



## Declining interest in general surgical training – Challenging misconceptions and improving access at undergraduate level<sup>☆</sup>



Amal Thomas<sup>a,\*</sup>, Aasim Nisar Murtaza<sup>a</sup>, Harry Victor Michael Spiers<sup>b</sup>, Alexander Zargaran<sup>a</sup>, Mohammed Turki<sup>a</sup>, Jai Mathur<sup>a</sup>, Akiko Fukui<sup>a</sup>, David Zargaran<sup>c</sup>, Omar Khan<sup>d</sup>

<sup>a</sup> St. George's, University of London, London, UK

<sup>b</sup> Manchester Royal Infirmary, Manchester, UK

<sup>c</sup> Academic Foundation Doctor, Imperial College Healthcare NHS Trust, London, UK

<sup>d</sup> St. George's University Hospital NHS Trust, London, UK

### ARTICLE INFO

#### Keywords:

Education  
Training  
Laparoscopy  
Simulation  
Surgical pathway

### ABSTRACT

**Background:** In recent years, general surgery has faced a decline in applicants for postgraduate training. The St. George's Surgical Society hosted a national surgical conference with an aim to explore the reasons for the decline and to investigate the effectiveness of a one-day intervention on students' perceptions of general surgery and surgical skills.

**Materials and methods:** The conference took place on 20th January 2018 at St. George's, University of London. During the conference, medical students received lectures on “careers in surgery” and small-group workshops introducing students to simulation-based laparoscopic machines. Delegates were invited to complete before and after questionnaires looking at various domains; (1) Perceptions of general surgery, (2) Simulation skills, and (3) Usefulness of the day.

**Results:** There were significant impacts on student perceptions of the speciality such as increases in the views that “general surgery contained the opportunities for personal and professional development” (26%,  $p = 0.04$ ), and of “general surgery as a rewarding speciality” (26%,  $p = 0.05$ ). There were also negative changes such as an increase in the perception that “general surgery is female unfriendly” (+32%,  $p = 0.01$ ). There were positive findings in all aspects relating to the use of laparoscopic simulation.

**Discussion:** The challenges faced in improving access to general surgery has been highlighted. More importantly the benefits of a one day intervention in addressing misconceptions and improving knowledge was seen. This study also shows the benefits of simulation teaching in the undergraduate curriculum.

**Conclusion:** The intervention has improved the perceptions on general surgery, surgical skills and knowledge and provided a platform for engaging students and clinicians.

## 1. Introduction

Given the national and international decline in the number of applicants for general surgery programmes in the past decade [1–5], it is more important than ever to inspire medical students to consider a career in the speciality. In the UK, the majority of final year medical students had not only lost their interest in applying from general surgery, but they had developed perceptions of the field which actively deterred them from the specialty [6]. It has been shown that choosing a specialty starts as early as medical student for many trainees [7]; if this population is not inspired early, the current decline in applications is likely to continue. Another aspect to consider is that students now are

pushed into primary care careers, with more than 50% of medical students now choosing to pursue primary care as their specialty of choice [8]. As well as more time being dedicated to primary care themes in medical school, government policies [9] aim to make these careers more inviting for medical students, already reducing the number of students considering surgical careers, let alone general surgery.

There are several challenges facing general surgery recruitment, with misconceptions of the specialty posing a particular challenge. Uniform stereotypes of surgeons as self-confident, intimidating, and rude, deter students from wanting to be general surgeons, because they feel as though the clinical environment is cutthroat and hierarchical;

<sup>☆</sup> The work described in this paper took place at St. George's, University of London.

\* Corresponding author. St. George's Surgical Society, St. George's University of London, Cranmer Terrace, London, SW17 0RE, UK.

E-mail address: [m1300624@sgul.ac.uk](mailto:m1300624@sgul.ac.uk) (A. Thomas).

some studies even hypothesize this as being one of the largest factors for the decline in application rates [2]. With the reduction in general surgery teaching in the saturated undergraduate curriculum [10], it is difficult to combat misconceptions of the speciality. Medical students also feel that there are hidden tasks necessary to become a general surgeon, where they must build connections prior to applying into the field, tick boxes of accolades, and try and adopt the “mentality” of a surgeon from early on in their training [11]. This aspect seems to be very daunting to students, and the majority seem to feel this way without guidance on the realities of the application process from mentors. Taking this multitude of factors into account, it is essential that medical students have appropriate teaching on general surgical pathologies and cases they will encounter, especially whilst on their attachments. It is paramount that they have positive general surgeon role models who bestow upon them the true requirements of applying to the field, and that they have a positive outlook on the clinical culture of general surgery. These elements are needed in order to erode the stigma that exists around the clinical perceptions and misperceptions of general surgery.

