journal records, including all of those from MEDLINE, surgeons may not find the additional pharmacology databases included in EMBASE beneficial to their searches. A notable benefit to the MEDLINE database is its open access through the Internet via PubMed. Google Scholar is another Internet source that searches a variety of databases. It has been shown to yield twice as many relevant clinical articles as PubMed, while providing access to a larger number of free full-text articles; however, the large number of articles retrieved may be tedious for literature searching purposes.

Filtered sources can save time for surgeons by reducing numerous aspects of the literature search process, potentially resulting in better patient outcomes owing to the high-quality review articles that can be accessed. Moreover, authors of publications within filtered databases often make recommendations for surgical practice.

Thus, filtered sources are often the best place to start, with unfiltered sources being the next step in finding an answer to a research question.

6S pyramid of hierarchical evidence

As a surgeon using EBM at point of care, it is critical for you to ensure you are taking advantage of the best sources for making clinical and surgical decisions. One method of organization of the available sources of evidence is the 6S pyramid developed by Haynes and colleagues. We provide a summary of this model and sources from each level that is of particular relevance to the surgeon. Table 4 summarizes all surgically relevant sources under the 6S.

The 6S (systems, summaries, synopses of syntheses, syntheses, synopses of single studies, single studies) pyramid (Fig. 2) denotes a hierarchy of evidence wherein the top of the pyramid encompasses the best available evidence for making clinical decisions. As you move toward the bottom of the pyramid, it may become more difficult to make decisions using the evidence therein. Critical appraisal will guide you in arriving at conclusions for the lower evidence on the pyramid, such as primary studies.

Systems represent the prototypical evidence for evidence-based surgery, wherein a surgeon is able to access the best available research integrated into an individual patient’s health record; an integrated system would offer the surgeon evidence of utmost quality and relevance. The system’s role would be to ensure that the cumulative research evidence concerning a surgical patient’s problem is immediately at hand. A resource for this level of evidence is not currently available in either surgical or medical domains, and thus we do not discuss it further. Although not applicable in surgery presently, we anticipate it will be relevant in the future.

Summaries provide the surgeon with expert review and summary of the literature germane to many common surgical problems. One can view these online sources as dynamic textbooks, wherein a comprehensive review on a particular topic in surgery is included; articles are not focused on a single research question, but rather attempt to cover all aspects of a procedure, technique or condition. Examples of summaries include evidence-based clinical practice guidelines (CPGs), there are many CPGs that are not evidence-based, so be sure to look for the details of whether/how evidence is incorporated as well as a general review of evidence-based medicine and surgery. The CMA Infobase and National Guideline Clearinghouse are 2 clinical practice guideline sources that cover surgical practices; UpToDate, DynaMed and Best Practice offer EBM summaries. A caveat to keep in mind with sources for summaries is that these resources appear to be geared toward medical literature presently and may not have comprehensive coverage of many surgical topics; for example, we noted a particular paucity in entries regarding the surgical specialties within CMA Infobase. Moreover, although these resources have expert reviewers responsible for presenting the information, the sources used are not always critically appraised in the standardized fashion expected from other filtered sources. UpToDate, for example, is incorporating GRADE (www.gradeworkinggroup.org/publications/) and DynaMed uses explicit evidence criteria and GRADE.

Synopses of syntheses are brief structured summaries of systematic reviews. They offer the benefit of a concise abstract of a detailed article, with the added advantage of having the evidence coming from literature that reviews
all available single studies on a given topic. Surgically relevant sources in this category include the Database of Abstracts of Reviews of Effects (DARE), Cochrane Summaries, ACP Journal Club, OrthoEvidence, NHS Economic Evaluation Database (NHSEED) and BMJ Clinical Evidence.

Syntheses are systematic reviews of all single studies germane to a particular question. Syntheses can fall under both filtered and unfiltered sources. Sources include the Cochrane Database of Systematic Reviews and systematic reviews published in other journals (Cochrane reviews make up less than one-third of all published reviews), almost all of which are available through ACCESSSSS and TRIP, which include both preappraised and nonpreappraised databases, such as MEDLINE.

Synopses of single studies will provide an expert review and brief summary of a single entry in the primary literature, often providing a clearer and more expeditious interpretation of what that literature means in the context of making surgical decisions. The ACP Journal Club, OrthoEvidence, and Evidence-Based Obstetrics and Gynecology offer articles within this level of evidence.

