

Does choice of medical school affect a student's likelihood of becoming a surgeon?

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Surgeons are an integral provider of elective and emergency secondary care in the UK. However, the supply of surgeons is struggling to keep up with the demand; for at least the past four years, there have remained unfilled core surgical training (CST) posts despite other specialties (eg radiology, public health medicine and ophthalmology) achieving consistent 100% fill rates.^{1,2}

Between 2012 and 2015, competition ratios for many specialties have declined but CST has faced one of the most substantial changes, dropping from 3.8 in 2012 to 2.3 in 2015,³ second only to neurosurgery (with a decline from 15.9 to 6.5 over the same time period). Although the number of recent UK graduates electing to pursue specialty training in the UK is declining as a whole,⁴ these figures reflect a waning interest in surgical careers compared with other specialties. This must be reversed if we are to meet the needs of the service over the coming years.

Medical students generally make the decision to become a surgeon early at medical school,^{5,6} attracted by the influence of role models,^{7,8} and the prestige and compe-

tion associated with the career.⁶ It is clear that women in particular are less inclined to pursue surgical careers,⁷⁻⁹ and students and junior doctors who are dissuaded from a career in surgery cite the perceived lack of work–life balance, the length of training and the high levels of competition as reasons not to pursue surgery as a career.^{8,10}

Anecdotal evidence suggests that some surgeons believe that prestigious universities are more likely to produce surgeons than other institutions and also refer to those based in a city centre. Our hypothesis was therefore that a significantly higher proportion of graduates would apply for CST if they had trained at medical schools located in more populous areas, at universities with

higher rankings and educational achievement, and at older institutions.

METHODS

Data were sourced from the General Medical Council on the number of students graduating from each university with a primary medical qualification (PMQ) between 2011 and 2013. Information regarding whether these graduates subsequently applied for CST two years after graduation was obtained from Health Education England.

Some students from the University of London (UoL) can choose whether to receive their PMQ award from UoL or the constituent college they attended. In 2011 this applied to Imperial College and King's College, in 2012

to Imperial College, King's College and St George's, and in 2013 to King's College and St George's. Details on the proportions of students at London medical schools being awarded their PMQ by UoL were provided following a freedom of information request to UoL.

Information was also gathered on the universities' average Educational Performance Measure (aEPM), their academic rankings, their founding date and the total population of the local authorities in which they were based from the UK Foundation Programme Office,¹¹ the Complete University Guide¹² and the Office for National Statistics.¹³ Correlation was sought between the proportions of graduates from each institution applying for CST and these attributes.

Statistical analysis

Data were analysed using Excel® (Microsoft, Redmond, WA, US) and SPSS® (IBM, New York, US). Proportions of graduates applying for CST two years after graduation were compared and correlation coefficients were calculated.

RESULTS

Overall, 21,879 graduates received a PMQ from 30 awarding bodies in the UK during the 3-year period studied. Of these, 2,212 graduates applied for CST two years after graduation. Data were available for all universities for the whole study period apart from three institutions: St George's (did not award a PMQ in 2013; included in the UoL numbers instead), Keele University (first graduates were in 2012) and the University of Wales (University of Wales College of Medicine merged with Cardiff University in 2013).

On average, 9.97% of graduates apply for CST two years following graduation. There was an absolute reduction of 0.83 percentage points in the proportion of graduates applying for CST between 2013 and 2015 (Table 1). There was a considerable difference in the proportion of graduates applying for CST from universities at the higher and lower ends of the spectrum: Hull York Medical School had the lowest proportion of CST applicants (5.47%, 95% confidence interval [CI]: 3.19–7.74%) while the University of

Wales had the highest proportion (15.71%, 95% CI: 9.68–21.74%) (Figure 1).

