

1
2
3 **Assessing the current state of quality improvement training in urology in the UK: Findings**
4 **from the General Medical Council 2018 trainee survey**
5
6

7 Elena Pallari*¹, Archie Hughes-Hallett^{2,3}, Silia Vitoratou⁴, Zarnie Khadjesari^{1,5},

8 Phil Cornford⁶, Roland Morley⁷, Nick Sevdalis¹ and James S. A. Green⁸
9

10 ¹Centre for Implementation Science, Health Service and Population Research Department, King's
11 College London, London SE5 8AF, UK; nick.sevdalis@kcl.ac.uk
12

13 ²Imperial College London, Department of Surgery and Cancer, South Kensington Campus, London,
14 SW7 2AZ, UK;
15

16 ³Imperial College Healthcare Trust, St Mary's Hospital, The Bays, S Wharf Rd, Paddington, London W2
17 1NY, UK; ahugheshallett@gmail.com
18

19 ⁴Psychometrics and Measurement Lab, Biostatistics and Health Informatics department, Kings College
20 London, London SE5 8AF, UK; silia.vitoratou@kcl.ac.uk
21

22 ⁵School of Health Sciences, University of East Anglia, Norwich Research Park, Norwich NR4 7TJ, UK;
23 Zarnie Khadjesari z.khadjesari@uea.ac.uk
24

25 ⁶Royal Liverpool and Broadgreen University Hospitals NHS Trust, Liverpool, UK;
26 philip.cornford@btinternet.com
27

28 ⁷Imperial College Healthcare NHS Trust, Charing Cross Hospital, London, UK;
29 roland.morley@gmail.com
30

31 ⁸Bart's NHS Trust, Whipps Cross Hospital, Urology Department, Whipps Cross Road, London E11 1NR,
32 UK; james.s.a.green@nhs.net
33

34 *Correspondence to: elena.pallari@kcl.ac.uk
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Abstract

Objective

The General Medical Council of the UK (GMC) has identified the need to support doctors through education in safety and quality improvement (QI) methods. This study reports findings from the GMC annual survey of 2018 from urology trainees regarding the state of QI training and their training needs.

Material and methods

We designed a set of four questions to assess how QI methods are being taught nationally; and inserted them in the 2018 annual GMC trainee survey for urology. This is a cross-sectional study assessing the current state of QI training and mentoring received by trainees and their self-assessed ability and confidence in completing a QI project as part of training requirements. Data were statistically analysed in Stata 15 stratified by Local Education Training Boards (LETBs)/Deanery and by specialty trainee level (ST3 to ST7).

Results

In total, 270 responses were received from urology trainees. Data showed significant variation across the country. Responses from ST3-7 trainees ranged from 5-20% on completing >3 QI projects, while 7-58% replied that they have done none. Across all ST grades, 40% of trainees stated they have not undertaken QI, whereas 0-27% reported they have not received any mentoring on QI to-date. There was significant variation across training region too: 11-74% of trainees answered that they have received training in QI methods; and 58-100% responded being confident in undertaking QI projects. Across all LETBs, 1-3% responded that they uploaded projects on national websites for dissemination; finally, a range of 0-18% stated they had completed >3 projects.

Conclusion

This is the first national snapshot of QI training for the entire urology specialty in the UK. The study demonstrates wide variation in QI training and activity undertaken by trainees and shows a lack of systematic implementation of QI education across training regions.

Keywords: quality improvement, quantitative research, cross-sectional study, survey, urology trainees

Practice points

- The QI part of the GMC survey showed that there is currently great variation across the country
- More than 75% of trainees said that they have not undertaken QI training before or they are not sure
- Despite high variance by regional level regarding mentoring in QI, the majority of trainees reported they are confident in undertaking QI projects
- The results point out a gap in the teaching, mentoring and conduct of QI projects that remains to be addressed by innovative curriculum development

Notes on contributors

Elena Pallari

Elena Pallari is a Biochemical Engineer with work experience in the evaluation of pharmaceuticals, healthcare services and educational interventions. She previously worked as a Research Assistant for

1
2
3 King's College London, University College London Medical School, the Brunel Institute of
4 Bioengineering, Imperial College London Business School and as Life Sciences Consultant.

6 **Archie Hughes-Hallett**

7
8 Archie Hughes-Hallett is a London based urology trainee, and honorary clinical fellow at Imperial
9 College of London. He completed a PhD at Imperial in 2015 and has an interest in medical education
10 and quality improvement.

