

Colorectal surgery training and patient safety: dissonance in an era of quality reporting

A crisis is looming in surgical education where the number of surgical approaches and techniques are expanding while the hours in which teaching can occur dwindle [1,2]. These competing influences test the prior balance between service delivery and training. Furthermore, work hour restrictions were implemented without evidence-based quality metrics to gauge their impact. Surgical trainees themselves are ringing the warning bells expressing sentiments that these changes result in reduced training quality and quantity [1,3]. A major paradigm shift in surgical education is inevitable and the final proverbial straw may be new findings that surgical trainee involvement is associated with worse patient outcomes [4–7]. The potential for trainees to increase patient risk urgently requires the surgical community to address this moral tension between patient safety and the necessity to train competent future surgeons in a limited time frame.

Reports about the trainee impact on outcomes tend to focus on four main themes: intra-operative differences in time and quality when trainees are included; postoperative end-points such as morbidity and mortality; patient satisfaction; and whether supervision alters outcome. For intra-operative differences associated with trainee cases, the most consistent evidence is the effect on operative time [8]. The average increase in operative time for colectomies involving trainees ranged from 20.5 to 33.7 min compared with cases performed by consultants alone [4,6,9–11]. Longer operations may be an acceptable trade-off for addressing educational needs but also represent lost opportunity cost for consultants [11]. Increased operative time itself may lead to poor outcome and may be part of the causal pathway for other downstream adverse outcomes evidenced by a decreased estimated effect when multivariate analysis of major complications is adjusted for operative time [4]. Other intra-operative adverse events with an associated increased risk in trainee cases include increased intra-operative blood loss and conversion rates [12], while additional markers of intra-operative quality suggest that trainee cases have equivalent surgical features. A single centre study of 130 cases from the UK evaluating the quality of mesorectal excision and recurrence for curative resection of rectal cancer found no difference in cases where supervised trainees performed the excision compared with consultants [13]. These conflicting findings make proclamations about trainee involvement

potentially dubious and underscore the importance of further study on trainee outcomes.

A consistent finding for colorectal resection is that mortality is not altered by trainee involvement [4,9,14–17]. No study published to date examining survival after colorectal cancer resection has demonstrated any trainee-associated impact, although evidence is limited owing to there being few studies with small sample size. Whilst not reaching statistical significance, a study of 640 emergency cases for obstructing colorectal cancer noted a 36% 5-year survival in consultant cases and 26% 5-year survival in cases involving trainees [15]. Reports accounting for supervision level show that some adverse events are avoidable with appropriate supervision and this may account for some of the variation seen between studies based on whether supervision level was addressed [14,18–20]. A study by the Northern Region Colorectal Cancer Audit Group found that survival was significantly decreased in unsupervised trainee cases compared with consultant cases or cases supervised by a consultant with an overall 5-year survival of 37.8% in unsupervised trainee cases compared with 48.6% in supervised or consultant cases ($P < 0.001$) [14]. Appropriate supervision is fundamental to safe surgical training, but how to increase autonomy progressively or demonstrate competency remains a challenge.

Trainee cases appear to be associated with increased postoperative complications [17]. Using the American College of Surgeons National Surgical Quality Improvement Program database to evaluate partial colectomy, we found that trainee involvement was associated with an 18% increased risk for major complications compared with consultants alone [4]. Evaluating all index laparoscopic cases Davis *et al.* [9] found that trainee involvement increased the crude morbidity rate after laparoscopic colectomy from 12.4% for consultants to 15.5% in cases with trainees, making the absolute crude risk difference 3.1% greater for trainee cases. Minor complications may also be increased in cases involving trainees with observed associations for both surgical site infection and urinary tract infections [4,10]. Although some of these findings may be attributable to residual bias associated with teaching institutions, the potential for increased morbidity in trainee cases remains of concern.

Another growing outcome measure is patient satisfaction in which trainees play an important role. Dalia *et al.* [21] demonstrated that 56% of patients identified the

first-year trainee as their primary physician while only 8% identified the consultant as their primary physician. While all patients were on teaching services, satisfaction on all tested domains was 90% overall, suggesting that patients are satisfied with care delivered by trainees. Another study using Press-Ganey surveys found that surgical trainees accounted for 33% of the variation in patient satisfaction although nursing involvement had an even greater impact accounting for 57% of satisfaction variability [22]. These studies highlight the vital role that trainees play in patient satisfaction; however, no study has compared patient satisfaction in non-teaching with teaching environments.

Some suggest that although the differences in surgical outcome are statistically significant they are not clinically meaningful. An absolute risk reduction of 3.1% may not seem clinically meaningful for an individual patient or institution, but when evaluated on a population or system level the public health impact quickly becomes relevant. Based on the limited effect for individual patients it is appropriate to provide reassurance that trainee involvement will not alter their outcome. Concurrently, system-wide steps must be taken to mitigate any potential adverse outcome associated with trainee involvement since with over 230 million annual surgeries worldwide the impact quickly becomes meaningful [23].