A higher proportion of male graduates applied for CST than female graduates (15.26% [95% CI: 14.53–15.99%] vs 6.31% [95% CI: 5.89–6.73%]). Proportions varied across universities (Figure 2). There was a significantly higher proportion of male graduates from King's College London and Imperial College London who applied for CST than from many other institutions (22.49% [95% CI: 17.98–27.00%] and 20.94% [95% CI: 17.40–24.49%] respectively). Significantly fewer male graduates than average applied for CST from the University of Liverpool (11.25%, 95% CI: 8.15–14.35%), Keele University (8.25%, 95% CI: 2.77–13.72%) and Hull York Medical School (6.45%, 95% CI: 2.58–10.32%). The proportion of male graduates who went on to CST was correlated strongly with the overall proportion of CST applicants from each university ($r=0.676$, $n=30$, $p=0.00$).

The proportions of female graduates from Keele University (12.14%, 95% CI: 6.73–17.55%) and Imperial College London (9.33%, 95% CI: 6.67–11.98%) were significantly above the mean (6.31%) for female application rates for CST, whereas the University of Aberdeen (4.22%, 95% CI: 2.16–6.38%), Cardiff University (3.40%, 95% CI: 1.97–4.83%) and Brighton Sussex Medical School (2.56%, 95% CI: 0.54–4.59%) were significantly below the mean. There was no correlation between the proportion of female applicants and male applicants from each university ($r=0.137$, $n=30$, $p=0.47$).

There were ten medical schools that consistently produced a lower proportion of surgical trainees than the mean for each year during the study period. Eight medical schools consistently produced a higher proportion (Table 1).

Correlation with educational performance, rankings, age of institution and location

There was no correlation between aEPM, university rankings, age of the institution or the population of the local authority in which the university was based and the proportion of graduates applying for CST (Table 2).

There was strong significant correlation between the proportions of graduates from each medical school applying two years after graduation and the total number of graduates from the 2011 cohort applying two, three and four years after graduation ($r=0.800$, $n=28$, $p<0.0001$). Figure 3 illustrates what proportions of the 2011 graduates from each institution applied for CST in each of these three years.

The University of London

Combining the findings from graduates awarded a PMQ by UoL with those receiving their degrees from its constituent colleges, 11.91% of London graduates applied for CST (95% CI: 11.03–12.79%). There appears to be a marked variation in surgical intent across the London medical schools (Table 1). Graduates who received a PMQ from Imperial College had the highest proportion of students applying for CST (15.41%). Unfortunately, data allowing calculation of an accurate CST application rate for all students from Imperial College (ie including those Imperial College graduates with a degree from UoL) were not available. Nevertheless, the response to our freedom of information request indicated that of the 2,271 students with a PMQ awarded by UoL, 6.57% had studied at Imperial College and even if none of these 149 graduates had applied for CST, the resulting overall CST application rate of 13.83% (95% CI: 11.77–15.89%) for students from Imperial College would still be significantly higher than the UK average of 9.97%.

The proportion of graduates with a degree awarded by King's College who applied for a CST post (12.76%) was also higher than the UK average. However, the response to our freedom of information request showed that 16.56% of the 2,271 students with a PMQ from UoL had studied at King's College and if none of these 376 students chose to apply for CST, the overall CST application rate for students from King's College would be below the UK average (8.69%, 95% CI: 7.13–10.25%). Of course, owing to the nuances of PMQ awarding within UoL and its constituent colleges, the actual figure cannot be accurately determined but will lie somewhere between 8.69% and 12.76%.

Table 1

The proportions of graduates applying for CST two years after graduation for the years 2011-2013. The University of London is shown twice: once including the figures from all constituent colleges and once excluding.