13 **Silia Vitoratou**

14
15 Silia Vitoratou is a Lecturer in Psychometrics and Measurement at the Biostatistics and Health
16 Informatics department at King's College London, and previously at the South London and Maudsley
17 (SLaM) Quality Improvement team and the Centre for implementation Science. Silia's research
18 interests are in using questionnaires to assess self-reported latent traits.

21 **Zarnie Khadjesari**

22
23 Zarnie Khadjesari is a Senior Lecturer in Health Promotion at the School of Health Sciences, University
24 of East Anglia. Her research interests are on implementing digital behaviour change interventions and
25 her teaching activity includes implementation science and quality improvement.

27 **James S. A. Green**

28
29 James S. A. Green is a Urological Surgeon and Network Lead for Urology at Barts Health NHS Trust and
30 Quality Improvement Director at Whipps Cross University Hospital. His interest in medical education
31 and improvement started when supporting the British Army and has published extensively on
32 teamworking and improving clinical care.

35 **Phil Cornford**

36
37 Phil Cornford is a Urological Surgeon and Cancer Lead at Liverpool University Hospitals NHS Trust and
38 current chair of the SAC in Urology. He was involved in the setting up of Urology National selection
39 the development of the ST-simulation bootcamp and is currently working with Roland on the re-write
40 of the Urology curriculum.

43 **Roland Morley**

44
45 Roland Morley is a Consultant Urologist at Imperial Healthcare NHS Trust and has recently completed
46 his term as Specialist Advisory Chair in Urology. he has a major interest in surgical education and non-
47 technical surgical skills.

49 **Nick Sevdalis**

50
51 Nick Sevdalis is Professor of Implementation Science and Patient Safety at King's College London. He is
52 Director of the Centre for Implementation Science. An experimental psychologist by training, his
53 expertise is in patient safety within hospital environments, with specific focus on team skills that
54 underpin safe, high-quality care delivery.

57 **Introduction**

58
59 Quality improvement (QI) methods are now well established as formal approaches within healthcare
60 and an important priority in the medical profession for the improvement of patient care^{1, 2}. Recently,
the Accreditation Council for Graduate Medical Education (ACGME) in the USA launched the new core

1
2
3 competencies report outlining the requirements for systems-based practice and participation in
4 quality improvement activities ³. Likewise, the Association of American Medical Colleges (AAMC)
5 recommends competency in quality improvement is integrated in undergraduate to postgraduate
6 training ⁴ and the American Board of Surgery (ABS) considers QI competency as a mandate for
7 maintenance of certification ⁵. Similar developments have taken place in the UK, where the Royal
8 College of Physicians launched the Quality Improvement Hub in 2016 in an effort to support physicians
9 in undertaking QI work and navigating through the tools they need to achieve this ⁶. The General
10 Medical Council (GMC) encourages the development of systematic and relevant QI activities to the
11 clinical work ⁷. All of the above professional bodies thus view education and competency in QI as
12 important attributes in the modern physician and surgeon and an essential mechanism to control costs
13 whilst improving patient outcomes. The new GMC framework on promoting excellence and setting the
14 standards for medical education and training includes QI as a general professional capability for all
15 doctors in training and assessment ⁸.

16
17
18
19
20
21 The views of these leading medical organisations about the central importance of QI skills in the
22 physician workforce are also reflected by initiatives undertaken by hospitals and other healthcare
23 delivery organisations. In recent years, there have been numerous national policy initiatives and
24 mandates in many countries worldwide to establish QI teams and services within healthcare
25 organisations (e.g. Healthcare Quality Improvement Partnership in the UK) ⁹ – and to augment the
26 physician workforce’s capability in undertaking QI and patient safety on-the-job projects ¹⁰. These
27 initiatives have created a demand for QI skills trained physician personnel ^{11,12}. These pressing hospital-
28 related and institutional-level requirements to improve healthcare quality have thus led to calls across
29 training levels and specialties for the development of core training, the engagement of house-staff in
30 QI activities, and the creation of a cultural alignment of QI efforts with institutional initiatives¹³.

31
32
33
34 The importance of QI skills education has permeated through to training programme directors’ level.
35 Studies surveyed the views of programme directors about the current state of QI in graduate surgical
36 education. Eight-five percent of those surveyed stated that education in QI is ‘essential’ or ‘very
37 essential’ to future professional work in the field of surgery ¹⁴. Likewise, in another study 90% of
38 training programme directors stated that they consider education in QI as ‘important’ or ‘very
39 important’ to a resident’s future success in otolaryngology ¹⁵. Within urological training, programme
40 directors have expressed a strong interest for residents to learn QI methodology (89% of those
41 surveyed) and importance of understanding how to apply it towards conduct a QI project (86% of those
42 surveyed) ¹⁶.