The many recent surgical education publications suggest a common theme: surgical educators must take up a call to action. Surgical education is changing from an apprenticeship model that is teacher driven with didactic learning to one that is learner centric and interactive creating an avenue for new strategies to make training more efficient and ultimately safer [24]. Whilst elucidating these techniques is beyond the scope of this discussion, a few promising strategies merit comment. Feedback particularly in the operating theatre is fundamental to surgical education and has been associated with improved technical performance and reduction in poor outcome. Despite this finding there is a relative lack of debriefing culture in surgery [25]. The use of a simple debriefing tool has been proved to improve the quality and quantity of feedback dramatically [25]. Such practices can be easily incorporated into the current clinical setting increasing teaching efficacy [25]. Structured simulation for laparoscopic cases has also been shown to improve trainee technical performance, and discussion is now changing from 'if' to 'how' simulation should be incorporated into current curricula [26–28]. Surgical education advances may not require a complete reinvention as greater utilization of currently available methods and technology may improve training efficacy and efficiency while becoming more individualized. Web-based and smartphone-based applications can

make tracking trainee competency more informative and are easily integrated into the workflow improving surgical mentoring [29]. Another example where ubiquitously available technology can improve education is through the use of video-based coaching. Video-based interventions can improve motion efficiency and adequacy of exposure by providing a third-person view less susceptible to participant denial [24]. Linking video-based interventions with coaching is essential to their success, and a recent paper by Gwande highlights how coaching may be an important adjunct for surgeons at all experience levels [30]. The tools are available for improved quality and ultimately safety of surgical education but adoption in part depends on the willingness to accept that the time for change is imminent. Recognizing that systematic problems cannot be blamed on individuals implies that trainee-associated outcome must be addressed at the level of the graduate surgical training system. The surgical 'hidden curriculum' that rewards and recruits personality traits that are likely to be beneficial in the operating theatre may increase inertia against necessary change [31].

Published studies have many limitations preventing definitive conclusions. Studies evaluating the outcome in cases with trainees do not meet the highest level of evidence, in part because randomized controlled trials in this setting may be difficult. Many studies suffer from type II errors claiming that no trainee effect was apparent when insufficient sample sizes were too small to detect a difference. Residual selection bias is another major concern since teaching hospitals often serve a different patient population. These limitations and conflicting conclusions may explain surgeons' hesitance to take action. Despite these issues, the important lessons remain: the necessity to track meaningful outcomes specific to training, the importance of appropriate supervision, and inclusion of methods to mitigate any potential risk.

Surgical education is verging on a paradigm shift, driven to the brink by the 'perfect storm' of work hour restrictions, changes in liability impacting on autonomy, and ever increasing scrutiny on surgical performance and outcome. Trainees are fundamental to the healthcare system both in terms of their current roles within the healthcare team and to supply the future surgeon workforce. Because these changes alter the historic equilibrium of service delivery and training, a new dialogue should be aimed at establishing a new balance. From a public health perspective the putative association of trainee involvement and poor outcome demands recognition. While the changes to the educational milieu may not be entirely to blame, strategies with proven educational merit must be utilized to a greater degree. A call to action for surgical educators must include broad

recognition that increased resource allocation towards surgical education is necessary and the status quo is no longer viable given today's constraints.