Awarding body	Total number of graduates over 3 years	CST applicants in 2013	CST applicants in 2014	CST applicants in 2015	Total percentage of graduates from 2011-2013 applying for CST 2 years after graduation (95% CI)
*Universities of Hull and York	384	5.36%	6.25%	4.86%	5.47% (3.19-7.74%)
Universities of Brighton and Sussex	382	8.33%	10.83%	3.90%	7.33% (4.72-9.94%)
*Cardiff University	926	6.99%	7.87%	7.51%	7.45% (5.76-9.14%)
*Universities of Exeter and Plymouth	545	9.04%	6.21%	8.91%	8.07% (5.79-10.36%)
*University of Liverpool	899	7.43%	10.13%	6.62%	8.12% (6.33-9.91%)
University of Leeds	709	7.73%	6.82%	9.67%	8.18% (6.16-10.20%)
*University of Sheffield	672	9.83%	8.06%	7.05%	8.33% (6.24-10.42%)
*University of Oxford	478	8.92%	7.50%	8.70%	8.37% (5.89-10.85%)
University of Edinburgh	719	8.30%	11.16%	6.45%	8.62% (6.57-10.67%)
*University of Aberdeen	537	9.68%	9.77%	6.78%	8.75% (6.36-11.14%)
*University of Newcastle	967	9.91%	9.72%	7.02%	8.79% (7.01-10.57%)
University of East Anglia	446	11.03%	7.43%	8.50%	8.97% (6.32-11.62%)
University of Warwick	500	5.11%	11.04%	11.18%	9.00% (6.49-11.51%)
*University of Leicester	665	10.10%	9.26%	8.71%	9.32% (7.11-11.53%)
*University of Bristol	704	10.14%	9.92%	8.16%	9.38% (7.22-11.53%)
University of Birmingham	1,127	9.89%	8.62%	10.36%	9.67% (7.95-11.40%)
St George's	81	-	5.41%	13.64%	9.88% (3.38-16.37%)
University of Manchester	1,461	9.79%	10.78%	9.20%	9.92% (8.39-11.46%)
University College London	1,083	9.29%	12.00%	9.54%	10.25% (8.44-12.06%)
Keele University	237	-	10.00%	11.02%	10.55% (6.64-14.46%)
University of London (excl PMQs from constituent colleges)	2,271	9.74%	13.44%	9.87%	10.96% (9.68-12.25%)
**Queen's University Belfast	754	10.29%	11.34%	12.30%	11.27% (9.02-13.53%)
**University of Cambridge	466	13.16%	10.69%	10.97%	11.59% (8.68-14.49%)
**University of Southampton	737	10.96%	12.93%	10.98%	11.67% (9.35-13.99%)
**University of London (incl PMQs from constituent colleges)	5,256	11.69%	12.65%	11.43%	11.91% (11.03-12.79%)
**University of Nottingham	968	11.50%	12.01%	12.73%	12.09% (10.03-14.14%)
**University of Glasgow	760	13.81%	10.87%	11.83%	12.24% (9.91-14.57%)
**University of Dundee	440	12.40%	14.19%	10.26%	12.27% (9.21-15.34%)
**King's College London	854	15.52%	11.16%	12.13%	12.76% (10.53-15.00%)
**Imperial College London	967	18.60%	13.51%	14.89%	15.41% (13.13-17.68%)
University of Wales	140	14.71%	16.67%	-	15.71% (9.68-21.74%)
Mean per year		10.27%	10.19%	9.44%	

CI = confidence interval; CST = core surgical training; PMQ = primary medical qualification

*Above the mean in each of the three years

**Below the mean in each of the three years

Table 2 Correlations between the proportion of graduates applying for CST and anecdotal attributes for why variation may exist

Factors correlated		Correlation coefficient	Summary
2013 aEPM	2013 graduates applying in 2015	0.094 (Pearson), <i>n</i> =29, <i>p</i> =0.627	No correlation
University rankings*	Total proportion of CST applicants	-0.028 (Spearman), <i>n</i> =28, <i>p</i> =0.888	No correlation
Approximate year of founding of institution	Total proportion of CST applicants	-0.252 (Spearman), <i>n</i> =29, <i>p</i> =0.188	No correlation
Population of local authority within which the institution is based**	Total proportion of CST applicants	0.194 (Spearman), <i>n</i> =30, <i>p</i> =0.304	No correlation
Percentage of women graduating 2011-2013	Total proportion of CST applicants	-0.535 (Pearson), <i>n</i> =30, <i>p</i> =0.002	Moderate correlation