43 44 45 46 47 **Research gap**

48
49 Despite the above educational, clinical and regulatory perspectives on the importance of QI skills
50 training from leading organisations and physicians, the current state of affairs in QI skills training within
51 medical education face numerous challenges as documented in a recent systematic review. These
52 included: misperception of QI compared to clinical research, lack of knowledge on QI methods, and
53 scepticism about the impact of QI on patient outcomes and institutional performance ¹⁷. Other recent
54 reviews focused on safety skills education (a specific aspect of QI) and revealed lack of widespread
55 knowledge of the safety and quality evidence base and specific techniques within the medical
56 workforce ^{11,12}. Such barriers have meant that widespread adoption of QI skills by penetration into the
57 physician and surgical workforce to support continuous service improvement remains an issue.
58
59
60

1
2
3 A significant gap in our understanding of how to address such bottlenecks remains the lack of detailed
4 study of the trainees' perspective. To the best of our knowledge, large scale trainee or resident
5 physician surveys have not focused on QI skills learning, development or application – focusing
6 typically on trainees' perception of their clinical skills training instead. Developing such a survey and
7 conducting it at scale would offer a broad-based 'training needs analysis' for QI skills within the training
8 curriculum. Such an analysis offers a necessary first step in designing relevant to trainees and scalable
9 QI skills training programmes.
10
11
12

13 The study we report here aimed to address this gap. We designed and conducted a training needs
14 analysis on QI skills for UK urological surgery trainees – via integrating it within the annual GMC
15 trainees survey of 2018.
16
17

18 **Methods**

19 **Study design**

20
21 This was a cross-sectional descriptive survey-based study assessing the current state of QI training and
22 mentoring received by trainees and their self-assessed ability and confidence in completing a QI
23 project as part of training requirements. King's College London Research Ethics Committee reviewed
24 the study and deemed it did not require ethical review as it was part of a standard professional
25 education survey, regularly carried out by the GMC, to which we were formally invited to contribute
26 (see section below).
27
28
29
30

31 **Study materials and procedure**

32
33 We designed a set of questions around QI skills training for completion by all urology trainees of the
34 UK. The questions were designed based on a balance between gathering important information for
35 our training needs analysis purposes yet keeping the survey very short so that it could be feasibly
36 delivered as part of the GMC annual survey – hence the four of questions was set from the start to be
37 small and highly prioritised. The questions were developed by EP and worded by a team that included
38 expertise in medicine and surgery (JSAG) and improvement science (NS, ZK). The finally selected
39 questions (n=4) are shown in Box 1.
40
41
42

43 These questions were subsequently reviewed and approved both by the Specialist Advisory Committee
44 (SAC) in Urology (Urology SAC) and GMC. They were ultimately inserted in the 2018 GMC annual
45 trainee survey of 2018. This is an annual assessment by the GMC of the quality of training provision
46 completed by trainees to get their views on satisfaction with existing training ¹⁸. Upon conclusion of
47 the survey data collection, the data were compiled by the GMC and subsequently shared with the
48 research team in fully anonymised format for analysis.
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

| | | | | |
|--|----------|----------------------------|-------|----------------|
| 1) Have you received any training in quality improvement methods to date? | | | | |
| yes/ no/ unsure | | | | |
| 2) To what extent do you agree or disagree with the following statement? I am confident that I can complete a quality improvement project. | | | | |
| Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
| 3) Where did your mentoring on quality improvement take place in the last year? | | | | |
| a. Locally | | | | |
| b. Within your trust | | | | |
| c. Regionally within your training programme | | | | |
| d. Nationally through your own/another professional network | | | | |
| e. Elsewhere: (please specify) | | | | |
| 4) During your specialty training, how many quality improvement projects (excluding audits) have you completed to date? | | | | |
| 0 | 1 | 2 | 3 | more than 3 |

Box 1. Final questions on quality improvement skills inserted into the GMC annual 2018 survey

Statistical analysis

To comply with the GMC's requirement for complete anonymity of survey responses, data were provided to the research team in grouped format. GMC did not provide raw scores for individual trainees or training regions, as this could potentially break respondent anonymity. Subsequently, we pseudonymised each region to further prevent inadvertent identification.

The grouped nature of the dataset determined the type of descriptive and inferential analyses that could be carried out and reported. Data were statistically analysed collectively, by the UK Local Education Training Boards (LETBs)/Deanery and by trainee level (ST3, ST4, ST5, ST6, ST7). The percentages per category in the five items were approximated by our team using the diagrams (up to integer level-no decimal points were used), and the frequencies were computed using as total number of observations $N=260$, to accommodate for the fact that in certain questions the number of responders was less than 270 (but no less than 260).