Non-clinical factors also play a significant role in determining the motivations of students considering this career avenue. Work-life balance and lifestyle controllability are important factors that medical students value [12–14]. Undergraduates are increasingly making their speciality decisions based on the amount of time they can spend independent of their medical practice, and are prioritising their personal time for leisure, family, and avocational pursuits over factors such as prestige, remuneration, and length of training [12]. Despite surgery increasingly offering flexible working options and academic opportunities, the field is still strongly associated with a challenging lifestyle, driving some students away.

Finally, surgery is a historically male-dominated field and attracting female applicants continues to be a challenge [15]. Women comprise only 33% of applicants to surgical training, despite constituting over 60% of all UK medical students [16]. Contributing to this are factors such as lack of opportunities connecting female medical students to female mentors in surgery, as well as perceived “surgical personality” and male-dominated culture often deterring them from applying to surgical training programs [17]. Although significant efforts are being made to combat the existing gender imbalance in surgery, many female students still make negative assumptions and decide against the speciality [18]. Without relevant connections and exposures, female students often make their decisions based on their limited experience and knowledge, and true flexibility of a surgical career is often not well-communicated to students.

In light of the challenges set out above, we carried out a one-day intervention with the aim of stimulating interest. Our study aims to identify whether or not a one-day intervention can inspire medical students to consider pursuing a general surgical career, as well as destigmatize perceptions of the field.

## 2. Materials and methods

The St. George's Surgical Society national conference took place on the 20 January 2018 at St. George's, University of London. Prior to the event, there was a four-week period of advertisement using physical posters as well as social media pages of St. George's Surgical Society. Medical students from across the UK were invited to attend. 36 medical students of various year groups attended, paying between £20–£25 to cover course administration.

The day was divided into multiple components, the general surgery component took the format of lectures in the morning covering “a career in general surgery” with an overview of common conditions encountered in this speciality, the theoretical basis for common general surgery procedures as well as the day to day life of a general surgeon. The lecture contained content about opportunities that exist within general surgery for training abroad, research, and teaching. The

surgeon also presented personal reasons for her decisions to pursue a career in the speciality.

In the afternoon, delegates were split into groups of 8–10 and had the opportunity to practise basic surgical skills and tackle assault courses on laparoscopic machines through simulation. Delegates were supervised by a general surgery senior registrar and were given one machine per pair.

Small group teaching was employed to run the simulation workshops, using state of the art, Karl Storz endoscope machines. The model abdomens were fitted with various challenges which ranged from requiring the delegate to loop a rope through metal, to balancing balls on pillars. Prior to practise, delegates were given a run-through of the surgical skills they were emulating, as well as the fundamentals of operating a laparoscope. This teaching was chosen to allow delegates to familiarise themselves with practical work as well as recognize the importance of team work; whilst one operated the machine, the other was required to assist with the camera probe.

Delegates were invited to complete before and after questionnaires looking at various domains, as follows:

1. Perceptions of general surgery: Delegates were shown various common positive and negative perceptions of general surgery and asked whether they identified with them or not.
2. Simulation Skills: Delegates were asked about their understanding of general surgery as both an observer and partaker, as well as their confidence of performing various basic laparoscopic skills
3. Usefulness of the day: Delegates were asked questions evaluating the usefulness and impact of the course on their career choice and perceptions regarding general surgery, as well as the usefulness of the course overall.

Perceptions of general surgery were recorded using the Guttman scale, with an option to respond with a “yes” or a “no”. Simulation skills and usefulness of the day were recorded on a Likert scale, ranging from 1 to 5 (1 = strongly disagree to 5 = strongly agree). A McNemar test for non-parametric data was used to assess changes in perceptions before and after the day. A Wilcoxon signed rank test was performed on subjective confidence and understanding from the simulation workshops.

Data analysis was conducted using SPSS Software and Microsoft Excel, with results accepted at a 5% significance level. Descriptive statistics were also carried out to demonstrate mean and standard deviation.

## 3. Results

### 3.1. Demographics

A total of thirty-six medical students completed questions prior to, and after the skills day. Four delegates were from external institutions. Out of thirty-six students, there were 15 females (41.7%) and 21 males (58.3%). Two questionnaires were incomplete and hence excluded. This gave a total sample size of thirty-four and a response rate of 94% (Fig. 1).