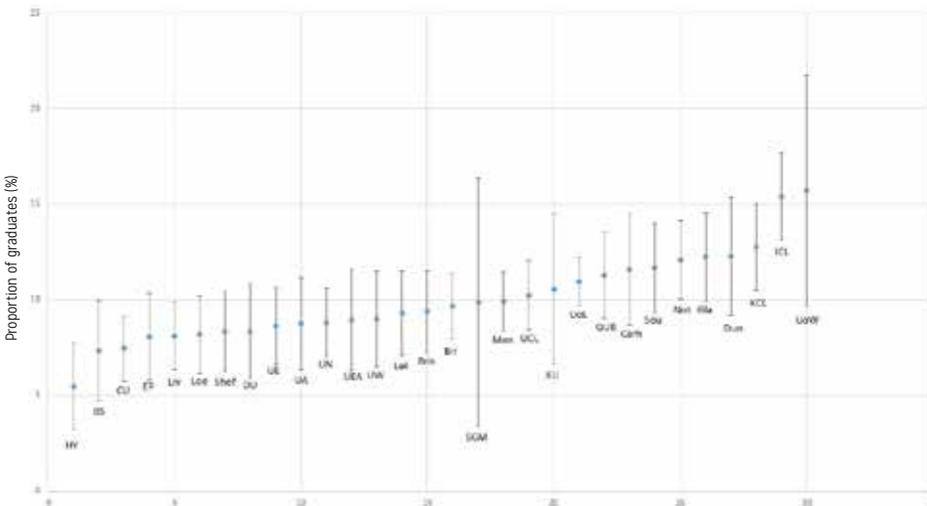
aEPM = average Educational Performance Measure; CST = core surgical training

*At time of application to medical school for 2013 cohort

**All medical schools in London were correlated with the total population of Greater London.

Abbreviations used in Figures 1-3:

Aber = University of Aberdeen; Bir = University of Birmingham; Bris = University of Bristol; BS = Universities of Brighton and Sussex; Cam = University of Cambridge; CU = Cardiff University; Dun = University of Dundee; Edin = University of Edinburgh; EP = Universities of Exeter and Plymouth; Gla = University of Glasgow; HY = Universities of Hull and York; ICL = Imperial College London; KCL = King's College London; KU = Keele University; Lee = University of Leeds; Lei = University of Leicester; Liv = University of Liverpool; Man = University of Manchester; New = University of Newcastle; Not = University of Nottingham; QUB = Queen's University Belfast; Oxf = University of Oxford; SG = St George's; Shef = University of Sheffield; Sou = University of Southampton; UCL = University College London; UEA = University of East Anglia; UoL = University of London; UoW = University of Wales; War = University of Warwick

Figure 1 The overall mean proportions of graduates from 2011-2013 applying for core surgical training between 2013 and 2015 with 95% confidence intervals

DISCUSSION

This study confirms that the proportions of students who apply for CST vary considerably for different medical schools. There are also significant but variable differences in the numbers of men and women who apply for CST. Nevertheless, our data provide no

evidence to support the hypothesis that graduates from universities with higher academic rankings or educational performance, older institutions or those based in more populous areas are more likely to apply for CST.

It is difficult to separate which aspects underlie the differing proportions of CST

applicants, and data on the specific content and student selection methods for each course were unavailable. A number of important factors have been demonstrated to influence medical students' surgical ambitions. These include dissection teaching¹⁴ and good experiences in surgical attachments.^{8,15} Research has also indicated the importance of role models in surgical career selection.^{7,8} If all are absent, undecided students are less likely to see surgery as a feasible and attractive career option. Some of the medical schools producing fewer surgical trainees have committed to high levels of exposure to primary care, which could possibly reduce opportunities to learn about and develop an interest in surgery.

Outside of the curriculum, surgical societies are well known to be important sources of information and inspiration for medical students considering a career in surgery.¹⁶ It is feasible that a highly active or inactive society may influence students' perceptions of surgery and their ambition to pursue this as a career.

In addition, there may be factors external to the university that could influence students in terms of whether to pursue a surgical career. One such example could be the prevalence and attractiveness of private practice among the surgical role models at the institution.

It is also possible that certain universities produce more surgeons because aspiring students selected their medical school on the basis of their reputation for surgical teaching. Selection criteria for certain universities may provide an advantage or disadvantage for those students who demonstrate characteristics that are stereotypically associated with surgeons (eg those with more 'macho' personality traits).¹⁷ Of course, students' personality traits may also influence which medical schools they consider.