The one sample χ^2 was used to test the hypothesis of majority (50%) of a response (or cluster of responses, as described in results) versus the rest of the responses. The analysis was conducted separately for each LETB, separately for each trainee level, but also for their totals. All analyses have been conducted in STATA 15¹⁹ and a chi-square (χ^2) test was performed for noncontinuous variables, with a p value of less than 0.05 for statistical tests considered statistically significant.

Results

In total, up to an estimated 270 responses were received from urology trainees (in grouped format). Data showed significant variation across the country, with results being statistically significant, $p < 0.05$. There was a great variation cross region where 11-74% of respondents answered that they have

1
2
3 received training in QI methods (Figure 1). Between 58% and 100% responded being confident in
4 undertaking QI projects – nationally (Figure 2), whereas 0-27% reported they have not received any
5 mentoring on QI up to date (Figure 3). From all LETBs, 1-3% responded that they uploaded projects on
6 national websites for dissemination; finally, a range of 0-18% stated they had completed >3 projects
7 (Figure 4). Responses from ST3-7 trainees ranged from 5-20% on completing >3 QI projects, while 7-
8 58% replied that they have done none, and across all ST grades, 40% of trainees stated they have not
9 undertaken QI.

10
11
12
13 There was no specific QI education programme that respondents were aware of (Table 1). This reached
14 statistical significance across all groups and in both subgroups analysed (overall, within each LETB and
15 at each level of training, $p < 0.001$ in all cases). In all but one LETB, the majority (within each LETB and
16 each training level, as well as over the totals) of the individuals responded that they were confident to
17 participate in a QI project ($p < 0.001$), except LETB 10 ($p = 0.160$). In most cases, the majority (within each
18 LETB and each training level, as well as over the totals) of the individuals responded that they
19 ‘participated in 3 or more QI projects’ ($p < 0.05$), except LETBs 3, 10, and 13 ($p > 0.05$).
20
21
22

23 Discussion

24
25 QI is a general professional capability for all postgraduate trainees in medicine in the new curricula
26 submitted to the GMC⁸. This study, for the first time to our knowledge, elucidates the state of training
27 in, and delivery of, QI projects by UK urology trainees – thus offering a training needs analysis for this
28 trainee cohort. Although less than 25% of trainees said that they have received QI training, more than
29 75% said that they feel comfortable in undertaking QI work. These may suggest that perhaps these
30 respondents or even more who said that they had participated in more than 3 QI projects, really refer
31 to audit projects rather than QI projects. Our findings raise questions around the variability of QI
32 activities as informed by educational pedagogies and current training structure. The large variability in
33 the responses indicates the need for a formalised QI curriculum and pedagogies.
34
35
36

37 Although we did not ask about QI curricula content specifically, our findings potentially point out to
38 variability of implementation across the LETBs training programmes. It may also point to the variability
39 in the availability of QI mentors too. A survey from program directors within paediatric programmes
40 pointed out great variability in QI curriculum design, content, and evaluation of within paediatric
41 residency programs²⁰. Similarly, in another study fewer than half of paediatric trainees responded that
42 they use standard QI methods making the case of standardising nationally QI curricula for systemic
43 improvement²¹. Furthermore, these gaps were also replicated in a systematic review focusing on
44 physicians, where lack of appropriate QI curricula was found²². The goal of any educational programme
45 should be to enable the effective knowledge transfer of QI concepts, models and tools from the
46 educators to the trainees, in a coherent manner across UK training programmes. Perhaps practical
47 demonstration of examples of QI work from the set-up to the evaluation²³ should be included within
48 QI skills training across training programmes. Subsequently, trainees could contribute to the evaluation
49 of the mechanism or strategy of improvement within the context of a specific QI project within their
50 own services. Within that, they could identify, measure and report appropriate outcomes on the
51 processes-of-care, patient outcomes, or measures of organisational benefit²⁴. These could be assisted
52 by the use of the SQUIRE guidelines in the reporting of QI projects²⁵. Such an approach requires further
53 development and testing; its ultimate aim would be to offer trainees a standardised training package
54 in practical QI skills. Finally, it can be used to upskill the trainers as well.
55
56
57
58
59
60

An innovation of this study is that it is the first time that such a survey is addressed to specialty trainees
and provides an important dimension in assessing the current state of QI training from the trainee

1
2
3 perspective – at national scale. The findings are also in agreement from an attitude survey of paediatric
4 trainees, whom 70% had no prior QI training and 82% did, responded that continuous QI is a positive
5 trend in health care, while 23% and 18% respectively remained undecided ²⁶. Another survey showed
6 that more than 60% of trainees in radiation oncology had no proper training in QI methods, and only
7 27% of residents felt that they were adequately trained in patient safety ²⁷.