Students from various stages of training attended the conference. Most students were in the clinical stage of training (94%), and further, the majority were from third year (45%). Students at this stage are more likely to be in a position where they are considering their options for postgraduate training, as they have had a greater period of exposure to the clinical environment. This would have validated and shaped their pre-existing perceptions of specialities and hence this sample provides an insight into the thoughts and perceptions of the next cohort of postgraduate trainees.

### 3.2. Changes in perceptions of general surgery

The following section looks at delegate's perceptions of general

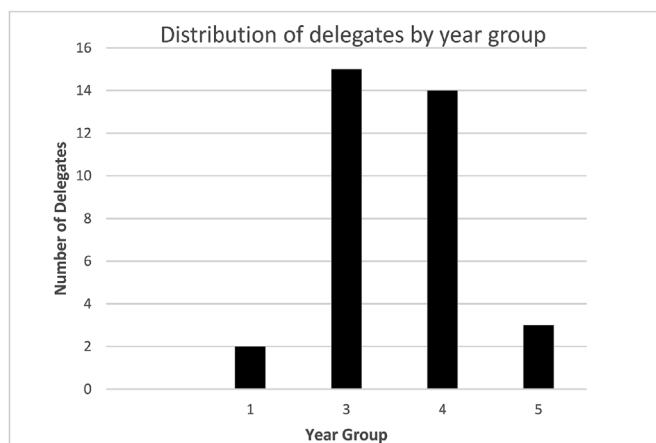


Fig. 1. Bar chart visualising distribution of delegates by year group.

surgery. These have been split into positive and negative perceptions.

### 3.3. Positive perceptions of general surgery

There were significant changes in two positive perceptions of general surgery (Table 1). There was a 26% increase in the view that general surgery contained the opportunities for personal and professional development ( $p = 0.04$ ) and there was 26% increase in the view that general surgery was a rewarding speciality ( $p = 0.05$ ) (Fig. 2).

### 3.4. Negative perceptions of general surgery

There were significant changes in three negative perceptions of general surgery (Table 2).

One negative perception worsened after the intervention, this was the perception that general surgery was female unfriendly, this view increased by 32% ( $p = 0.01$ ) (Fig. 3).

Two negative perceptions were ameliorated after the intervention; there was a 24% decrease in the view of general surgery having a negative impact on family life ( $p = 0.01$ ), and a 21% decrease in the perception that the public had a negative opinion of general surgery ( $p = 0.01$ ) (Fig. 3).

### 3.5. Simulation and laparoscopic skills

All outcomes measured in this section showed statistically significant positive changes (Table 3). Pre-course, all seven domains scored means lying between four and five, corresponding to agree to strongly agree. Of importance to medical students, there was an increase in understanding of indications and advantages of laparoscopy, its relevance to the future of surgery, and confidence in understanding what the surgeon is performing when observing laparoscopic

Table 1

Table one shows the changes in positive perceptions of general surgery. Significant changes are shown in bold.

	Number Yes pre- Course (% Yes pre-course)	Number Yes post course (% Yes post – course)	Change (% Change)	Chi-Square	Alpha	Critical Value	P value
Positive Perceptions							
Broad base of knowledge	32 (94%)	34 (100%)	+2 (5.88%)	0.12	0.05	3.84	0.73
Diverse	31 (91%)	34 (100%)	+3 (8.82%)	0.32	0.05	3.84	0.57
Competitive	32 (94%)	34 (100%)	+2 (5.88%)	0.12	0.05	3.84	0.73
Wide range of subspecialties	20 (59%)	22 (65%)	+2 (5.88%)	0.19	0.05	3.84	0.66
<b>Personal professional development</b>	<b>22 (65%)</b>	<b>31 (91%)</b>	<b>+9 (26.47%)</b>	<b>4.16</b>	<b>0.05</b>	<b>3.84</b>	<b>0.04</b>
<b>Rewarding</b>	<b>24 (71%)</b>	<b>33 (97%)</b>	<b>+9 (26.47%)</b>	<b>3.87</b>	<b>0.05</b>	<b>3.84</b>	<b>0.05</b>
Well Paid	30 (88%)	34 (100%)	+4 (11.76%)	0.62	0.05	3.84	0.43

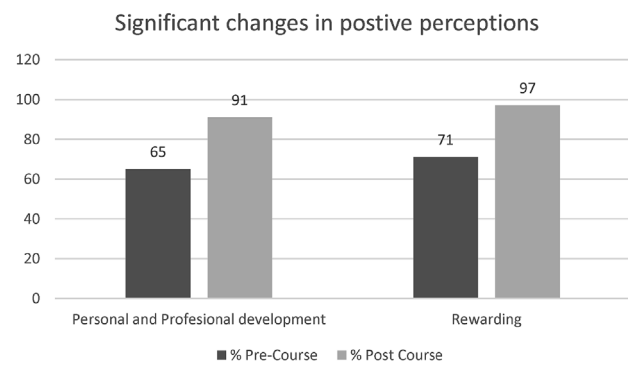


Fig. 2. Bar chart showing the significant changes in positive perceptions of general surgery.

operations (Fig. 4).

