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Pilot implementation and evaluation of a national quality improvement taught curriculum for urology residents: lessons from the United Kingdom

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Abstract

Background

We report the immediate educational impact of a previously developed quality improvement (QI) curriculum for UK urology residents.

Materials and Methods

Prospective pre/post-training evaluation, using the Kirkpatrick framework: residents' QI knowledge, skills and attitudes were assessed via standardized assessments. We report descriptive/inferential statistics and scales psychometric analyses.

Results

Ninety-eight residents from across the UK provided full datasets. *Scale reliability* was good (Cronbach-alphas=0.485-0.924). Residents' *subjective knowledge* (Mpre=2.71, SD=0.787; Mpost=3.97, SD=0.546); *intentions* to initiate QI (Mpre=3.65, SD=0.643; Mpost=4.09, SD=0.642); *attitudes towards doing QI* (Mpre=3.67, SD=0.646; Mpost=4.11, SD=0.591); *attitudes towards QI at work* (Mpre=3.80, SD=0.511; Mpost=4.00, SD=0.495); and *attitudes towards influencing QI* (Mpre=3.65, SD=0.482; Mpost=3.867, SD=0.473) all improved post-training (all ps<0.0001). *Objective knowledge* remained stable (58% to 59%, p>0.05). Residents' satisfaction was high.

Conclusions

Our novel QI training is educationally sound and feasible to deliver. Longitudinal evaluation and scalability are planned.

Keywords

urology; quality improvement; education; pilot; evaluation

Introduction

Over the past two decades, awareness of the need to improve the safety and quality of surgical services has increased. A number of prominent interventions have been developed and published in the surgical literature. These include checklists [1], care bundles to improve safety and quality of care delivery [2], and large national data registries. Examples of such registries include the National Surgical Quality Improvement Program in the USA [3-5] and national clinical audits in the UK, such as the National Emergency Laparotomy Audit [6] and the National Prostate Cancer Audit [7]. Such national registries are aimed at auditing and thereby benchmarking service quality, subsequently allowing feedback on performance to be delivered to individual services/organizations. Quality improvement (QI) interventions and programs can then be targeted at weaker performance areas.

Surgical education has followed these developments: surgical residents are now expected to be involved in surgical QI projects as part of their residency training. National-level curricula have explicitly included QI and system-based practice as core competency requirements. In the USA, for example, the above competencies are described by the Accreditation Council for Graduate Medical Education (ACGME) [8]. Patient safety and QI approaches are supported by reference resources like the Quality in Training Initiative (QITI) [9]. In the UK, the Intercollegiate Surgical Curriculum Program includes the requirement for QI training [10] and the General Medical Council [11] has made a mandatory requirement that residents before they can graduate from any residency program need to complete at least two QI projects.

A major barrier, however, to the successful and consistent implementation of such QI skills development initiatives remains the lack of capacity and capability within residency programs to instill QI skills in residents. The problem is multifaceted and not peculiar to

surgery. Comprehensive evidence reviews have shown that lack of improvement science knowledge and skills is a major barrier faced by both physicians and surgeons in improving patient safety [12]. Large scale studies have been undertaken to address these barriers and increase capacity for safety reflection and improvement within residencies outside surgery [13]. The above capacity problems have led to at least two major weaknesses in surgical QI training. Firstly, delivering the requirement for residents to complete educationally meaningful and clinically impactful QI is problematic. Secondly, the scalability and sustainability of surgical QI also remains limited, as surgeons or residents are typically unable to carry out such work with enough depth of time for it to show clinical effects. In practice, this means that more often than not successful surgical QI is led by very few centers or research teams, who can afford the capacity and time to their staff surgeons and residents and often have in-house QI experts.

The EQUIP research program

To start addressing this wide capacity problem for QI training and subsequent implementation within surgery, in 2017 we launched the '*Education in Quality Improvement Program*' (EQUIP). EQUIP is a funded research program at the interface of improvement science and surgical education. The program aims to develop an evidence-based, user-informed, practical and scalable QI skills training curriculum for surgical residents in the UK. In the first instance, and for reasons of feasibility, the program is focused on urology residents – but with a view to be applicable across any surgical subspecialty [14]. As part of EQUIP, to-date:

1. We have carried out a review of published evidence regarding how best to teach QI skills to healthcare personnel

2. Based on (1) and expert stakeholder input, we have developed a draft, pragmatic, introductory QI skills curriculum for urology residents, deliverable within half a day of face to face teaching. The teaching duration is constrained due to competing time pressures, and to allow scaled implementation in busy surgical residencies in the future. Stakeholders who have reviewed the curriculum in depth have included Attending and resident urologists, specialist urology nurses, patients, clinical service managers, and medical education and improvement science experts. The teaching involves taught lectures, workshops, and small group work.

3. Delivered the curriculum to one cohort of urology residents who attended a national skills 'bootcamp' to carry out proof-of-concept and feasibility testing (during 2017).

We have reported in detail the above developmental research in a recent publication in this journal [14]. Here we report the follow-on research, which focuses on evaluating the immediate educational effectiveness of the EQUIP training. We specifically aimed to evaluate whether the half day QI skills training that we offered within a bootcamp setting was effective in imparting knowledge and skills and improving residents' attitudes towards undertaking QI projects as part of their residencies.

Material and methods

Study design

This was a prospective, uncontrolled pre-post training intervention, using previously validated assessment tools. The evaluation was guided by the well-established in surgical education Kirkpatrick framework for evaluating complex training interventions [15] – see Evaluation Framework section below.