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References

- Canter R. Impact of reduced working time on surgical training in the United Kingdom and Ireland. *Surgeon* 2011; **9**(Suppl 1): S6–7.
- Carlin AM, Gasevic E, Shepard AD. Effect of the 80-hour work week on resident operative experience in general surgery. *Am J Surg* 2007; **193**: 326–9; discussion 329–30.
- Bittner JGT, Coverdill JE, Imam T, Deladisma AM, Edwards MA, Mellinger JD. Do increased training requirements in gastrointestinal endoscopy and advanced laparoscopy necessitate a paradigm shift? A survey of program directors in surgery. *J Surg Educ* 2008; **65**: 418–30.
- Iannuzzi JC, Rickles AS, Deeb AP, Sharma A, Fleming FJ, Monson JR. Outcomes associated with resident involvement in partial colectomy. *Dis Colon Rectum* 2013; **56**: 212–8.
- Scarborough JE, Pappas TN, Cox MW, Bennett KM, Shortell CK. Surgical trainee participation during infrainguinal bypass grafting procedures is associated with increased early postoperative graft failure. *J Vasc Surg* 2012; **55**: 715–20.
- Tseng WH, Jin L, Canter RJ *et al.* Surgical resident involvement is safe for common elective general surgery procedures. *J Am Coll Surg* 2011; **213**: 19–26; discussion 26–8.
- Raval MV, Wang X, Cohen ME *et al.* The influence of resident involvement on surgical outcomes. *J Am Coll Surg* 2011; **212**: 889–98.
- van der Leeuw RM, Lombarts KM, Arah OA, Heineman MJ. A systematic review of the effects of residency training on patient outcomes. *BMC Med* 2012; **10**: 65.
- Davis SS Jr, Husain FA, Lin E, Nandipati KC, Perez S, Sweeney JF. Resident participation in index laparoscopic general surgical cases: impact of the learning environment on surgical outcomes. *J Am Coll Surg* 2013; **216**: 96–104.
- Kiran RP, Ahmed Ali U, Coffey JC, Vogel JD, Pokala N, Fazio VW. Impact of resident participation in surgical operations on postoperative outcomes: National Surgical Quality Improvement Program. *Ann Surg* 2012; **256**: 469–75.
- Hwang CS, Wichterman KA, Alfrey EJ. The cost of resident education. *J Surg Res* 2010; **163**: 18–23.
- Daetwiler S, Guller U, Schob O, Adamina M. Early introduction of laparoscopic sigmoid colectomy during residency. *Br J Surg* 2007; **94**: 634–41.
- Maslekar S, Sharma A, Macdonald A, Gunn J, Monson JR, Hartley JE. Do supervised colorectal trainees differ from consultants in terms of quality of TME surgery? *Colorectal Dis* 2006; **8**: 790–4.
- Borowski DW, Ratcliffe AA, Bharathan B *et al.* Involvement of surgical trainees in surgery for colorectal cancer and their effect on outcome. *Colorectal Dis* 2008; **10**: 837–45.
- Chester J, Britton D. Elective and emergency surgery for colorectal cancer in a district general hospital: impact of surgical training on patient survival. *Ann R Coll Surg Engl* 1989; **71**: 370–4.
- Khan OA, Lin PF, Chaudhuri J *et al.* Training outcomes in colorectal cancer surgery in a district general hospital. *Acta Chir Belg* 2008; **108**: 503–7.
- Renwick AA, Bokey EL, Chapuis PH *et al.* Effect of supervised surgical training on outcomes after resection of colorectal cancer. *Br J Surg* 2005; **92**: 631–6.
- Singh KK, Aitken RJ. Outcome in patients with colorectal cancer managed by surgical trainees. *Br J Surg* 1999; **86**: 1332–6.
- Farnan JM, Petty LA, Georgitis E *et al.* A systematic review: the effect of clinical supervision on patient and residency education outcomes. *Acad Med J Assoc Am Med Coll* 2012; **87**: 428–42.
- Fallon WF Jr, Wears RL, Tepas JJ 3rd. Resident supervision in the operating room: does this impact on outcome? *J Trauma* 1993; **35**: 556–60; discussion 60–1.
- Dalia S, Schiffman FJ. Who's my doctor? First-year residents and patient care: hospitalized patients' perception of their 'main physician'. *J Grad Med Educ* 2010; **2**: 201–5.
- Resnick AS, Disbot M, Wurster A, Mullen JL, Kaiser LR, Morris JB. Contributions of surgical residents to patient satisfaction: impact of residents beyond clinical care. *J Surg Educ* 2008; **65**: 243–52.
- Weiser TG, Regenbogen SE, Thompson KD *et al.* An estimation of the global volume of surgery: a modelling strategy based on available data. *Lancet* 2008; **372**: 139–44.
- Hu YY, Peyre SE, Arriaga AF *et al.* Postgame analysis: using video-based coaching for continuous professional development. *J Am Coll Surg* 2012; **214**: 115–24.
- Ahmed M, Arora S, Russ S, Darzi A, Vincent C, Sevdalis N. Operation debrief: a SHARP improvement in performance feedback in the operating room. *Ann Surg* 2013; March 8 [Epub ahead of print].
- Palter VN, Orzech N, Reznick RK, Grantcharov TP. Validation of a structured training and assessment curriculum for technical skill acquisition in minimally invasive surgery: a randomized controlled trial. *Ann Surg* 2013; **257**: 224–30.
- Zendejas B, Brydges R, Hamstra SJ, Cook DA. State of the evidence on simulation-based training for laparoscopic surgery: a systematic review. *Ann Surg* 2013; **257**: 586–93.
- Selzer DJ, Dunnington GL. Surgical skills simulation: a shift in the conversation. *Ann Surg* 2013; **257**: 594–5.
- Roach PB, Roggin KK, Selkov E Jr, Posner MC, Silverstein JC. Use of a novel, web-based educational platform facilitates intraoperative training in a surgical oncology fellowship program. *Ann Surg Oncol* 2009; **16**: 1100–7.
- Gwande A. (2011) Personal best. *The New Yorker*.
- Jin CJ, Martimianakis MA, Kitto S, Moulton CA. Pressures to 'measure up' in surgery: managing your image and managing your patient. *Ann Surg* 2012; **256**: 989–93.