### 3.6. Utility

Candidates were asked broad questions regarding the usefulness of various parts of the skills day; these results were not statistically analysed, but nevertheless, give an insight into how various components can shape a delegate's perception of a speciality (Fig. 5). The results from this section show that students were more likely to consider a career in general study, has changed their perceptions on general study and importantly left them better able to understand surgery they had observed in the past.

## 4. Discussion

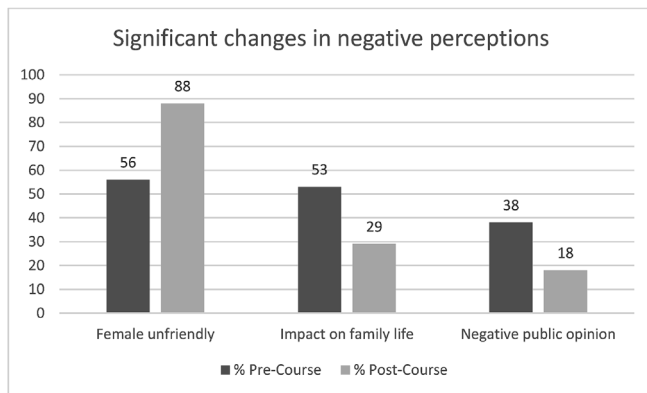
### 4.1. Perceptions of general surgery

#### 4.1.1. Positive perceptions

There was an increase of 26% in the view that general surgery contained opportunities for personal and professional development. The lecture presented to delegates contained content about numerous opportunities that exist within general surgery for training abroad, research, and teaching. This combined with the lecturer's own experience have modified the perceptions of the delegates, in particular with regard to what can be considered the positive aspects of a general surgical career. It is important to recognize the growing desire for trainees to take time out of set training schedules, not only for professional development, but also for personal development, travel, and taking part in opportunities such as emergency relief work. The lecture also had the benefit of increasing the view that general surgery was a rewarding speciality (26%). All positive perceptions delegates were asked to report on, and showed higher levels after the skills day.

**Table 2**  
Table one shows the changes in negative perceptions of general surgery. Significant changes are shown in bold.

	Number Yes pre-	Number Yes post	Change (%) Change)	Chi-Square	Alpha	Critical Value	P value
Negative Perceptions	Course (% Yes precourse)	course (% Yes post – course)					
Long Hours	24 (71%)	27 (79%)	+3 (8.82%)	0.41	0.05	3.84	0.52
Long Training Program	31 (91%)	28 (82%)	-3 (-8.82%)	0.35	0.05	3.84	0.55
Competitive	21 (62%)	22 (65%)	+1 (2.94%)	0.03	0.05	3.84	0.86
Procedures transferred or transformed to other specialties	26 (76%)	23 (68%)	-3 (-8.82%)	0.42	0.05	3.84	0.51
<b>Female unfriendly</b>	<b>19 (56%)</b>	<b>30 (88%)</b>	<b>+11 (32.35%)</b>	<b>6.82</b>	<b>0.05</b>	<b>3.84</b>	<b>0.01</b>
<b>Impact on family life</b>	<b>18 (53%)</b>	<b>10 (29%)</b>	<b>-8 (-23.53%)</b>	<b>6.16</b>	<b>0.05</b>	<b>3.84</b>	<b>0.01</b>
Unwilling to teach	16 (47%)	14 (41%)	-2 (-5.88%)	0.27	0.05	3.84	0.60
<b>Negative public opinion</b>	<b>13 (38%)</b>	<b>6 (18%)</b>	<b>-7 (-20.59%)</b>	<b>6.87</b>	<b>0.05</b>	<b>3.84</b>	<b>0.01</b>
Opinion of other Specialities	32 (94.12%)	32 (94.12%)	0 (0.00%)	0.01	0.05	3.84	0.94



