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Development and implementation of a national quality improvement skills curriculum for urology residents in the United Kingdom: A prospective multi-method, multi-center study

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ABSTRACT

Background: Surgical quality improvement (QI) is a global priority. We report the design and proof-of concept testing of a QI skills curriculum for urology residents.
Methods: 'Umbrella review' of QI curricula (*Phase-1*); development of draft QI curriculum (*Phase-2*); curriculum review by Steering Committee of urologists (Attendings & Residents), QI and medical education experts and patients (*Phase-3*); proof-of-concept testing (*Phase-4*).
Results: Phase-1: Six systematic reviews were identified of 4332 search hits. Most curricula are developed/evaluated in the USA; use mixed teaching methods (incl. didactic, QI exercises & self-reflection); and introduce core QI techniques (e.g., Plan-Do-Study-Act). *Phase-2*: curriculum drafted. *Phase-3*: the curriculum was judged to represent state-of-the-art, relevant QI training. Stronger patient involvement element was incorporated. *Phase-4*: the curriculum was delivered to 43 urology residents. The delivery was feasible; the curriculum implementable; and a knowledge-skills-attitudes evaluation approach successful.
Conclusion: We have developed a practical QI curriculum, for further evaluation and national implementation.

Introduction

Improving the quality of surgical care is a global priority. Quality improvement (QI) is defined as *'better patient experience and outcomes achieved through changing provider behavior and organization through using systematic change methods and strategies'*.[1] In recent years, significant QI efforts have been implemented internationally to improve healthcare (e.g., the Healthcare Quality Improvement Partnership in the UK: www.hqip.org.uk). Such efforts have been driven by patient advocacy, clinical leaders, and policy-making. QI has been developing rapidly as a burgeoning multidisciplinary field, where methods from manufacturing and behavioural sciences have been applied to improve care processes and delivery; improve patient outcomes; and improve patient experiences of care.[2,3]

One requirement for successful clinical QI is adequate capability in the form of knowledge of and skills in QI theory and methods. In England, the need to develop capabilities in delivering QI is clearly articulated by the National Health Service (NHS), which explicitly identified the need to support clinical leaders through education and training in QI methods.[4] Health Education England (HEE) aims to ensure that the healthcare workforce is equipped to deliver health improvement to patients and the public.[5] In surgery, QI skills are addressed through the Intercollegiate Surgical Curriculum Program (ISCP: www.iscp.ac.uk). In the USA, a similar trend has appeared, with the development, for instance, of large-scale improvement programs with standardized training and metrics, e.g. the National Surgical Quality Improvement Program (NSQIP: www.facs.org/quality-programs/acs-nsqip). This includes a Quality In-Training Initiative (QITI) for surgical residents.[6] Both NSQUIP and

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QITI are supported by the American College of Surgeons and increasingly evidenced.[7–9]

Whilst adequate capability in QI is a necessary, indeed logical, step in enabling QI to take place, it should not be taken for granted. Significant gaps remain in QI skills and knowledge across all of healthcare. Evidence suggests that lack of knowledge and expertise amongst physicians undermines efforts to improve patient safety, a fundamental dimension of quality.[10,11] Lack of expertise means that QI methods can be poorly applied, with poor results. A systematic review of one of the most-quoted QI methods, the 'Plan-Do-Study-Act' (PDSA) method, found published applications of PDSA technically deficient.[12] Poor application of an effective method is likely to lead to no QI, waste of financial and human resources or even detrimental effects. Within the ISCP, QI skills are covered; but there is no clear implementation and delivery plan, hence training programs are left to devise their own training provision to address these skills.

We report the early design, validation and proof-of concept testing of a novel QI skills curriculum for urology residents in the UK. The study forms the early part of a research program aimed at addressing some of the above gaps in surgery, the 'Education in Quality Improvement Program' (EQUIP).

Materials and methods

The EQUIP research program: EQUIP is a prospective multi-phase, multi-method, multi-center research program, grounded in improvement, education and implementation sciences and using theoretical and measurement frameworks from all of them. The program aims to develop an evidence-based, scalable means to impart QI knowledge and skills to urology residents nationally in the UK (as an exemplar specialty, for later spread to other surgical specialties); such that, in turn, they undertake better-designed QI projects within their residency programs; which will ultimately improve patient care through resident effort. EQUIP is thus a hybrid surgical education and QI research program, aiming to bridge the existing gap between the two fields. In designing a QI curriculum for national implementation, the EQUIP program is informed by the Kern framework for curriculum development.[13] In summary, the Kern 6-step approach as applied to EQUIP to-date is as follows (the approach will evolve as EQUIP progresses):