Finally, single studies largely come from unfiltered sources, such as MEDLINE, EMBASE and the Central Register of Controlled Trials (CENTRAL).

**Access to resources**

Many of the sources discussed thus far do not provide free full-text access to their material. Sources such as PubMed, the Cochrane Library and UpToDate will allow you to search their databases free of charge; however, access to most of the full-text articles will still require a subscription to the respective database. PubMed and the Cochrane Library do, however, allow you to view abstracts to virtually all of their articles, and some full-text articles can be

<table>
<thead>
<tr>
<th>Table 4. Sources of evidence in the 6S pyramid</th>
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<tr>
<td><strong>Summaries</strong></td>
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<td>Evidence-based summaries</td>
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<td>UpToDate (<a href="http://www.uptodate.com">www.uptodate.com</a>)</td>
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<tr>
<td>DynaMed (dynamed.ebscohost.com)</td>
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<tr>
<td>Best practice (bestpractice.bmj.com)</td>
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<td>Clinical practice guidelines</td>
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<tr>
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<td>National Guideline Clearinghouse (<a href="http://www.guidelines.gov">www.guidelines.gov</a>)</td>
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<tr>
<td><strong>Synopses of syntheses</strong></td>
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<td>BMJ Clinical Evidence (clinicalevidence.bmj.com)</td>
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<tr>
<td>Cochrane Summaries (summaries.cochrane.org)</td>
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<tr>
<td>ACP Journal Club database (<a href="http://www.acpjc.org">www.acpjc.org</a>)</td>
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<tr>
<td>OrthoEvidence (<a href="http://www.myorthoevidence.com">www.myorthoevidence.com</a>)</td>
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<td><strong>Syntheses</strong></td>
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<tr>
<td>McMaster PLUS (in ACCESSSSS and Evidence Updates)</td>
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<tr>
<td>The Cochrane Database of Systematic Reviews (<a href="http://www.thecochranelibrary.com">www.thecochranelibrary.com</a>)</td>
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<tr>
<td>MEDLINE (Unfiltered Source); PubMed (<a href="http://www.pubmed.com">www.pubmed.com</a>)</td>
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<tr>
<td>EMBASE (Unfiltered Source); OvidSP (gateway.ovid.com)</td>
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<tr>
<td><strong>Synopses of single studies</strong></td>
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<td>McMaster PLUS (in ACCESSSSS and Evidence Updates)</td>
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<td>OrthoEvidence (<a href="http://www.myorthoevidence.com">www.myorthoevidence.com</a>)</td>
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<td>Evidence-Based Obstetrics and Gynecology (<a href="http://www.sciencedirect.com/science/journal/1361259X">www.sciencedirect.com/science/journal/1361259X</a>)</td>
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<td>EMBASE (Unfiltered Source); OvidSP (gateway.ovid.com)</td>
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<td>The Central Register of Controlled Trials (Unfiltered Source) (<a href="http://www.cochrane.org/editorial-and-publishing-policy-resource/cochrane-central-register-controlled-trials-central">www.cochrane.org/editorial-and-publishing-policy-resource/cochrane-central-register-controlled-trials-central</a>)</td>
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accessed for free; UpToDate allows you to access sample portions of their articles. These resources can allow you to find a potential article without a subscription.

Institutions, such as academic centres, hospitals, and clinics, as well as organizations, such as the Canadian Medical Association and provincial and territorial medical associations, often subscribe to a number of relevant databases for their workers. These institutions use online, searchable interfaces, such as OvidSP and EBSCOhost, to provide full-text access to databases and comparable strategies for finding an article to that of PubMed. Owing to the wide variety of institutional access interfaces that exist, our guide cannot provide a detailed commentary for each. Fortunately, these interfaces tend to incorporate many of the same organization and search engine tools as that of PubMed. For more information regarding institutional access, we recommend contacting your institution’s librarian.

Google Scholar: Should you use it?