Study limitations

The main limitation to this study is the timeframe over which data were sourced. It is possible that the data presented reflect a transient fluctuation in the production of surgical trainees rather than a long-term

Figure 2 The mean proportions of male and female graduates from 2011–2013 applying for core surgical training between 2013 and 2015 with 95% confidence intervals

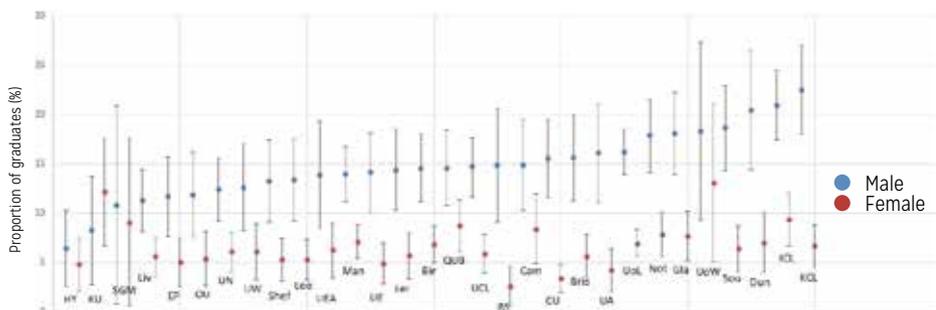
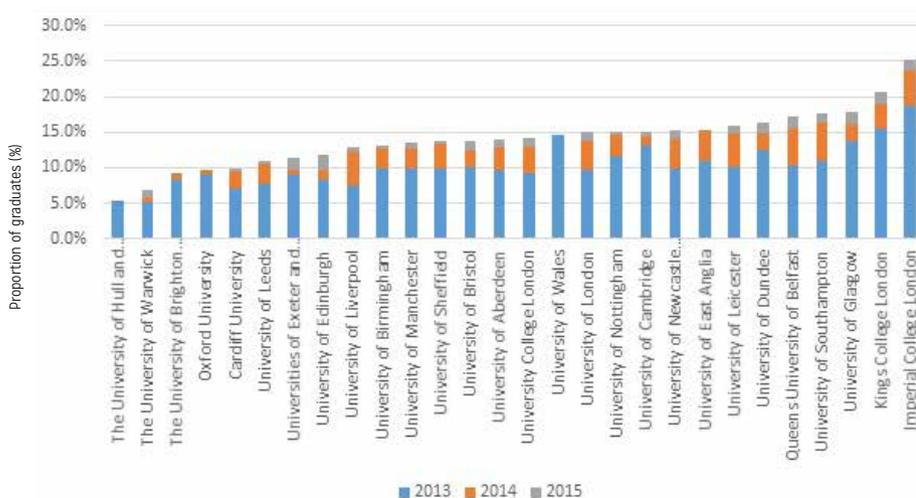


Figure 3 The proportions of graduates with a primary medical qualification from 2011 applying for core surgical training two, three and four years after graduation



trend. The data also cannot account for graduates who take time out of training, move abroad for training or apply for multiple core training programmes. Furthermore, completing CST does not consistently indicate that a person will become a surgeon.⁹ Demographics such as age and background have not been controlled for in this study, and could exert an effect.^{5,8,15}

CONCLUSIONS

There is a clear difference between medical schools in the proportions of students who apply for CST, ranging from 5.5% to 15.7% of graduates with a PMQ. While this cannot be explained by the variables suggested anecdotally and analysed in our study, our findings highlight an imperative to examine and learn from the practices of the most 'surgical' universities, not only to encourage the best

potential surgeons to enter the specialty in the future but also to ensure a high standard of teaching in surgery for all students. It is incumbent on the current generation of surgeons and educators to understand what factors influence students' career choices, and to focus their attention on addressing the underlying issues that may dissuade students from aspiring to a surgical career. Without concentrating on these important points, surgical recruitment may continue to falter, jeopardising our supply of future talent.

This study illustrates that the choice of medical school affects a student's likelihood of becoming a surgeon. The next step is to understand what it is that institutions producing large numbers of surgeons are doing differently, in order to reduce any inequalities in experience that may exist between medical schools.

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