8
9
10 In improving and informing the development of future QI education programmes, emphasis should be
11 placed on the development of experiential learning, informed by sociocultural theories²⁸. Supporting
12 leadership within hospital QI infrastructure and identifying pathways to engage relevant stakeholders
13 in this process are key drivers ²⁹. Previously, an analysis showed significant variability of the ACGME
14 milestones essentially demonstrating variability of QI expectations across 26 specialties in the USA ³⁰.

15
16 The identified barriers of time constraints and institutional change culture overlap with those found
17 from a study assessing the effectiveness of educational programs on medical event reporting ³¹. A
18 potential solution was an attempt to implement a QI collaborative across eight USA residency
19 programs, which provided a structural approach to achieve this in a unifying manner ³². As the GMC
20 survey results are evident of similar heterogeneity across the 13 LETBs across the UK with respect to
21 QI training implementation, perhaps emphasis should be placed in addressing such barriers and
22 introduce a collaborative approach.

23
24 We propose the provision of such contextual support and QI collaboratives to optimise practice-based
25 learning. For example, teaching trainees at a nationally organised courses, disseminating materials and
26 providing support regionally so they can undertake QI projects within their own programs, and using
27 online platforms for sharing best practices in QI project work virtually. We have started to develop
28 such a comprehensive supportive framework for the provision of QI training within UK urology trainees
29 – through the iterative development of a basic QI skills curriculum, which we have shown is feasible
30 and educationally effective. This approach remains to be further scaled up and evaluated.

31 32 33 34 35 **Limitations**

36 Our study was limited in scope due to feasibility: we could only provide a small number of questions
37 to the annual GMC trainee survey, and hence excluded important topics such as curriculum content,
38 pedagogical tools or evaluation methods. Also, our sample size was substantial, but we cannot rule out
39 self-selection – due to the number of trainees who ultimately chose to participate in the survey. This
40 is a limitation of all survey studies. Finally, this was a cross-sectional study, hence we cannot establish
41 a cause and effect due to temporal restrictions between exposure and assessed outcomes.

42 43 44 45 46 **Conclusions**

47 This is the first national snapshot of QI training for any group of surgical trainees. The study
48 demonstrates wide variation in QI training, activity and understanding amongst trainees, and shows
49 lack of systematic implementation of coherent QI education across training regions. We propose that
50 these questions are annually included in the survey to offer a longitudinal perspective on the state of
51 training in formal QI skills training and mentoring within the trainees' population, as QI initiatives are
52 introduced.

Figures

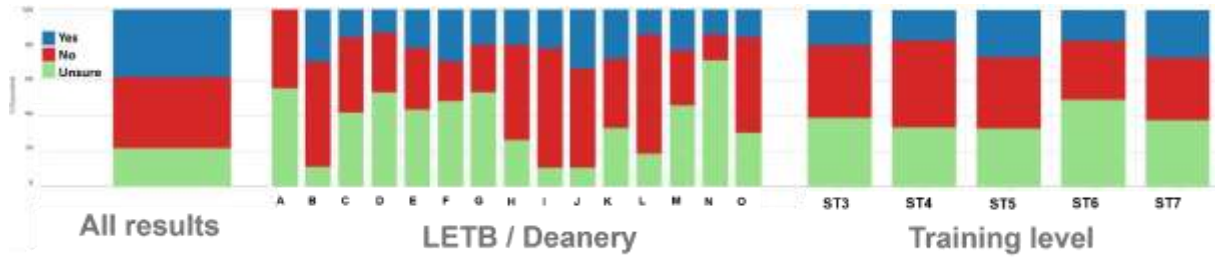


Figure 1. Q1: Have you received any training in quality improvement methods before?



Figure 2. Q2: To what extent do you agree or disagree with the following statement: I am confident that I can complete a QI project?