The study was reviewed and approved as training evaluation by the faculty boards of the Urology Skills Bootcamps, where the training was delivered (see section below).

Participants & setting

The EQUIP QI training session was delivered as part of two Urology Skills Bootcamps [16, 17] with national remit (Leeds, October 2017, 43 residents; Leicester, January 2018, 63 residents). Study participants were the entire cohort of urology residents attending the Bootcamps (N=106). The development of the training and initial feasibility evidence from the Leeds 2017 first ever cohort we trained was reported in Pallari *et al.* [14]. The knowledge, skills and attitudinal dataset reported here, including pre-post training comparisons and psychometric evaluation of the assessment tools, is larger than the original dataset (as it includes the additional 2018 training cohort) and has not been reported to-date. The study was reviewed and approved as an educational intervention evaluation prior to data collection by the faculty Directors as part of the in-built evaluation strategy of each one of the Bootcamps.

The study cohort included residents at different stages of their training. The residents who took part in this study were specialist urology residents (attending the Leeds bootcamp) and core nonspecialized residents with an expressed interest in pursuing specialist urologic surgery residency (attending the Leicester bootcamp). For clarity: in the UK, following medical school completion, trainees (or residents in USA terms) go onto 2 years of *foundation training*, during which they rotate across specialties. This is then followed by another 2 years (typically) of *core training*, during which the rotations continue – so not all core trainees will progress to becoming urologists. Finally, *specialist training* takes place after the core training has been completed and is specialty-specific, *i.e.*, all specialist urology trainees who complete the training successfully will become urology Attendings.

Evaluation framework

To offer a theory-driven and structured evaluation, we applied the well-established Kirkpatrick framework to evaluate the QI skills training [15]. Briefly, Kirkpatrick proposes that training programs should be evaluated on at least four separate but inter-related levels: *Level 1* refers to the reaction of the participants to the learning event and is typically measured through self-reported feedback forms. *Level 2* refers to the learning that occurs following the training and concerns the acquired knowledge, skills and attitudes following participation. *Level 3* refers to participants' behavior change following the completion of the training. Lastly, *Level 4* of the framework refers to organizational results and improvements typically seen longitudinally and linked to the training events. In this study, we operationalized the evaluation framework through the delivery of previously validated materials in the format of attitudinal and knowledge assessments [13] – described below. For coherence, we present the results of the study by following the same framework structure.

Evaluation tools

To ensure robustness in the data collection, we chose an established assessment tool [13]. The tool has been designed in line with the Kirkpatrick framework; developed to capture similar assessment domains (*i.e.* safety and quality of care); and used before in a similar context and with a similar population (safety and quality training addressed to junior residents). The tool therefore allowed us to capture the requisite Kirkpatrick levels 1 to 3, which was feasible within the timeframe of the assessment (*i.e.* within the same day of the training). The tool covered the following domains (all items included within Table 2):

Part A (4 items), Kirkpatrick level 2a: residents' attitudes towards carrying out a QI project. Sample items: (i) Carrying out a QI project would be difficult (1) … easy (5); (ii) not expected of me (1) … expected of me (5).

Part B (8 items), Kirkpatrick level 2a: residents' attitudes towards QI more broadly at their workplace. Sample items: (i) By concentrating on addressing causes of poor quality I can contribute to improving patient care and safety (1-5); (ii) Acknowledging and dealing with quality problems where I work is an important part of my job (1-5).

Part C (8 items), Kirkpatrick level 2a: residents' attitudes towards their own ability to influence QI at their workplace: Sample items: (i) I feel able to raise concerns about poor quality of care in the service I work (1-5); (ii) I feel my voice is heard when quality improvement projects are chosen and prioritized (1-5).

Part D (8 items), Kirkpatrick level 3: residents' intentions to engage in QI at their place of work/residency following the training. Sample items: (i) I will actively find out about quality improvement projects/initiatives currently ongoing (1-5); (ii) I plan to support trainee colleagues or seniors involved in a quality improvement project or initiative (1-5).

Part E (10 items), Kirkpatrick level 2b: objective assessment of residents' QI knowledge through standardized multiple-choice questions (see Appendix for the full list).

Part F (8 items), Kirkpatrick level 2b: subjective assessment of residents' QI knowledge through questions mapped onto the course learning objectives. Sample items: Circle the number that best describes the level of knowledge that you feel you have for each item: (i) Different elements of 'high quality care'; (ii) What the 'Plan-Do-Study-Act' method is (1-5).

Part G (18 items and open-ended questions), Kirkpatrick level 1: residents' satisfaction with the training; only administered post-course: these were a set of previously standardized satisfaction with training questions, which we adapted minimally from a previous study [14]. The questions covered course content (7 items), delivery (6 items), and general satisfaction with it (5 items; all items included within Figure 2); additionally, residents were able to offer

open ended comments regarding strengths of the course and areas for future improvement, to be used for future refinement of the program and its delivery.

Of note in relation to the tool development:

- Parts A to D were reviewed and adapted to the improvement (rather than patient safety) focus of the training (by NS, who has over 15 years of QI expertise in surgery) to ensure the attitudinal assessment on the whole was appropriate for use with residents and fully mapped onto the concepts and techniques that the course covered. The modified scales were reviewed for coverage and suitability by the EQUIP Steering Group prior to the course (Attending and resident urologists, patients, medical education and improvement science Faculty).