1. *Problem identification & general needs assessment*: this is evidenced by the lack of QI curriculum for national implementation in urological/surgical training (as reviewed in the Introduction).
2. *Targeted needs assessment*: as part of EQUIP we are using interview and focus group methodology to carry out a national needs assessment of urology training program directors; Attendings; residents; and clinical and opinion leaders of the British Association of Urological Surgeons, BAUS. This will be completed within 2018.
3. *Goals and objectives*: the EQUIP goals are described above. The QI curriculum we report here has a set of specific learning objectives (Phase 2), which were derived from early assessments of need (as above); stakeholder inputs (Phase 3); and pragmatism (i.e. feasibility of delivery; Phases 3–4).
4. *Educational strategies*: these are explored through this study (Phase 1)
5. *Implementation*: this study offers a pilot implementation analysis (Phase 4)
6. *Evaluation and feedback*: this study reports pilot satisfaction data (Phase 4)

All study phases are described under 'study procedure' below.

Study design: This multi-method study forms an early phase of the EQUIP program, including evidence review methodology (Phase 1), stakeholder-driven curriculum design (Phases 2–3), and prospective proof-of-concept testing (Phase 4; see Study Procedure).

Participants and setting: The study took place within urology as an early adopter specialty of the EQUIP program. Participants of the study included a multidisciplinary mix of expert stakeholders (Phase 3) and urology trainees from across the UK (Phase 4; see Study Procedure).

Study procedure: the study proceeded in a number of interrelated phases, from January to December 2017) – as follows:

Phase 1: systematic evidence review and synthesis (Jan–Jun 2017)

We conducted an 'umbrella review' of evidence (i.e., review of reviews) on QI curricula used in medicine and surgery. The review aimed to identify systematic reviews on QI education within medicine/healthcare with a comparative evaluation component. The goal of this phase was to offer a solid evidence basis on which to formulate a curriculum. The approach of using an evidence review as part of curriculum development has been used before within surgery, both for entire areas of surgical care as well as for specific procedures. For example, evidence review has been used in the development of training curricula for residents for surgical ward-based care[14]; and for laparoscopic cholecystectomy.[15] Such reviews allow identification of both content and delivery methods and also assessment tools as evidenced in the existing literature. In our study, the review focused on what QI topic areas are taught; and curriculum delivery methods (e.g., lecturing, workshops, coaching, etc.). The review was undertaken using a systematic search strategy, without any time or language restrictions; see Appendix 1 for the search strategy.

Phase 2: QI curriculum development (Apr–May 2017)

Based on the review results, we developed a draft basic QI curriculum. The specific learning objectives of the QI curriculum were to familiarise residents with basic QI concepts; cover sources of information available to them on the quality of their services; facilitate reflection on how best to prioritise areas for improvement; make them aware of the 'Plan-Do-Study-Act' QI method; enable them to identify stakeholders for a QI project they are planning; enable them to describe the leadership skills required for effective QI; and energize them to lead and/or contribute to a QI project post-training.

The goal of this phase was to use best available evidence to inform the content and delivery methods for our curriculum; whilst we also aimed to keep the curriculum practically deliverable. We sought advice and recommendations from BAUS and from national urologic 'bootcamp' training program leaders (see Phase 4) regarding what is implementable at scale. Based on this advice, we designed a half-day introductory practical QI training session for urology residents.

Phase 3: QI curriculum stakeholder review (May–Sep 2017)

We submitted the curriculum for review by a senior Steering Committee, consisting of urologists (Attendings & Residents), experts in QI and medical education, patients, and 3rd sector representatives (see Appendix 2 for details on committee membership). Clinically, the Steering Committee represented the two national bodies of urologic care, the British Association of Urological Surgeons and the British Association of Urological Nurses – as QI is inherently multidisciplinary. Through this phase of the research we aimed to establish the 'evaluability' of the training, for further

large-scale evaluation. Evaluability is defined as a '*pre-evaluation activity designed to maximize the chances that any subsequent evaluation of programs, practices, or policies will result in useful information*'.[16] This is an important element of the EQUIP program, as the ultimate aim of it is national scale-up of the QI curriculum within the UK and capability to deliver training to all urology residents.

Steering group meetings (2hrs each) took place in May and September 2017 (for input into the curriculum and evaluation approach) and in December 2017 (for reflection and input into the proof-of-concept testing of Phase 4) and were attended in person or virtually; all study authors were also in attendance at these meetings. Further to the meetings, Steering Committee members offered recommendations virtually (through emails) throughout the study period. All stakeholder commentary on the curriculum was scribed by the first author (EP) in the form of formal meeting notes (these covered both live and virtual discussion); these were subsequently reviewed by all authors and shared with the stakeholders in written format of meeting minutes with all stakeholders (for transparency), with actions tracked and reviewed iteratively between meetings, to ensure the comments were implemented.