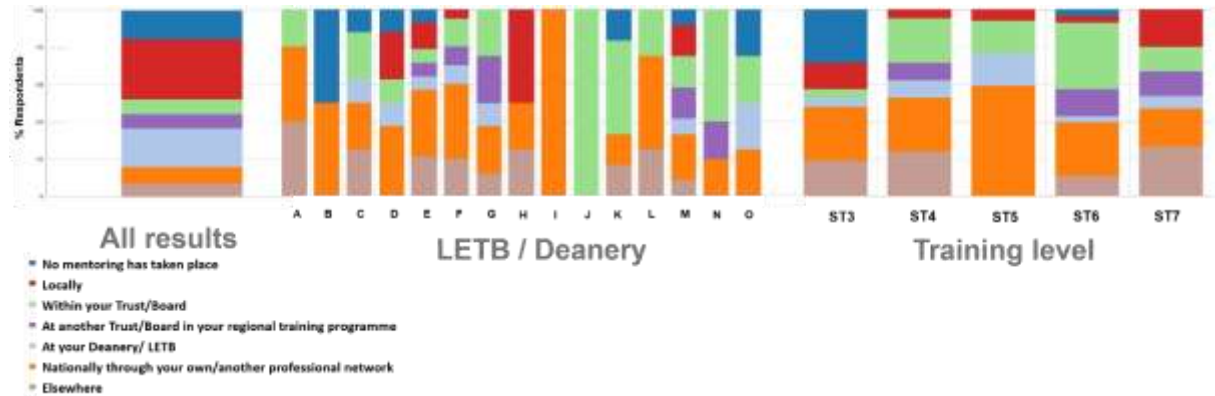


Figure 3. Q3: Where did your mentoring on quality improvement take place in the last year?

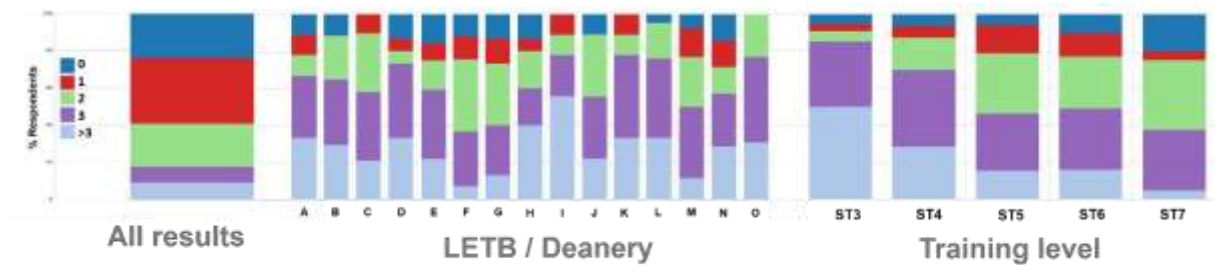


Figure 4. Q4: During your specialty training, how many quality improvement projects (excluding audits) have you completed to-date?

Table

Table 1. Significant associations using Pearson's chi- square (χ^2) between LETB and ST level with Q2, Q4, and Q5 for the majority (>50%)

| | | Q2: 'no or unsure > 50%' | | Q4: 'strongly disagree or disagree > 50%' | | Q5: '3 or more projects > 50%' | |
|-------------|--------|--------------------------|--------|---|--------|--------------------------------|--------|
| | | χ^2 | p | χ^2 | p | χ^2 | p |
| LET B | 1 | 173.33 | <0.001 | 13.93 | <0.001 | 17.57 | <0.001 |
| | 2 | 24.36 | <0.001 | 88.18 | <0.001 | 13.93 | <0.001 |
| | 3 | 67.28 | <0.001 | 31.35 | <0.001 | 3.41 | 0.065 |
| | 4 | 88.18 | <0.001 | 82.08 | <0.001 | 31.35 | <0.001 |
| | 5 | 44.50 | <0.001 | 118.48 | <0.001 | 5.25 | 0.022 |
| | 6 | 24.36 | <0.001 | 92.41 | <0.001 | 9.05 | 0.003 |
| | 7 | 51.43 | <0.001 | 82.08 | <0.001 | 5.25 | 0.022 |
| | 8 | 51.43 | <0.001 | 72.59 | <0.001 | 5.25 | 0.022 |
| | 9 | 44.50 | <0.001 | 92.41 | <0.001 | 44.50 | <0.001 |
| | 10 | 13.93 | <0.001 | 1.98 | 0.160 | 1.98 | 0.160 |
| | 11 | 26.25 | <0.001 | 6.55 | 0.010 | 44.50 | <0.001 |
| | 12 | 78.19 | <0.001 | 55.89 | <0.001 | 38.18 | <0.001 |
| | 13 | 44.50 | <0.001 | 173.33 | <0.001 | - | >0.999 |
| | 14 | 78.19 | <0.001 | 173.33 | <0.001 | 2.50 | 0.114 |
| | 15 | 72.59 | <0.001 | 7.50 | 0.006 | 40.64 | <0.001 |
| Total | 786.01 | <0.001 | 841.47 | <0.001 | 120.99 | <0.001 | |
| ST level | 3 | 55.89 | <0.001 | 72.59 | <0.001 | 72.59 | <0.001 |
| | 4 | 63.88 | <0.001 | 44.50 | <0.001 | 21.67 | <0.001 |
| | 5 | 32.40 | <0.001 | 106.03 | <0.001 | 0.77 | 0.380 |
| | 6 | 63.88 | <0.001 | 63.88 | <0.001 | - | >0.999 |
| | 7 | 29.25 | <0.001 | 44.50 | <0.001 | 7.50 | 0.006 |
| | Total | 237.47 | <0.001 | 319.41 | <0.001 | 16.11 | <0.001 |