- Part E questions (see Appendix) were derived from the QI questions of various modules freely available offered by the Open School of the Institute for Healthcare Improvement (IHI) [18]. To arrive at the desirable set of questions for our purposes we took into account content (to ensure the materials were covered by the course) and feasibility (*i.e.*, a number of questions that was feasible to administer). Question selection proceeded in stages: IHI questions were all reviewed by an Attending urologist with expertise in improvement science (JSAG)-*stage 1*; 20 questions were longlisted, which were subsequently reviewed by a senior Faculty member with expertise in improvement science (NS), who arrived at 10 multiple-choice questions (MCQs)-*stage 2*. These MCQs were jointly reviewed for language and instructions by both experts (JSAG and NS)-*stage 3*. Lastly, the questions were pilot-completed and reviewed by 2 improvement science experts within our research Center-*stage 4*. Both experts got a least 9 of the 10 MCQs right; and they offered minor linguistic

modifications, which we made prior to the final inclusion as Part E of our assessment tool-*stage 5*.

All attitudinal (parts A to D), subjective knowledge (part F), and satisfaction with the course (part G) questions were scored on 5-point Likert scales, with higher numbers indicating higher agreement with the statement.

Participating residents also filled in their demographic information, which included personal and residency data as well as questions about the number of QI projects they have carried out to-date, and what training and mentoring in QI they had received to-date.

Data collection and analyses

The full assessment tool was administered before and after the half-day QI course as part of the two Urology Skills Bootcamps in October 2017 (Leeds, UK) and January 2018 (Leicester, UK). Participants' responses between the baseline/pre-course and post-course assessments were matched. To maintain participant anonymity, each assessment pack was assigned a random four-digit code printed on a sticker. Each participant was provided with two stickers and instructed to stick one on their respective pre- and post-course assessment pack. This way, the only person who was aware of an individual sticker code was the participant themselves – hence the research team were kept blinded to the responses at all times. This was done to ensure minimization of social desirability bias in the attitudinal responses; and honesty on the part of the participants.

All data were analyzed quantitatively using inferential statistics through SPSS 21.0 (IBM Corp.) [19]. Cronbach alpha coefficients (α) were used to evaluate the internal consistency (reliability) of the attitudinal (parts A to D) and subjective knowledge (part F) scales of the assessment tool. Alphas can take a value of up to 1.0, with typically acceptable values between 0.70 and 0.90 – lower values indicate scales that include items that are not scored in

a similar manner; higher values indicate scales that include redundant items). Descriptive and inferential analyses were subsequently carried out on the scaled scores, as well as the objective MCQ scores (converted to % correct, out of the 10 MCQs), and the satisfaction data. Non-parametric Wilcoxon matched pairs signed ranks test was used to test for pre-post course differences in the scaled variables and McNemar's test was used to compare the MCQ performance. For all analyses, $p<0.05$ was set as statistically significant.

Free-text comments by the residents on strengths and improvements of the course were analyzed qualitatively following a thematic analysis approach using NVivo11 (QSR International) [20]. The thematic categories we obtained were directly analogous to those reported in Pallari *et al.* [14] the main added scientific value being that the themes were produced through analysis of a larger resident cohort. For simplicity and brevity, we do not report these themes; the detailed thematic table, including residents' written quotes, is available from the corresponding author.

Results

Participants' demographics & prior quality improvement work

One hundred and three residents attended the two Bootcamps; of those, 98 returned completed and usable datasets. Residents were from all 13 Local Education Training Boards (LETBs) across the entire UK, as well as Europe (Table 1 & Figure 1).

Only 24% of residents reported having not done any QI work at all at the time of the training. Approximately three quarters of the residents (72%) reported having been involved in at least one QI project (1 project=29%, 2-3 projects=18%, over 3 projects=18%). Most residents, however, reported not having received formal QI skills training (63%, with a further 11% reporting being unsure about this question). Likewise, most residents reported that they had

not received any mentoring in QI prior to this course (68%). Of those who stated they had had such mentoring, (23%) the mentor was located locally (10%), within their NHS Trust/hospital (5%), nationally through their own professional network (2%), or finally 'elsewhere' (*e.g.*, through informal on the job learning; 4%).

Residents' satisfaction with the training (Kirkpatrick level 1; assessment part G)

Residents reported very high satisfaction levels with content, delivery and overall training (n=76 residents scoring 4 or 5 on the 5-point scale), over 80% of respondents agreed/strongly agreed with individual items; see Figure 2. Two items were scored lower. Firstly, on the delivery aspect, the teaching and learning materials' quality was perceived as low (N=29 residents scoring 4 or 5 on the 5-point scale). Secondly, just over 60% of residents (N=59) agreed or strongly agreed that they would like an opportunity to practice the techniques that they learned on practical QI work.

Residents' attitudes towards QI (Kirkpatrick level 2a; assessment parts A to C)

All the scaled attitudinal assessments are reported in Table 2 (including both scale scores and individual items scores pre and post training). Reliability analyses overall met acceptable statistical standards, with alpha (α) values over the typically acceptable 0.70 cut-off value – except for the pre-course attitudes towards doing QI (α=0.485). We are not clear why this result emerged; and the same scale showed good reliability post-training (α=0.727). Hence, we did not edit the scale for subsequent analyses.

Examination of individual items reveals that residents' attitudes started from a positive baseline: the majority of medians were 4 on the 5-point scales. Despite the high starting point on the scales, all three attitudinal scales showed improvement from baseline to post-training, indicating a more positive view of QI work after the course.