Google Scholar is frequently used by practising surgeons to access the literature. There are several advantages and disadvantages to using Google Scholar. If you know exactly what you are looking for (e.g., a specific article, articles by a specific author), Google Scholar provides the best results. Conversely, if you are unsure that you can recognize the “right answer” (e.g., the current best evidence concerning a treatment) or if you lack the skillset or time to appraise individual items, Google Scholar provides no direction. Perils in the latter situation include millions of hits, search optimization (i.e., gaming the system to push items to the top of the search retrieval based on characteristics other than quality), and the lack of quality filters to help sort the wheat from the chaff in a database that is almost all chaff for a given question. Unfortunately, most relevant clinical questions are ones for which the clinicians do not know the best answer. Using preappraised evidence resources, such as the ones discussed in this guide, is much more likely to be productive than using Google Scholar for these questions.

Too many resources and not enough time: the role of federated search engines

We have listed a number of resources that cater to surgeons for the sake of completeness; however, you often will not need to go through all of them in search of your answer. A group from McMaster University has created a federated search engine known as ACCESSSSS (plus, mcmaster.ca/accessss). A federated search facilitates simultaneous searching of more than 1 database from a single convenient search query; ACCESSSSS allows you to enter your search strategy and simultaneously search multiple sources from all available levels of the 6S pyramid below the systems level, presenting the results under their respective level of the pyramid. The sources within each 6S category include filtered sources, and unfiltered sources are included at the very bottom. Currently, although the site is free, you are required to register to use it. The TRIP database (www.tripdatabase.com) has a similar function. These resources offer an expedited search, consulting only 1 site for results. However, you may find yourself overwhelmed with the number of results despite the intelligent filters used by the creators; TRIP yielded 198 hits with our example search strategy, and ACCESSSSS provided 106 results and hundreds of unfiltered hits;

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Fig. 2. The 6S (systems, summaries, synopses of syntheses, syntheses, synopses of single studies, single studies) pyramid.
Executing a search

Based on the sources discussed, there are plenty of resources that can be used to carry out an effective literature search. For our clinical scenario, a search was performed using ACCESSSS by copying our search strategy into the main search bar of the website (Appendix 1, Fig. S1, available at canjsurg.ca) This search yielded hits within summaries and synopses of syntheses, with no further results from other filtered sources (Appendix 1, Fig. S2). At the time of this search, there were no entries within these categories that effectively answered the research question. However, 1 of the synopses of syntheses articles briefly reports on some association of ketorolac with bleeding complications (Appendix 1, Fig. S3). You decide to pursue an answer further in the unfiltered results from PubMed and PubMed Clinical Queries, from which 1 study provides compelling evidence specifically regarding your research question (Appendix 1, Fig. S2). To ensure your search of the unfiltered literature is comprehensive, you decide to conduct your search in PubMed.

A lack of results from filtered sources will likely be a common occurrence. The pace of new information from unfiltered sources moves much quicker than from filtered sources; as such, you will need to defer to databases such as MEDLINE to acquire your evidence. Our search in ACCESSSS provided unfiltered results as well; however, you may wish to search databases such as PubMed directly. This guide will hereafter provide instruction on how to optimally search these databases to ensure that you are confident with and in control of the results. MEDLINE searches are currently the most common technique within the surgical community. Although you can access MEDLINE through your institution (i.e., OvidSP), we proceed using the PubMed search engine; the methods discussed are applicable to all database interfaces.

After navigating to PubMed, click on “advanced” to access the advanced search options (Appendix 1, Fig. S4). The advanced search itself can also be used in much the same way as the Cochrane search engine: individual search terms can be added to each search box (combined with AND, OR, and NOT operators). As with the other example in the Cochrane database, concepts in the same search query box will be automatically grouped with parentheses, which are thus not required. Alternatively, there is a search builder at the top of the page, where you can manually add your search strategy along with Boolean operators and parentheses to easily group all terms from each concept. Again, we recommend that you limit your keyword search to titles and abstracts, either via the dropdown menu to the left of each search bar, or via search field tags if you are using the search builder to manually input your search strategy. Both methods are shown in Appendix 1 (Fig. S5), but only 1 is required to carry out the search.

Conducting the aforementioned search from the clinical scenario yields 116 articles. Even the most assiduous of clinicians would agree that the volume of results is unmanageable for searching on a day to day basis. Fortunately, several techniques exist to appropriately limit your search by focusing it toward certain qualities that are desirable for use as clinical evidence.