Acknowledgments

The authors would like to thank all respondents to the survey who remain anonymous and the GMC for organising the administration of the survey. The authors would also like to thank the members of the EQUIP Steering Group for their valuable feedback.

Funding

This is from The Urology Foundation (grant 4305 EQUIP), which in turn acknowledges the support of the Schroder Foundation. NS' research is supported by the National Institute for Health Research (NIHR) Applied Research Collaboration (ARC) South London at King's College Hospital NHS Foundation Trust. NS is a member of King's Improvement Science, which offers co-funding to the NIHR ARC South London and comprises a specialist team of improvement scientists and senior researchers based at King's College London. Its work is funded by King's Health Partners (Guy's and St Thomas' NHS Foundation Trust, King's College Hospital NHS Foundation Trust, King's College London and South London and Maudsley NHS Foundation Trust), Guy's and St Thomas' Charity and the Maudsley Charity.

Disclosure statement

NS is the Director of London Training & Safety Solutions Ltd which delivers patient safety, quality improvement, and team training to hospitals on a consultancy basis. There are no conflicts of interest identified by the rest of the authors whether academic, institutional, political, financial, personal or other.

The guarantor is JSAG.

References

1. Institute of Medicine of the National Academies, Kohn LT, Corrigan JM, et al. *To err is human. Building a safer health system* 1999; 600: 2000.
2. Institute of Medicine. *Crossing the quality chasm: a new health system for the 21st century*. Washington, DC: National Academy Press, 2001.
3. Accreditation Council for Graduate Medical Education A. ACGME Common Program Requirements (Residency) <https://www.acgme.org/Portals/0/PFAssets/ProgramRequirements/CPRResidency2019.pdf> (2018, accessed 30 August 2019).
4. Association of American Medical Colleges. *Teaching for Quality: Integrating Patient Safety and Quality Improvement Across the Continuum of Medical Education: An Expert Report*. 2013.
5. Malangoni M and Shiffer C. The American Board of Surgery Maintenance of Certification Program: The first 10 years. *Bulletin of the American College of Surgeons* 2015; 100: 15-19.
6. Choudry MI, Stewart K and Woodhead T. The Royal College of Physician's Quality Improvement Hub—how can it help physicians to improve patient care? *Future hospital journal* 2016; 3: 211-216.
7. General Medical Council G. Your supporting information – quality improvement activity, <https://www.gmc-uk.org/registration-and-licensing/managing-your-registration/revalidation/guidance-on-supporting-information-for-appraisal-and-revalidation/your-supporting-information---quality-improvement-activity> (accessed 30 August 2019).
8. Council GM. *Promoting excellence: standards for medical education and training*. 2016. General Medical Council.
9. The Healthcare Quality Improvement Partnership H. Measuring and improving our healthcare services, <https://www.hqip.org.uk/about-us/#.Xb11X5r7Qgw> (accessed 2nd November 2019).