Residents' knowledge of QI (Kirkpatrick level 2b; assessment parts E & F)

Objective knowledge was overall relatively high at baseline (58%) and did not significantly increase post-training (59%, $p>0.05$) (Table 3). Subjective knowledge, which was mapped onto the specific learning objectives of the course, showed statistically significant improvements between baseline and post-training.

Residents' intentions to engage in QI (Kirkpatrick level 3; assessment part D)

Residents' intentions to initiate or engage in a QI project in the 6 months following that course increased significantly (Table 2).

Discussion

Study summary

The study aimed to offer a theory-driven, structured evaluation of the immediate educational effectiveness of the EQUIP training in QI skills in the context of a surgical skills bootcamp. Overall, the study found that the short training module that we have developed based on existing evidence on how to train QI skills and multi-stakeholder inputs (from patients, residents, surgeons, nurses, and education and improvement scientists) offers an educationally feasible intervention with a range of immediate positive impacts on residents. Following the course, we found that urology residents reported significantly enhanced attitudes towards QI and also felt that their knowledge has improved. Their intentions to engage in QI work were reportedly better and their general overview of the course was positive. The course, however, did not impact statistically on objective knowledge on QI. We reflect on this, and other aspects of the study, below.

Reflection on the findings

There are a few areas to highlight from this study. Firstly, the baseline scores across almost the entire assessment battery (which was done in full anonymity to reduce socially desirable responding) were high. Related to this, the majority of the residents reported having been involved in at least one QI project at the time of the training – indeed many of them had done more than that. As the resident sample we had comes from a wide range of regions and residencies, this pattern of findings suggests a positive outlook for QI training in urology programs in the UK. The EQUIP program is thus in synergy with what appears (based on the exposure to QI reported by the residents of this study) to be a spread-out QI culture in urology departments and NHS hospitals.

Secondly, the residents were receptive to the training and found it relevant and useful. A theme that emerged from free-text comments on how to further improve the course (data not reported) was that they require support to undertake QI within their own residencies after the conclusion of the Bootcamps. The request for support post-course corroborates previous findings, which showed that residents suggested offering the course to Attending urologists, such that a body of mentors for them gets developed across UK residency programs [14]. Our interpretation of these findings is that we are looking at a body of early-career residents with an existing understanding of QI and motivation to engage with it, with an adequate support infrastructure.

Lastly, we were surprised regarding the objective knowledge scores, which at baseline were higher than what we would have expected, approaching 60%. We did not expect this, especially in light of the fact that the majority of residents also reported not having had formal training in QI methods. One explanation for this pattern is that the course covered introductory concepts – such that the residents could have been exposed to them as part of

'on the job' training. Most, if not all, NHS Trusts in the UK have a QI team or department, hence coverage of the terminology and methods is perhaps higher than one would have expected by examining the urology curriculum alone. This offers a positive environment for QI work – but biases our assessment, as we had no way to control the exposure to QI that residents had prior to the Bootcamps. A further explanation for this pattern of results is that the residents had pre-course access to a basic QI source (*Quality Improvement Made Simple*, a freely-accessible booklet produced by the UK's Health Foundation [21]). We have no way of ascertaining who had gained access and read the booklet – but this alone could have offered many of the correct answers. Furthermore, the MCQs we used could be improved. Whereas the items come through the well-established IHI, they have not been subjected to validity testing a such; and the wording and response options in some of the items could be improved. Objective knowledge assessment as part of this training requires further development.

Strengths and limitations

This study has limitations typical of training evaluations carried out in the short-term. This was a pre-post training evaluation that lacked controls and randomization, hence causal inference is limited [22]. The study horizon was short, as we carried out all assessments within the same day, hence retention of the taught skills and techniques is unknown. For the same reason, we cannot ascertain how much of the taught materials went into use after the residents returned to their programs post-Bootcamps. The evaluation rested on self-reported metrics and, as discussed above, a higher quality objective knowledge assessment is required for future evaluations. Furthermore, the core QI faculty at these Bootcamps included an Attending with QI expertise (Green), an improvement scientist (Sevdalis) and further faculty facilitators with a good grounding in QI (Pallari, Khadjesari). As not all residencies have improvement science experts, replication of this model could be limited and requires further

development and evaluation. Similarly, integration of the QI training as a 'module' of a residential Bootcamp may be a delivery model that is feasible to some but not all residency programs globally – which represents a further limitation of the scalability of this study.

The study also has strengths. These data extend the initial pilot evaluation that we reported recently [14]. A limitation of that study was that the small resident sample size we had meant that we could not carry out a detailed statistical analysis of residents' attitudes, knowledge and skills improvement from baseline to post-training. This has now been completed. The evaluation was informed by a well-established framework in the form of Kirkpatrick [15], which allows a breakdown of the taught materials' impacts. It also logically allows us to develop the evaluation further, through following up the residents' activity longitudinally once they have completed the Bootcamp and have resumed their clinical duties in their hospitals.

Lastly, the study offers a secondary deliverable in the form of an attitudinal survey (Parts A to D of our assessment instrument), which has been psychometrically evaluated through reliability analysis. This means we now have an additional tool that can be used by colleagues globally to evaluate attitudes towards QI and intentions to engage in it – to the best of our knowledge this is a first such tool for use with surgical residents.