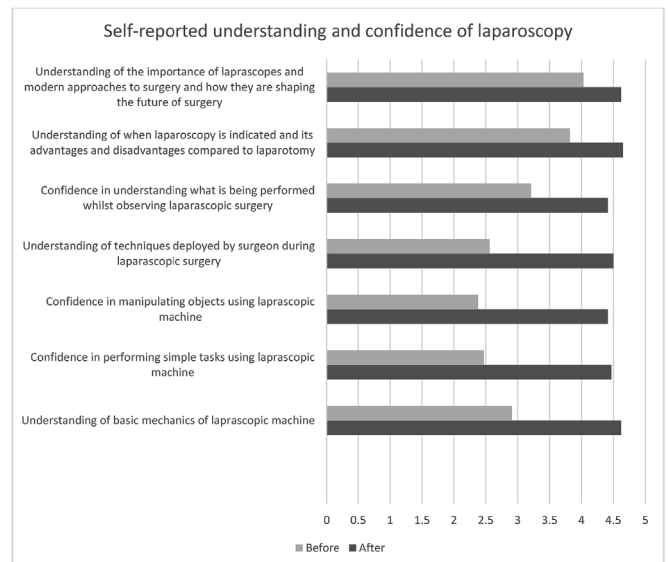
**Fig. 3.** Bar chart showing the significant changes in negative perceptions of general surgery.

4.1.2. Negative perceptions

The conference also had an impact in lowering negative perceptions of general surgery. The view that general surgery had a negative impact on family life had decreased (-24%). This is particularly significant as studies from various countries show that lifestyle is the principal factor for medical students when it comes to choosing their postgraduate career [19]. The opportunity to hear about general surgery, first hand, during the lecture, as well as interact with the surgeon during the workshop is thought to have had a positive impact on dispelling these perceptions of general surgery. The above factors also contributed to the perceptions that the public had a negative view of general surgery, decreasing by 21%. This reinforces the importance of the need for more interaction with clinicians and mentorship within the medical curriculum as these are factors that are not talked about or covered conventionally – yet play some of the biggest parts in shaping the career choices of students.

**Table 3**  
Shows the impact of laparoscopic simulation as determined by pre-course and post-course, self-reported confidence and understanding of laparoscopy.

	Before		After		Difference	P value
	Mean	St Dev	Mean	St Dev		
Understanding of basic mechanics of laparoscopic machine	2.91	1.31	4.62	0.49		
Confidence in performing simple tasks using laparoscopic machine	2.47	1.35	4.47	0.56	2	< 0.00
Confidence in manipulating objects using laparoscopic machine	2.38	1.35	4.41	0.7	2.03	< 0.00
Understanding of techniques deployed by surgeon during laparoscopic surgery	2.56	1.26	4.5	0.56	1.94	< 0.00
Confidence in understanding what is being performed whilst observing laparoscopic surgery	3.21	1.25	4.41	0.7	1.2	< 0.00
Understanding of when laparoscopy is indicated and its advantages and disadvantages compared to laparotomy	3.82	1.38	4.65	0.54	0.83	< 0.001
Understanding of the importance of laparoscopes and modern approaches to surgery and how they are shaping the future of surgery	4.03	1.17	4.62	0.55	0.59	< 0.004



**Fig. 4.** Bar chart showing changes in self-reported outcomes.

Surgery is well known for having difficulty in attracting women into the field. This has been put down to a variety of factors, from lifestyle, to male trainees being given more access to opportunities [20]. Even though the lecture and skills day was delivered by a female general surgeon, the perception of general surgery being female unfriendly had risen by 32%. Gender inequality remains a blight on surgical specialities; whilst much is being done to rectify this and encourage more women to pursue surgery, this finding gives an insight into how much more growth is needed for posterity. The surgical training path needs to take on a more inclusive approach and redefine itself in such a way that

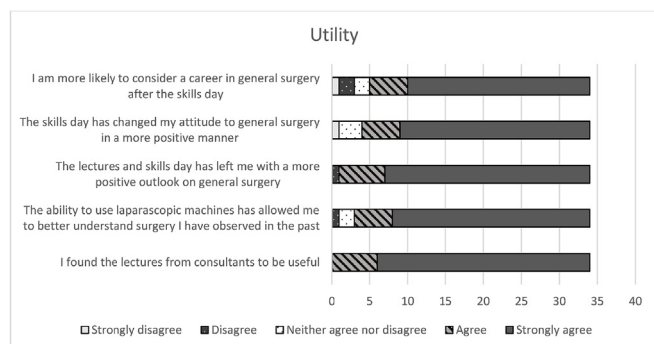


Fig. 5. Stacked bar chart showing results of broad questions regarding the intervention.

the lifestyle is adaptable and compatible with family life, and other issues limiting opportunities to women.