Phase 4: QI curriculum proof-of-concept trialling (Oct–Dec 2017)

We delivered the curriculum to a cohort of urology residents as an early 'proof-of-concept' and feasibility evaluation. The QI training was piloted as part of the annual Urology Simulation National Bootcamp (Leeds (UK), October 2017).[17] The QI training formed a half-day session of the 5-day bootcamp and was delivered by all authors – including lectures by NS (senior implementation and improvement scientist) and JSAG (Attending urologist); and workshop facilitation by NS, JSAG, EP (engineer, research assistant in improvement science) and ZK (postdoctoral-level improvement scientist).

Informed by our Phase 3 expert stakeholders and in light of what was optimal within the timeframe of delivery (half-day) we designed a pre-post training evaluation based on the well-established Kirkpatrick framework for evaluation of training interventions.[18] This approach was further designed to fit with the overall Bootcamp evaluation strategy: satisfaction data are elicited for the entire Bootcamp; supplemented with focused in-depth self-contained evaluations of specific sessions within the Bootcamp (e.g., see recent evaluation of residents' knowledge of endoscopic instruments used in urologic surgery, carried out within the bootcamp).[19] We assessed residents' knowledge (through multiple choice questions adapted from the bank of questions available from the Institute for Healthcare Improvement (IHI: www.ihi.org); self-reported skills in carrying out a QI project; attitudes towards QI (through adapted multi-item scales previously validated for use in assessing junior residents' attitudes to patient safety(10); and satisfaction with the content and delivery of the curriculum (assessed via items scored on 1–5 Likert scales, with higher scores indicating higher satisfaction; and free-text comments).

Analysis: We report the findings of the evidence review and synthesis in evidence tables; the curriculum outline, as revised and delivered; descriptive statistics of the residents' satisfaction with the curriculum (so Kirkpatrick level 1 data regarding how the training was experienced by the learners); simple thematic analysis

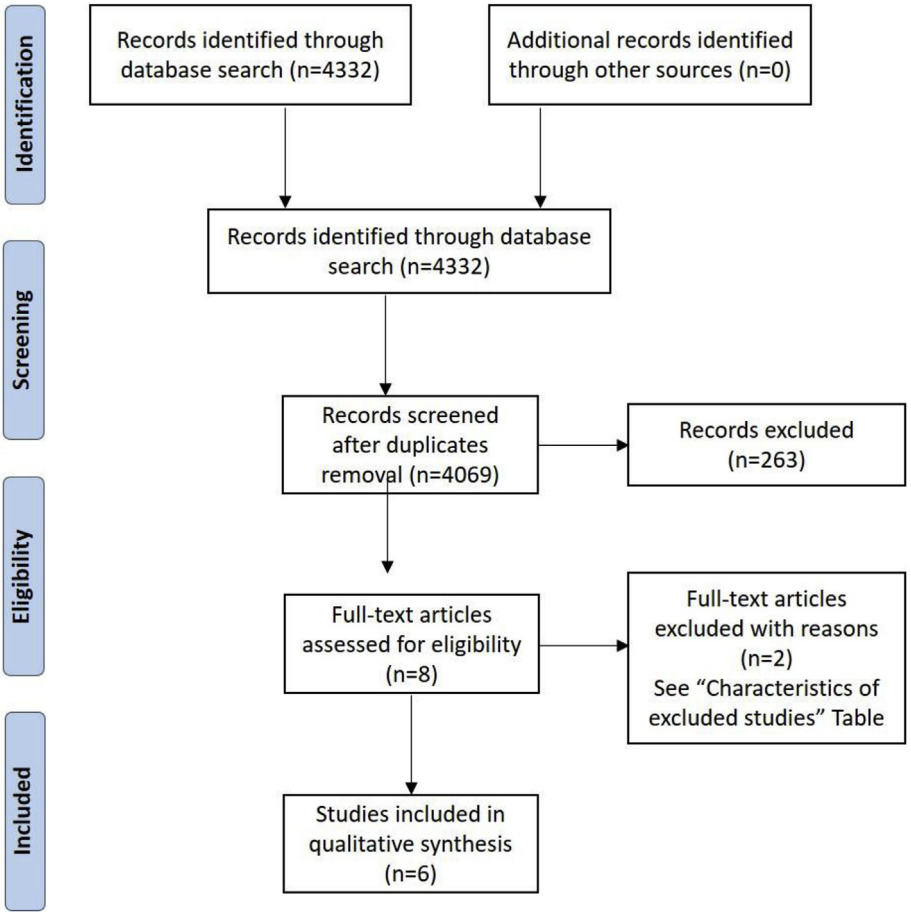


Fig. 1. Prisma flowchart of articles through the evidence review process.