Future research and implementation of the EQUIP program

Following this evaluation, as of 2018 the annual autumn Urology Skills Bootcamp became a mandatory requirement for UK urology residents starting the ST3 year (*i.e.*, going categorically into specialist urologic surgery training). This was done under the aegis of the British Association of Urological Surgeons (BAUS), which is a section of the Royal College of Surgeons of England [23]. The Bootcamp now fully incorporates the QI module (which we delivered again in October 2018 with a short satisfaction survey, which fully replicated the

data reported here). This is an important policy development that means we now have an annual cohort of 50 urology residents who will receive our standardized QI module. With an estimated trainee population of 300-350 in the UK, this means that in the coming years we will have offered the course to all urology residents. This development offers a strong scale-up strategy [24], so that UK urologists are routinely exposed to QI skills training.

The need, however, remains to develop a cadre of senior Attending urologist mentors for the residents, who will have a basic understanding and interest in supporting residents' QI work. This has been expressly articulated as a research need in the studies we have carried out to-date and also by the EQUIP Steering Group. We are now developing a train-the-trainers model [25], which will incorporate similar training for urology Attendings. We are seeking to determine whether the training could be offered nationally or regionally; and how regularly, to allow adequate numbers of Attendings to take part. We are further seeking to establish what the educational efficacy of such a course would be (in a similar manner to what we reported here).

A parallel arm of the EQUIP development will include a facilitated forum for residents to have access to completed QI projects (as exemplars), as well as ongoing QI projects which will be open for them to contribute to. The specification of such a forum (likely web-hosted) and its delivery remain to be designed, piloted and evaluated. Such a forum will address the practical need for residents to enroll themselves into ongoing QI work; or to initiate their own and share it with their peers. It will also allow us to achieve the longitudinal evaluation of how much QI work and of what impact the trained residents carry out post-course [26] – hence address an ongoing limitation of the studies that we have reported to-date. Metrics of what constitutes an educationally and clinically 'meaningful' QI project for a resident to be involved in need, remains to be agreed. Large numbers of projects undertaken by residents is not in itself a metric of success: improvement scientists recently warned about the caveat of

excessive ‘project work’ following QI training, *i.e.* the proliferation of large number but low impact QI projects [27]. The surgical education and improvement community should remain conscious of these challenges but also optimistic that they can be overcome to improve resident education and generate improvements in perioperative care.

Conclusions

The study supports feasibility and immediate educational impact of our practical QI curriculum for UK urology residents; and offers evidence on the psychometric suitability of an attitudinal assessment battery for QI skills. Objective knowledge assessment needs further development. Ongoing research should focus on evaluating the impact of the curriculum in residents initiating QI projects; and large-scale implementability in the UK.

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List of Tables & Figures

Table 1. Participants demographic information

		N	%
Gender	**Female**	29	30
	Male	69	70
Training region	Midlands and East of England	27	28
	North England	21	21
	London and South East	18	18
	South England	8	8
	Rest of the UK	15	15
	Scotland	8	8
	Wales	6	6
	Northern Ireland	1	1
	Republic of Ireland	5	5
	Rest of Europe	3	3
	Rest of the world	1	1
Resident level	**Core training (CT) level**	**31**	**32**
	CT1	1	1
	CT2	29	30
	CT4	1	1
	Specialist training (ST) level	**52**	**53**
	ST3	49	50
	ST4	3	3
	Non-specified (other ST level & clinical fellows)	**15**	**15**

Table 2. Standardized pre-post training assessment of residents' attitudes towards quality improvement (parts A-C), intentions to engage in quality improvement work (part D), and knowledge of quality improvement (parts E-F)

Standardised evaluation questionnaire: parts A to E & individual items		α	PRE (N=96-98)			α	POST (N=93-94)			p
			Mean	Median	SD		Mean	Median	SD	
Part A: Attitudes towards doing QI	1. Carrying out a QI project would be: difficult (1) … easy (5)		3.13	3.00	0.981		3.57	4.00	0.849	<0.0001
	2. [as above]: worthless (1) … worthwhile (5)		3.87	4.00	0.959		4.39	5.00	0.736	<0.0001
	3. [as above]: not expected of me (1) … expected of me (5)		3.84	4.00	1.155		4.00	4.00	0.939	0.260
	4. [as above]: unhelpful to the service (1) … helpful to the service (5)		3.83	4.00	1.016		4.46	5.00	0.634	<0.0001
	Subscale totals	**0.485**	**3.67**	**3.00**	**0.646**	**0.727**	**4.11**	**4.00**	**0.591**	**<0.0001**
Part B: Attitudes towards QI at work	1. By concentrating on addressing causes of poor quality I can contribute to improving patient care and safety		4.14	4.00	0.674		4.35	4.00	0.581	0.009
	2. If I keep reflecting on quality, I can improve services for urological patients		4.07	4.00	0.736		4.31	4.00	0.640	0.002
	3. Acknowledging and dealing with quality problems where I work is an important part of my job		3.59	4.00	0.983		4.10	4.00	0.734	<0.0001
	4. It is appropriate to challenge well-established practices if they compromise quality of care		4.44	4.00	0.593		4.40	4.00	0.574	0.580
	5. Being vocal about improving services is generally acceptable at my place of work		3.68	4.00	0.880		3.92	4.00	0.741	0.014
	6. Suggesting an area for quality improvement at my place of work would be met with support and encouragement from hospital management		3.45	3.00	1.006		3.78	4.00	0.895	0.001
	7. Suggesting an area for quality improvement at my training rotation would be met with encouragement and support by my supervisors		3.98	4.00	0.837		4.11	4.00	0.679	0.192