#### 4.1.3. Simulation and laparoscopic skills

Self-reported scores across all domains showed significant improvements. Laparoscopic simulation could be an invaluable tool in helping medical students to understand general surgical conditions, studies have shown that endoscopic simulation is effective in teaching gastroenterology at medical school level and improve interest in that career [21,22]. Simulation provides a simple tool for medical students to get a flavour of what a career in surgery might entail as well as bridge the gap between the classroom and the clinical environment. The most pivotal improvements were seen in the domains of confidence in manipulating objects and performing simple tasks; although as a medical student or house officer, the opportunity to use a laparoscope may not arise, basic theoretical and practical knowledge forms a greater understanding – this perhaps being reflected in increases seen in the domains of understanding of techniques deployed by the surgeon and understanding laparoscopic procedures the delegate has observed. The increase in these domains reinforce the educational value simulation offers if offered as an adjunct to traditional approaches to teaching surgery. However, perhaps a more “real-life” case-based workshop, as opposed to an obstacle course, can provide greater educational value in laparoscopic simulation.

#### 4.1.4. Utility

After the conference, delegates were more likely to look at general surgery in a positive light. This highlights the importance of such events in dismantling misconceptions an individual may have of a medical speciality. Whilst we cannot predict whether such results will translate to genuine increases in delegates choosing a career path in this speciality, results from other domains are of value across the board for medical students, irrespective of career interest. The conference has left 88.6% of the delegates with a better understanding of surgery they have observed in the past. This poses the question of the educational value to students of observing surgery, if they may be lacking the understanding of the techniques and procedures being done.

#### 4.1.5. Limitations

We accept this study is not without limitations. Firstly, the sample size is small, a sample of thirty-six may not be representative of the approximately 6000 medical students in the UK, which is likely to have limited the generalisability of the study. Other limitations include the high risk of selection bias – students that attend a surgical conference or skills day are likely to have a more positive perception of a surgical career than the general medical student populous. There is also the possibility of reporting bias as delegates may report what they perceive to be positive answers to satisfy the hosting organization. Finally, whilst the study gives the results of the immediate impact on delegates, it does

not examine whether the changes in perceptions were sustained further down the line nor whether it ultimately led to a change in the delegates choice of postgraduate career options. This will be addressed in a separate study.

#### 4.1.6. The importance of extra-curricular exposure to surgical specialities

In the current medical curriculum, there is a lack of opportunity to explore surgical careers along with a lack of practical exposure and understanding of surgical techniques. This leads to decreased confidence in surgical skills amongst medical students. Exposure to appropriate mentors and skills is vital to shape positive perceptions of a surgical career and dispel false impressions. Both student societies and universities have a responsibility to ensure that students are given adequate exposure to their fields of interest. It has been shown that hands-on surgical teaching helps to demonstrate technical skills required during surgery [23,24]. Simple measures such as exposure to one hour of laparoscopic training have been shown to result in increased confidence and acquisition of surgical skills [25]. Student societies, have an obligation to supplement areas where the curriculum is lacking. The St Georges National Surgery Conference has shown that a one-day skills day is effective in changing perceptions of general surgery. This intervention has left delegates with a more realistic perception of and understanding of a career in general surgery. The results show increased understanding of procedures delegates have observed previously and improvements in the self-reported surgical skills.

Surgical training increasingly relies on trainees being comfortable with various techniques to achieve their full potential [26]. Events such as simulation training provide an opportunity for students to familiarise themselves with basic surgical procedures and techniques in a safe environment allowing graduating doctors to develop basic surgical competency. However, exposure to simulation training varies between medical schools and is often not surgically themed. Therefore, student societies and other organisations can step in to fill the gap and ensure that medical students have the relevant exposure to commonly encountered problems in areas of their interest, before they choose their career pathway. It has been shown that appropriate exposure can help medical students make the better decisions [10,15,27,28] with regard to speciality training. An area often overlooked is the importance of mentorship; students receiving hands on teaching from general surgeons were more likely to have an interest in a surgical career [29]. Students were left with a view of surgeons as content, well-balanced and respectful professionals following this apprenticeship.