Using filters to narrow your search

Search engine filters

All the search engines discussed have built-in tools to limit your search results. Within PubMed, you can access all of the search filters on the left side of the search results page. However, it is important to note that the filters built into these search engines have limitations. For example, the filters used by MEDLINE rely on the indexed MeSH terms to filter the search. Owing to the risks associated with missing viable articles as a result of inappropriately indexed or nonindexed articles, the “additional filter method” has been included for the filters most affected by this phenomenon. Nevertheless, the built-in search filters offer a rapid way to reduce the number of records yielded by your search.

Study design

In order to be confident with any clinical decision rooted in EBM, it is critical to ensure the best quality evidence. Thus, it is ideal to initially filter for the highest level of evidence. The hierarchy of evidence has been discussed in previous users’ guide articles. In brief, systematic reviews and meta-analyses of randomized controlled trials (RCTs) represent the best evidence, as they are unbiased in their acquisition of multiple articles and provide statistical analysis and quantitative measures of these articles. In particular, RCTs are considered the highest form of single-study evidence owing to their robust methodologies; single RCTs should also be considered when searching for articles to answer your research question. However, it is important to ensure that your particular research question can be answered through this study type. For instance, if your research question deals with a scenario wherein a study population couldn’t be randomized (e.g., owing to harmful exposure, patient preference), then you will not be able to yield RCTs or systematic reviews of RCTs in your search. Because surgical studies in particular are plagued with issues regarding randomization more often than medical studies, there is all the more reason to conduct a full search of the primary literature.

For an additional filtering method, you can include the study design filter as its own concept, including each study
type twice, once with the search field tag [pt] and once with the tag [tiab], or the equivalent for other search engines. For example, if you wanted to limit your search to include only RCTs and meta-analyses, you would add the following to your search query:

AND (randomized controlled trial[pt] OR meta-analysis[pt] OR randomized controlled trial[tiab] OR meta-analysis[tiab])

Including the study type as part of a concept ensures that the search engine will not only search exclusively these article types as indexed under publication type [pt], but also the article type in the title and abstract [tiab] in the event that the publication type is not indexed appropriately. You must ensure that for those terms appended with [pt], the exact wording of the study type is used. Otherwise the search engine will not properly apply this filter. Also a list of study types that are relevant to surgeons are included in Table 5.

**Publication date**

Depending on your research question, you may want to specify a range for the publication date. In surgical practice, where procedures and technology are ever-changing, you want to ensure that your results take all of these changes into account, and thus filtering for up to date articles is a reasonable filter.

In the case of the clinical scenario, you might choose to limit your search by article type. Aiming for the highest levels of evidence, you choose to limit your search to “meta-analysis” and “randomized controlled trials” using the additional filtering method. This filter alone cuts your search down to 47 articles. Further filtering to reveal only the meta-analysis study type yields only 1 article, the first meta-analysis on this topic, entitled “Ketorolac does not increase perioperative bleeding: a meta-analysis of randomized controlled trials” by Gobble and colleagues.20

**Optimized search filter: Clinical Queries**

Clinical Queries incorporates a number of filters targeted toward clinical questions using the MEDLINE database. As with PubMed searching, results from Clinical Queries are also presented in ACCESSSSS. However, this section provides a more in-depth explanation of this filtering tool, as well as a description of how to use it.

Available through PubMed and OvidSP, Clinical Queries provides an optimized filter that allows you to limit your search not only to clinically relevant articles, but also to specific subsets of clinical articles to appropriately address your question. In effect, Clinical Queries seeks to provide the best balance between sensitivity and specificity based on analysis of many popular strategies. Studies have shown that the Clinical Queries tool continues to provide an effective methodological and topical filter for searching literature related to clinical care. Clinical Queries can be accessed at www.ncbi.nlm.nih.gov/pubmed/clinical, or in the same resources menu as MeSH. You can enter your search strategy into the search bar near the top of the page. Once entered, you will notice results are displayed under 3 columns: “clinical study categories,” which includes individual clinical studies; “systematic reviews,” which includes all systematic review articles related to your search query; and “medical genetics,” which is perhaps not as applicable to surgical literature. The clinical study categories column contains further filters that can be applied and are discussed in detail.

**Category**

The category option contains 5 different categories from which to filter your search: “therapy” will retrieve clinical studies that involve disease treatment, “diagnosis” yields diagnostic articles, “etiology” searches articles dealing with causes of disease or pathology, “prognosis” will search for articles associated with prognostic factors and “clinical prediction guides” retrieves clinical studies that deal with methods for predicting outcomes.