Standardised evaluation questionnaire: parts A to E & individual items		α	PRE (N=96-98)			α	POST (N=93-94)			p
	(clinical and educational)									
	8. Quality improvement is only applicable to poor services		4.17	4.00	0.862		4.07	4.00	0.997	0.602
	Subscale totals	**0.731**	**3.80**	**3.00**	**0.511**	**0.823**	**4.00**	**4.00**	**0.495**	**<0.0001**
Part C: Ability to influence QI at work	1. It is easier to find someone to blame rather than focus on the causes of poor quality care		3.16	3.00	1.233		3.17	3.00	1.179	0.771
	2. I feel able to raise concerns about poor quality of care in the service I work		3.51	4.00	0.803		3.80	4.00	0.770	0.001
	3. I feel my voice is heard when quality improvement projects are chosen and prioritized		3.16	3.00	0.850		3.52	4.00	0.864	<0.0001
	4. I feel able to lead a quality improvement project or initiative		3.50	4.00	1.008		3.91	4.00	0.713	<0.0001
	5. I feel able to contribute to a quality improvement project or initiative led by someone else		4.10	4.00	0.696		4.29	4.00	0.580	0.018
	6 I believe that being involved in a quality improvement project or initiative helps improve quality of care		4.07	4.00	0.750		4.31	4.00	0.605	0.001
	7. I feel able to talk about quality gaps in the care of my own patients		3.67	4.00	0.883		4.06	4.00	0.700	0.001
	8. I feel able to act on concerns or suggestions for improvement raised by patients in my own care		3.66	4.00	0.873		4.02	4.00	0.688	<0.0001
	Subscale totals	**0.748**	**3.65**	**3.00**	**0.482**	**0.798**	**3.87**	**3.00**	**0.473**	**<0.0001**
Part D: Intentions to engage in QI	1. I will actively find out about quality improvement projects/initiatives currently ongoing		3.63	4.00	0.913		4.04	4.00	0.961	<0.0001
	2. I intend to clearly communicate my concerns regarding quality of care to members of my team or service		3.88	4.00	0.662		4.14	4.00	0.697	<0.0001
	3. I plan to support trainee colleagues or seniors involved in a quality improvement project or initiative		4.02	4.00	0.658		4.26	4.00	0.702	<0.0001

Standardised evaluation questionnaire: parts A to E & individual items		α	PRE (N=96-98)			α	POST (N=93-94)			p
	4. I plan to engage directly with patients to identify opportunities for improvement in our service		3.32	3.00	0.980		3.90	4.00	0.917	0.001
	5. I plan to engage directly with nurses to identify opportunities for improvement in our services		3.29	3.00	0.984		3.90	4.00	0.88	<0.0001
	6. I plan to engage directly with hospital management to identify opportunities for improvement in our services		3.07	3.00	1.028		3.79	4.00	0.960	<0.0001
	7. I will intervene whenever I think a patient may be exposed to poor quality care		4.04	4.00	0.798		4.35	4.00	0.617	<0.0001
	8. I plan to make a point of learning from others' quality improvement work		3.99	4.00	0.780		4.34	4.00	0.648	<0.0001
	Subscale totals	**0.887**	**3.65**	**3.00**	**0.643**	**0.917**	**4.09**	**4.00**	**0.642**	**<0.0001**
Part F: Subjective knowledge	1. Different elements of 'high quality care'		2.88	3.00	0.807		3.79	4.00	0.701	<0.0001
	2. Different sources of information regarding level of quality in patient care (including quality problems)		2.61	3.00	0.836		3.75	4.00	0.721	<0.0001
	3. How to set up a quality improvement project from scratch		2.56	2.00	1.030		3.93	4.00	0.707	<0.0001
	4. What the 'Plan-Do-Study-Act' method is		2.47	2.00	1.146		4.19	4.00	0.660	<0.0001
	5. Who the 'stakeholders' of a quality improvement initiative are		2.44	2.00	1.060		4.03	4.00	0.754	<0.0001
	6. What improvement outcomes can include		2.76	3.00	0.910		4.04	4.00	0.624	<0.0001
	7. How to evaluate whether a quality improvement project is actually improving quality of care		2.84	3.00	0.909		3.99	4.00	0.577	<0.0001
	8. Skills I need to lead and deliver a quality improvement project successfully		2.86	3.00	1.001		4.03	4.00	0.663	<0.0001
	Subscale totals	**0.904**	**2.71**	**2.00**	**0.787**	**0.924**	**3.97**	**4.00**	**0.546**	**<0.0001**

Standardised evaluation questionnaire: parts A to E & individual items		α	PRE (N=96-98)		α	POST (N=93-94)		p
Part E: Objective knowledge	**Subscale totals**		**58%**	**54-61%**		**59%**	**56-62%**	**0.554**

Notes: *Part A instructions*: Carrying out a Quality Improvement project would be….; *Part F instructions*: circle the number that best describes the level of knowledge that you feel you have for each item (items F1 to F8); *Part E sample size* for both pre- and post-training assessments N=87; *Part E statistics* reported include % correct answers and 95% confidence intervals; *alphas* reported represent Cronbach Alpha internal consistency subscale reliability coefficients; *p-levels* generated by Wilcoxon (Parts A to D; for scales) and McNemar (Part E; for MCQs) paired samples tests throughout. We have also carried out the statistical analyses on the subgroup of residents who reported having had no formal QI training at the time of the Bootcamps. All the results remained similar – *i.e.* in the same direction pre-post training; showing the same level of post-training improvement for the attitudinal and skills scales, and no improvement on the objective knowledge MCQs.