## 5. Conclusion

This study has shown that one solution to the problem of declining applicants to general surgery lies in grassroots events. Careers and skills days – whether run as an adjunct to, or as part of, the medical curriculum are key to eliminate misconceptions, boost confidence and inspire students to consider a career in general surgery. They also provide a glimpse into the reasoning for trends in the decline and increase in applicants for training in various specialities. This is crucial in addressing the concern of medical students and challenging barriers in order to make careers more inviting and appealing to those considering it. Whilst we acknowledge the limitations of the study, we find the results to be encouraging. We recommend that other student surgical societies, larger organisations (such as the Association of Surgeons in Training and Associations of Surgeons Great Britain and Ireland) and universities, offer careers and skills days to expand student understanding of careers and hence educate and empower them in their career choices.

#### Ethical approval

No ethical approval was needed.

## Sources of funding

No funding was required for this project.

## Author contribution

As per the guidelines of the international committee of Medical Journal Editors (ICMJE), all authors of this paper (Amal Thomas, Alexander Zargarán, Mohammed Turki, Aasim Nisar Murtaza, Jai Mathur, Akiko Fukui, Harry Victor Michael Spiers, David Zargarán and Omar Khan) certify that all authors made substantial contributions to this study. Significant contributions to the design of this study were made by (Amal Thomas, Alexander Zargarán, Mohammed Turki, Aasim Nisar Murtaza, Harry Victor Michael Spiers, Omar Khan) and acquisition of data, analysis and interpretation by (Amal Thomas, Alexander Zargarán, Jai Mathur, David Zargarán, Akiko Fukui). All authors contributed to drafting the work (Amal Thomas, Jai Mathur, Akiko Fukui) or revising it critically (Aasim Nisar Murtaza, Harry Victor Michael Spiers, David Zargarán and Omar Khan). All authors have approved the final version to be published and agreed to be accountable for integrity and accuracy of all aspects of work and any questions that may require investigation and resolution.

## Conflicts of interest

There are no conflicts of interests to report regarding this paper.

## Research registry number

N/A.

## Guarantor

Amal Thomas.

## Consent

N/A.

## Provenance and peer review

Not commissioned, externally peer reviewed.

## Permissions

No items requiring permissions were used in this paper.

## Acknowledgements

We would like to thank the St George's Advanced Patient Simulation Centre (GAPS) centre at St. George's Hospital London for the use of the laparoscopic simulators.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amsu.2018.11.002>.