**Scope**

The scope option allows you to adjust the sensitivity and specificity of your search. Choosing “broad” increases the sensitivity of your search results, finding all articles relevant to your query, including less relevant ones that may not include all of your concepts. Choosing “narrow” increases the specificity of your search, changing the scope to include only the most relevant articles by incorporating as many of your concepts as available.

Applying our original search strategy to Clinical Queries yields the results shown in Appendix 1, Figure S6. It is evident that the meta-analysis discovered from the previous search filtering has shown up under systematic reviews, organized in the middle column of the results page. However, we also see 103 results from other clinical studies on the left; changing the scope to “narrow” cuts the results roughly in half to 46 articles. By clicking “see all” at the bottom of the results section, you could apply additional filters specific to your requirements, as discussed previously, to reduce that number even further.
AN ESSENTIAL FRAMEWORK FOR YOUR LITERATURE SEARCH

Our guide has provided many different tools to conduct a literature search in order to cater to the preferences of all readers. It is not, however, necessary to exhaust all of these tools to answer your research question. Rather, we encourage you to consider the methods discussed, their strengths and weaknesses, and determine what methods address your needs.

For the surgeon looking to distill this process into its most basic form, we propose the essential steps necessary for completion of a literature search. These steps include generating a research question, developing a search strategy and applying that strategy using an appropriate search engine. Since no additional filters or adjustments to your search are involved in this basic formula, using an appropriate search engine, such as the federated search engine ACCESSSS, is critical. Figure 3 provides a basic framework to guide your search from start to finish, using the clinical scenario provided in this guide.

Resolution to the clinical scenario

By incorporating the search strategy along with any of the sources discussed (Federated Search Engine, PubMed, PubMed Clinical Queries) you find the article by Gobble and colleagues.20 This is the first meta-analysis of its kind, which examined 27 RCTs on postoperative bleeding occurrences with ketorolac compared with a control group in a variety of different surgical settings, including plastic surgery. The study indicates that ketorolac does not increase bleeding risk and recommends considering its use as a pain control therapeutic agent postoperatively.

Fig. 3. Basic framework to guide a literature search from start to finish.
You inform the anesthesiologist of the evidence provided by this article, and ketorolac remains a consideration for future use to control pain postoperatively.

**CONCLUSION**

The surgical literature continues to grow at a breakneck pace. Although the wealth of knowledge available to surgeons offers greater opportunities to provide optimal surgical care, the weight of this knowledge can become crippling to busy surgeons if they are unable to effectively and efficiently access it. However, the search strategies outlined in this guide will allow surgeons to execute successful literature searches which will provide robust and clinically meaningful data to improve patient care. The Royal College of Physicians and Surgeons of Canada makes a point of professionalism in recommending that every physician and surgeon stay current with the literature in clinical topics associated with his or her practice, and the new CanMEDS competencies recommend use of preappraised resources. A combination of the ability to identify clinically relevant questions in your practice, routine exploration of these questions in your schedule and the appropriate skills for seeking out answers obtained from this guide will strengthen your role in honouring this requirement. Once again, we encourage readers to consult earlier users’ guides when appraising the chosen literature.

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**Competing interests:** None declared.

**Contributors:** All authors contributed substantially to writing and/or revising and to the conception and design of the manuscript and approved the final version for publication.

**References**

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**Academic Thoracic Surgeon**

Department of Surgery, University of Manitoba and Surgery Program, Winnipeg Regional Health Authority

The Department of Surgery, Faculty of Health Sciences at the University of Manitoba and the Surgery Program of the Winnipeg Regional Health Authority are recruiting an academic thoracic surgeon (position number 19332). This is a contingent geographical full-time position at the Health Sciences Centre. The position encompasses inpatient and ambulatory patient care responsibility, and requires qualified individuals to further undergraduate and postgraduate teaching, research, and tertiary care medicine in the field of thoracic surgery. Remuneration is derived from fee-for-service billings and academic rank will be commensurate with experience and qualifications. Physicians may be eligible to receive a recruitment incentive. Please contact physicianrecruitment@wrha.mb.ca for further information. The start date for this position is negotiable.