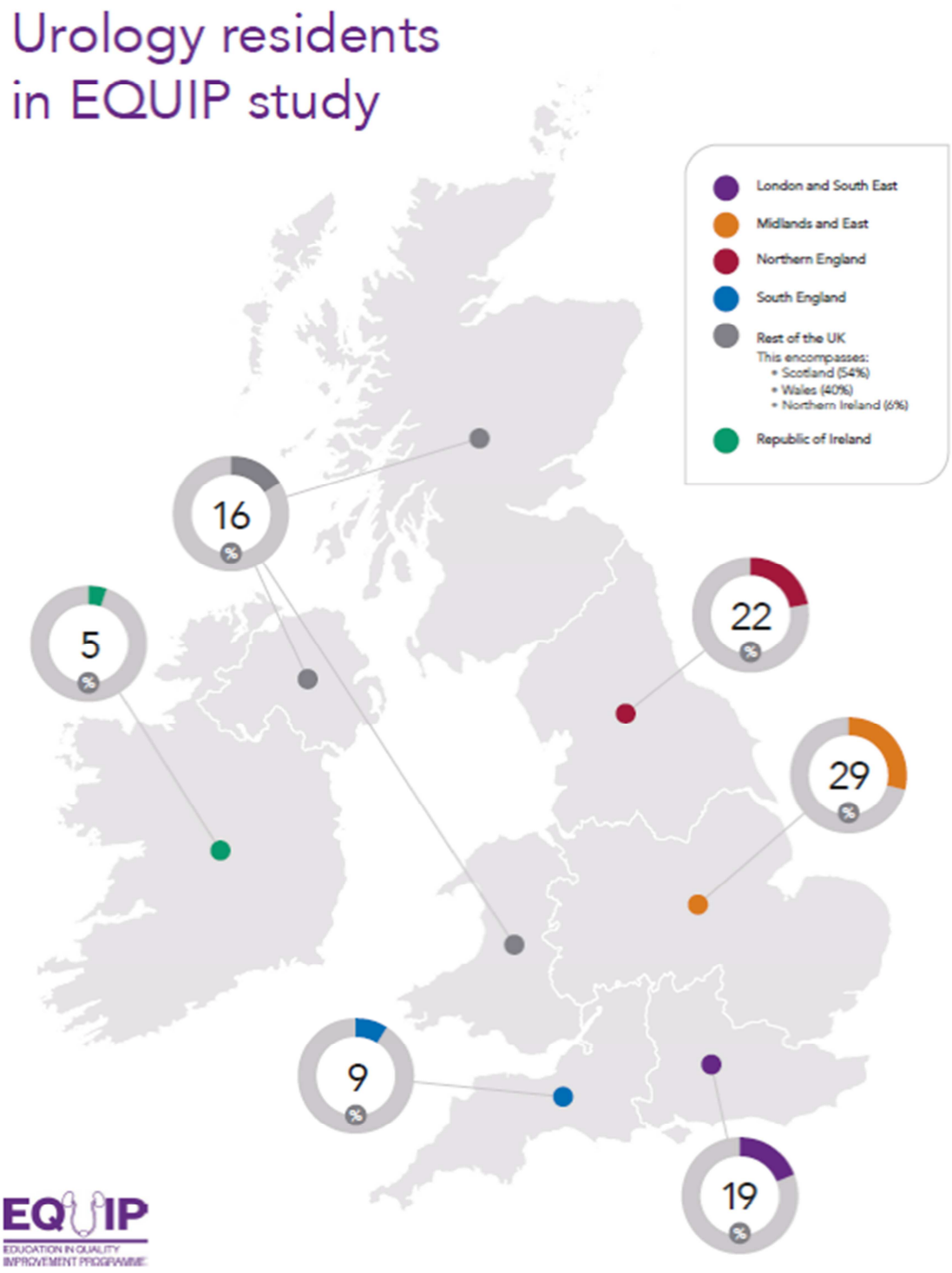

Figure 1. Participating residents visually mapped across the UK urologic surgery training regions (N=98)