10. Improvement N. Building capacity and capability for improvement: embedding quality improvement skills in NHS providers. *NHS Improvement* 2017.
11. Wong BM, Etchells EE, Kuper A, et al. Teaching quality improvement and patient safety to trainees: a systematic review. *Academic Medicine* 2010; 85: 1425-1439.
12. Kirkman MA, Sevdalis N, Arora S, et al. The outcomes of recent patient safety education interventions for trainee physicians and medical students: a systematic review. *BMJ open* 2015; 5: e007705.
13. Liao JM and Kachalia A. Providing educational content and context for training the next generation of physicians in quality improvement. *Academic Medicine* 2015; 90: 1241-1245.
14. Kelz RR, Sellers MM, Reinke CE, et al. Quality in-training initiative—a solution to the need for education in quality improvement: results from a survey of program directors. *Journal of the American College of Surgeons* 2013; 217: 1126-1132. e1125.
15. Bowe SN. Quality improvement in otolaryngology residency: survey of program directors. *Otolaryngology—Head and Neck Surgery* 2016; 154: 349-354.
16. Ziemba JB, Matlaga BR and Tessier CD. Educational Resources for Resident Training in Quality Improvement: A National Survey of Urology Residency Program Directors. *Urology practice* 2018; 5: 398-404.
17. Massagli TL, Zumsteg JM and Osorio MB. Quality Improvement Education in Residency Training: A Review. *American journal of physical medicine & rehabilitation* 2018; 97: 673-678.
18. General Medical Council G. National training surveys, <https://www.gmc-uk.org/education/how-we-quality-assure/national-training-surveys>.
19. StataCorp. *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC, 2017.
20. Mann KJ, Craig MS and Moses JM. Quality improvement educational practices in pediatric residency programs: survey of pediatric program directors. *Academic pediatrics* 2014; 14: 23-28.
21. Craig MS, Garfunkel LC, Baldwin CD, et al. Pediatric resident education in quality improvement (QI): a national survey. *Academic pediatrics* 2014; 14: 54-61.
22. Windish DM, Reed DA, Boonyasai RT, et al. Methodological rigor of quality improvement curricula for physician trainees: a systematic review and recommendations for change. *Academic Medicine* 2009; 84: 1677-1692.
23. Davis NL, Davis DA, Johnson NM, et al. Aligning academic continuing medical education with quality improvement: a model for the 21st century. *Academic Medicine* 2013; 88: 1437-1441.
24. Eccles M, Grimshaw J, Campbell M, et al. Research designs for studies evaluating the effectiveness of change and improvement strategies. *BMJ Quality & Safety* 2003; 12: 47-52.
25. Ogrinc G, Armstrong GE, Dolansky MA, et al. SQUIRE-EDU (Standards for Quality Improvement Reporting Excellence in Education): Publication Guidelines for Educational Improvement. *Academic Medicine* 2019.
26. Lipstein EA, Kronman MP, Richmond C, et al. Addressing core competencies through hospital quality improvement activities: attitudes and engagement. *Journal of graduate medical education* 2011; 3: 315-319.
27. Spraker MB, Nyflot M, Hendrickson K, et al. A survey of residents' experience with patient safety and quality improvement concepts in radiation oncology. *Practical radiation oncology* 2017; 7: e253-e259.
28. Goldman J, Kuper A and Wong BM. How Theory Can Inform Our Understanding of Experiential Learning in Quality Improvement Education. *Academic Medicine* 2018; 93: 1784-1790.
29. Till A, Banerjee J and McKimm J. Supporting the engagement of doctors in training in quality improvement and patient safety. *British Journal of Hospital Medicine* 2015; 76: 166-169.
30. Lane-Fall MB, Davis JJ, Clapp JT, et al. What every graduating resident needs to know about quality improvement and patient safety: A content analysis of 26 sets of ACGME milestones. *Academic Medicine* 2018; 93: 904-910.
31. Coyle Y, Mercer S, Murphy-Cullen C, et al. Effectiveness of a graduate medical education program for improving medical event reporting attitude and behavior. *BMJ Quality & Safety* 2005; 14: 383-388.

1
2
3 32. Daniel DM, Casey Jr DE, Levine JL, et al. Taking a unified approach to teaching and
4 implementing quality improvements across multiple residency programs: the Atlantic Health
5 experience. *Academic Medicine* 2009; 84: 1788-1795.
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 **Declarations of interest**
4

5 **Conflicting interests:** NS is the Director of London Training & Safety Solutions Ltd which delivers
6 patient safety, quality improvement, and team training to hospitals on a consultancy basis. There are
7 no conflicts of interest identified by the rest of the authors whether academic, institutional, political,
8 financial, personal or other.
9

10
11 **Funding:** This is from The Urology Foundation under grant 4305 EQUIP.
12

13 **Informed consent:** Not applicable
14

15 **Ethical approval:** Not applicable
16

17 **Contributorship:** EP and JG developed the initial set of questions. EP drafted the manuscript with
18 critical feedback from AHH. SV conducted the statistical analyses. PC and RM provided support with
19 the dissemination of the survey and overall comments on the manuscript. ZK and NS provided
20 critical feedback on the manuscript.
21

22 **Acknowledgements:** The authors would like to thank all respondents to the survey who remain
23 anonymous and the GMC for organising the administration of the survey. The authors would also like
24 to thank the members of the EQUIP Steering Committee for their valuable feedback.
25
26

27 **Guarantor:** JSAG
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60