Candidates must be eligible for registration with the College of Physicians and Surgeons of Manitoba. Certification in Thoracic Surgery by the Royal College of Physicians and Surgeons of Canada is required. Experience with endobronchial ultrasound, advanced minimally invasive thoracic and foregut surgery experience is preferred.

Preference will be given to individuals with strong research background with demonstrated academic productivity and track record.

The Section of Thoracic Surgery is based at the Health Sciences Centre, the major tertiary hospital for thoracic surgery in Manitoba. There are currently three full-time Thoracic Surgeons, who provide service to the majority of Manitoba and Northwest Ontario, a population close to 1,000,000. Primary responsibilities for the successful candidate are clinical. Thoracic Surgery at the University of Manitoba has an active Royal College of Physicians & Surgeons of Canada-certified fellowship program. Inpatient ward, consults and outpatient clinic management are supported by 2 full time Clinical I Physician Assistants and a dedicated Thoracic Clinic Nurse in addition to surgical house staff. The Program incorporates a rich mix of emergency and elective Thoracic Surgery.

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The University of Manitoba and the Winnipeg Regional Health Authority are committed to creating a diverse and inclusive workplace. Applications are encouraged from qualified applicants including members of visible minorities, Aboriginal peoples, people with disabilities, and people of all sexual orientations and genders. All qualified candidates are encouraged to apply; however, Canadian citizens and permanent residents will be given priority.

Dr. Jack Mcpherson
Head, Department of Surgery
AE101- 820 Sherbrook Street
Winnipeg, Manitoba, Canada R3A 1R9

Application materials, including letters of reference, will be handled in accordance with the protection of privacy provisions of “The Freedom of Information and Protection of Privacy Act” (Manitoba). Please note that the curriculum vitae may be distributed to participating members of the search process.

Closing Date: October 31, 2015

For more information on this and other opportunities, please visit: umanitoba.ca/employment
Western University and
London Health Sciences Centre/St. Joseph's Health Care London
invite applicants for the position of

LIVER TRANSPLANT SURGEON, DEPARTMENT OF SURGERY

The Divisions of General and Transplant Surgery, Department of Surgery, Schulich School of Medicine & Dentistry at Western University are seeking a full-time limited term or continuing clinical academic liver transplant surgeon at the rank of Assistant, Associate, or Full Professor to join the three liver transplant surgeons. The successful candidate must have a strong academic background in living related liver transplantation, teaching and supervisory experience, and will be expected to participate in the Division's academic and educational initiatives including teaching and supervision of undergraduate students, residents, and fellows. Applicants considered at the rank of Associate or Full Professor must demonstrate the ability to publish in the highest quality academic and subspecialty outlets and be a recognized expert in his or her field of research. Rank and appointment status will be determined by the candidate's qualifications.

The Divisions of General and Transplant Surgery are affiliated with London Health Sciences Centre and St. Joseph's Health Care London. The successful candidate will have the opportunity to practice general and HPB surgery and will be expected to participate in the Division's academic and educational initiatives. The individual will work in a highly collaborative environment with clinicians and researchers in several Faculties and Departments and will have ample opportunity to develop his/her research interests.

Qualified candidates must have an MD or equivalent; have completed an accredited general surgery training program from the Royal College of Physicians and Surgeons of Canada (or equivalent); a minimum of 2 years of certified liver transplant fellowship training, with living liver related transplant experience, and be eligible for licensure in the Province of Ontario.

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Interested candidates should send a letter of interest, curriculum vitae, and the names and addresses of three references to:

Kenneth Leslie MD MHPE FRCSC
Chair/Chief, Division of General Surgery
London Health Sciences Centre
London, ON Canada N6A 4V2
Tel 519 667-6778 • Fax 519 667-6764
E-mail ken.leslie@lhsc.on.ca

Applications will be accepted until the position is filled. Review of applications will begin after October 1, 2015 with an anticipated start date of July 1, 2016 or as negotiated.

Please ensure that the form available at: http://uwo.ca/facultyrelations/physicians/Application_FullTime_Clinical.pdf is completed and included in your application.

Positions are subject to budget approval. Applicants should have fluent written and oral communication skills in English. All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority. Western University is committed to employment equity and diversity in the workplace and welcomes applications from all qualified individuals, including women, members of visible minorities, aboriginal persons, persons with disabilities and persons of any sexual orientation or gender identity.
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