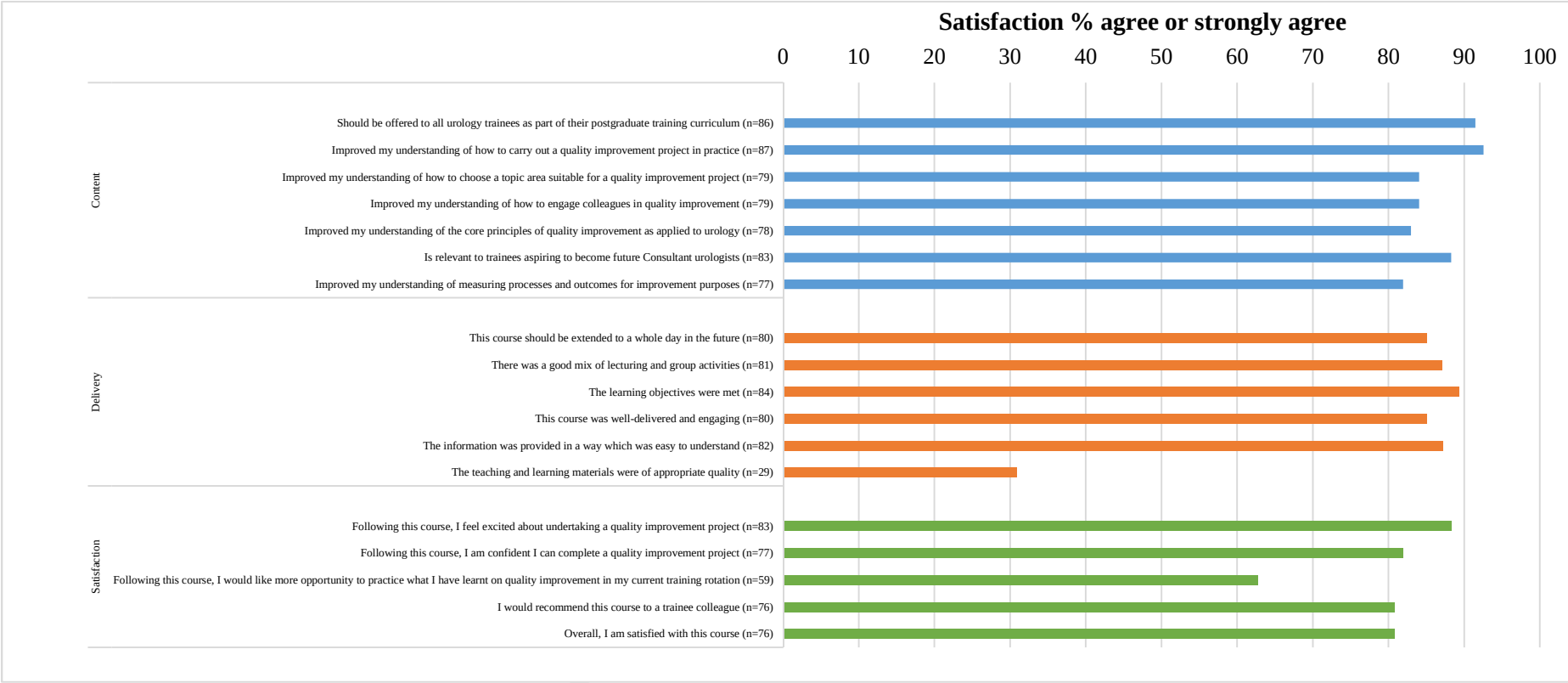

Figure 2. Residents' self-reported satisfaction with the quality improvement course (N=98, 1-5 Likert scales throughout)

Appendix

Assessment Part E: Objective knowledge multiple choice questions

1. **The 'Model for Improvement'…:**

(A) Is the best approach to plan a quality improvement project

(B) Can only truly be generalized to USA settings

(C) Offers a structured and logical approach to designing a quality improvement project

(D) Allows the development of statistical models of how to improve patient outcomes

2. **The four steps for testing whether change results in improvement are:**

(A) Plan-Do-Study-Act

(B) Innovation-Pilot-Study-Act

(C) Plan-Implement-Pilot-Spread

(D) Innovation-Pilot-Implementation-Spread

3. **When implementing a quality improvement project one reason <u>not</u> to use a RCT is that:**

(A) RCTs require very large samples to be done well

(B) The results of RCTs are only truly generalizable to academic settings

(C) RCTs are too complex and time consuming to do

(D) The bias control within RCTs does not allow adjusting improvement ideas as the project progresses

(E) Both C and D

4. **Why might you consider collecting 'balancing' measures?**

(A) To show that you met your project aims

(B) To make sure you are able to publish your study

(C) To demonstrate to your hospital board that you were justified in using resources for this project

(D) To make sure you did not unintentionally damage other aspects of the unit's work

5. **A urology department plans to improve patient flow in their clinics. They carry out a small test of change (changing their appointments system) with 6 patients on a Tuesday morning. What's the next thing the improvement team should do?**

(A) Change their measures

(B) Measure to see if the change led to improvement

(C) Report their results to the clinic leadership and prepare a briefing document for the Trust board

(D) Implement the new appointment system to the entire clinic for 6 months and re-evaluate

6. **Which of the following is an effective measurement technique for improvement?**

(A) Always strive for bias-free data

(B) Use quantitative and qualitative data

(C) Always ensure staff-members collecting data are trained how to do so

(D) All of the above

7. **Which one of the statements below is a recommended starting point to plan a quality improvement project?**

(A) Discussing improvement priorities with your Consultant

(B) Defining what you are trying to accomplish

(C) Defining service priorities with the audit team

(D) Deciding what improvement measures you will use

8. **Which of the following is a key question of the 'Model for Improvement'?**

(A) How will we spread the idea for change?

(B) What are we going to do if the test of change fails?

(C) How will we know whether a change is an improvement?

(D) All of the above

9. In assembling an improvement team, it is helpful to:

(A) Choose people who are unlikely to disagree with one another

(B) Have a mix of different types of people

(C) Have everyone on the team exhibit similar personalities to avoid conflict and optimise outcomes

(D) All of the above

10. Why should you consider collecting a variety of measures when undertaking an improvement?

(A) It makes the project more publishable

(B) A single measure may not be enough to determine the impact of a change on the system

(C) All improvement projects are complex, so they require multiple measures

(D) All of the above

Highlights

- Surgical residents globally need to enhance their quality improvement (QI) skills
- We developed and evaluated a practical QI training course for surgery residents
- The training improved residents' attitudes regarding QI and partly their knowledge
- Longitudinal evaluation of the training and UK scale-up is underway

Conflicts of interest: NS is the director of London Safety & Training Solutions ltd, which provides training and advisory services to healthcare organisations and training programs globally. The other authors report no conflicts of interest.