## References

- [1] J.E. Fischer, The impending disappearance of the general surgeon, *J. Am. Med. Assoc.* 298 (2007) 2191–3.
- [2] E.J.R. Hill, K.A. Bowman, R.E. Stalmeijer, Y. Solomon, T. Dornan, Can i cut it? Medical students' perceptions of surgeons and surgical careers, *Am. J. Surg.* 208 (5) (2014) 860–867.
- [3] W.T. Cockerham, J.B. Cofer, M.D. Biderman, P.L. Lewis, S.M. Roe, Is there declining interest in general surgery training? *Curr. Surg.* 61 (2) (2004) 231–235.
- [4] K. McDonald, J. Sutton, Surgical workforce: an emerging crisis, *Bull. Am. Coll. Surg.* 94 (5) (2009) 21–26.
- [5] J.B. Cofer, R.P. Burns, The developing crisis in the national general surgery workforce, *J. Am. Coll. Surg.* 206 (5) (2008) 790–795.
- [6] P.A. Sutton, J. Mason, D. Vimalachandran, S. McNally, Attitudes, motivators, and barriers to a career in surgery: a national study of UK undergraduate medical students, *J. Surg. Educ.* 71 (5) (2014) 662–667.
- [7] J. Rees-Lee, S. Lee, Reaching our successors: the trend for early specialisation and the potential effect on recruitment to our speciality, *J. Plast. Reconstr. Aesthetic Surg.* 61 (10) (2008) 1135–1138.
- [8] V.Z. Erzurum, R.J. Obermeyer, A. Fecher, P. Thyagarajan, P. Tan, A.K. Koler, et al., What influences medical students' choice of surgical careers, *Surgery* 128 (2) (2000) 253–256.
- [9] N. Deakin, Where will the GPs of the future come from? *BMJ* (2013) f2558.
- [10] J.K. O'Herrin, B.J. Lewis, L.F. Rikkers, H. Chen, Medical student operative experience correlates with a match to a categorical surgical program, *Am. J. Surg.* 186 (2) (2003) 125–128.
- [11] E. Hill, K. Bowman, R. Stalmeijer, J. Hart, You've got to know the rules to play the game: how medical students negotiate the hidden curriculum of surgical careers, *Med. Educ.* 48 (9) (2014) 884–894.
- [12] E.R. Dorsey, D. Jarjoura, G.W. Rutecki, Influence of controllable lifestyle on recent trends in specialty choice by US medical students, *J. Am. Med. Assoc.* 290 (9) (2003) 1173–1178.
- [13] L. Enoch, J.T. Chibnall, D.L. Schindler, S.J. Slavin, Association of medical student burnout with residency specialty choice, *Med. Educ.* 47 (2) (2013) 173–181.
- [14] T.D. Shanafelt, O. Hasan, L.N. Dyrbye, C. Sinsky, D. Satele, J. Sloan, et al., Changes in burnout and satisfaction with work-life balance in physicians and the general US working population between 2011 and 2014, *Mayo Clin. Proc.* 90 (12) (2015) 1600–1613.
- [15] A.P. Berger, J.C. Giacalone, P. Barlow, M.R. Kapadia, J.N. Keith, Choosing surgery as a career: early results of a longitudinal study of medical students, [Internet], *Surgery* 161 (6) (2017) 1683–1689. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0039606016308741>.
- [16] E. Hill, S. Vaughan, The only girl in the room: how paradigmatic trajectories deter female students from surgical careers, *Med. Educ.* 47 (2013) 547–556.
- [17] L.E. Schmidt, C.A. Cooper, W.A. Guo, Factors influencing US medical students' decision to pursue surgery, *J. Surg. Res.* 203 (2016) 64–74.
- [18] H.J. Braun, M.N. Dusch, S.H. Park, P.S. O'Sullivan, A. Harari, E. Harleman, et al., Medical students' perceptions of surgeons: implications for teaching and recruitment, *J. Surg. Educ.* 72 (6) (2015) 1195–1199.
- [19] C. Yap, S. Rosen, A. Sinclair, I. Pearce, What undergraduate factors influence medical students when making their choice of postgraduate career? *Br. J. Med. Surg. Urol.* 5 (1) (2012) 11–15.
- [20] A. Garner, V. Bowbrick, *BMJ Careers - suturing the surgical gender gap* [Internet]. *Careers.bmj.com*, [cited 1 March 2018]. Available from: [http://careers.bmj.com/careers/advice/Suturing\\_the\\_surgical\\_gender\\_gap](http://careers.bmj.com/careers/advice/Suturing_the_surgical_gender_gap) (2015).
- [21] J. Maurice, E. Wood, K. Jack, Endoscopy simulation for medical students, *Clin. Teach.* 11 (6) (2014) 416–420.
- [22] O. Courteille, L. Felländer-Tsai, L. Hedman, A. Kjellin, L. Enochsson, G. Lindgren, et al., Mixed virtual reality simulation -Taking endoscopic simulation one step further, *Studies in Health Technology and Informatics*, 2011, pp. 144–146.
- [23] M. Sideris, A. Papalois, K. Theodoraki, I. Dimitropoulos, E.O. Johnson, E.M. Georgopoulou, et al., Promoting undergraduate surgical education: current evidence and students' views on ESMSC international wet lab course, *J. Invest. Surg.* 30 (2) (2017) 71–77.
- [24] R. Kneebone, R. Aggarwal, Surgical training using simulation, *BMJ* [Internet] 338 (2009) b1001. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/19443913>.
- [25] H.Y. Chiu, Y.N. Kang, W.L. Wang, H.C. Huang, C.C. Wu, W. Hsu, et al., The effectiveness of a simulation-based flipped classroom in the acquisition of laparoscopic suturing skills in medical students-A pilot study, *J. Surg. Educ.* 75 (2) (2018).
- [26] H. Sadideen, A. Alvand, M. Saadeddin, R. Kneebone, Surgical experts: born or made? *Int. J. Surg.* 11 (9) (2013) 773–778.
- [27] K.A. Haggerty, C.A. Beaty, T.J. George, G.J. Arnaoutakis, W.A. Baumgartner, Increased exposure improves recruitment: early results of a program designed to attract medical students into surgical careers, *Ann. Thorac. Surg.* 97 (6) (2014) 2111–2114.
- [28] S.C. Montgomery, A.R. Privette, P.L. Ferguson, M. Mirdamadi, S.M. Fakhry, Inadequately marketing our brand: medical student awareness of acute care surgery, *J. Trauma Acute Care Surg.* (2015) 858–864.
- [29] C.M. Reid, D.Y. Kim, J. Mandel, A. Smith, M.A. Talamini, V. Bansal, Impact of a third-year surgical apprenticeship model: perceptions and attitudes compared with the traditional medical student clerkship experience, *J. Am. Coll. Surg.* (2014) 1032–1037.

[1] J.E. Fischer, The impending disappearance of the general surgeon, *J. Am. Med.*