Table 1
Summary of the scope of included systematic reviews (Phase 1).

Source & year	Country	Clinical context	Aim	Search strategy
Boonyasai et al. 2007[20]	USA 33 studies (85%) and other 7 studies (18%-French, Canadian, Spanish and Swedish settings)	Ambulatory practice 22 (56%); inpatient/nursing home 10 (26%), educational setting 4 (10%) and mixed-clinical setting 3 (8%)	To evaluate the effectiveness of QI curricula for clinicians and to determine whether teaching methods influence the effectiveness of such curricula.	4 databases (MEDLINE, EMBASE, CINAHL, ERIC), English-language only from 1980 to 2007
Windish et al. 2009[21]	USA 17 studies (94.5%) and other 1 study (5.5%)	Not stated	To determine whether QI curricula for medical students and residents adhere to guidelines for teaching specific domains of practice-based learning and improvement and established standards for assessing the quality of medical education research	4 databases (MEDLINE, EMBASE, CINAHL, ERIC), English-language only from 1980 to 2008
Wong et al. 2010[22]	USA 38 studies (93%); Canada 2 studies (5%) and UK 1 study (2%)	Ambulatory care 18 (44%); classroom/non-clinical setting 23 (56%); In-patient hospital 7 (17%); mixed clinical setting 3 (7%); distance learning 2 (5%) and not stated 2 (5%)	To review QI curricula directed at medical students or residents[1]: to describe educational content and teaching methods,[2] assess the learning outcomes achieved, and[3] determine factors that promote or limit successful implementation of these curricula	3 databases (MEDLINE, EMBASE, HealthSTAR), English-language only from 2000 to 2009
Medbery et al. 2014[23]	USA only 50 studies	Surgery 12 (24%) Non-surgery 24 (48%): primary care 20 (40%); radiology 2 (4%); critical care 1 (2%); ER 1 (2%). Generic GME 14 (28%)	To identify a surgical curriculum for graduate medical education	3 databases (EMBASE, PubMed, Google Scholar), English-language only from 2000 to 2013
Jones et al. 2015[24]	39 studies (countries not reported)	Outpatient (primary care 15 (38%); psychiatry 2 (5%) and paediatrics 1 (2.5%) and inpatient (general medical unit 2 (5%); adult intensive care unit 2 (5%); Neonatal intensive care unit 1 (2.5%) paediatric emergency department 1 (2.5%) and radiology 1 (2.5%)	To define key characteristics of successful QI curricula in medical education	3 databases (MEDLINE, Cochrane Library, Web of Science) 2000–2013, no language restriction
Starr et al. 2016[25]	Total of 99 studies: USA 85%; non-USA 13); both 1%	Educational (50%); Inpatient (19%); Outpatient (33%); mixed inpatient/outpatient (17%)	To evaluate the prevalence of QI curricula with clinical measures and their association with several curricular features	4 databases (MEDLINE, EMBASE, CINAHL, ERIC) with no language restrictions, 2007–2013

of free-text comments; and feasibility/evaluability analysis.

Results

Phase 1

Six relevant systematic reviews that fully met our inclusion criteria were identified from 4332 search hits (see Fig. 1). The included reviews offer a view of a total of 287 QI education studies in the period 1980–2013. Numerous study designs and metrics were reported across reviews. Importantly for our purposes, most reported curricula and training interventions were developed and evaluated in the USA; used mixed teaching methods (incl. didactic, workshops, QI exercises & self-reflection); and introduced core QI techniques, of which the 'Plan-Do-Study-Act approach was consistently prominent in coverage (Tables 1 and 2).

Phases 2 & 3

We developed a draft curriculum (Phase 2), taking into account the review findings (Fig. 2). For delivery, we chose a combination of didactic teaching to introduce key concepts; and hands-on facilitated workshops for delegates to acquire some practical experience of designing a QI project. Based on the review findings, and also input from our stakeholder groups through the Steering Committee, we chose to introduce the IHI's Model for Improvement with the associated PDSA methodology: this is an approach commonly used across NHS hospitals and services and thus potentially scalable as the trainees are likely to be exposed to it through multiple sources and multiple times during their training. We further introduced to residents, sources of potential need/ideas for QI projects and basic implementation science principles, such that the projects they design have an embedded sustainability element. We included a real example of a QI project led by a urology resident that was subsequently published, as a case-study trainee delegates would find relevant and achievable. The workshop element of the curriculum was designed across four thematic areas: (i) prioritization and planning of QI projects, (ii) leadership skills required and stakeholder engagement, (iii) measurement to show impact and improvement, and (iv) QI project implementation and sustainability. Of note, the workshop was focused on a urology case example (improving the management of a complex multimorbid patient) for the residents to work up an improvement approach in the context of their own specialty. However, this is intentionally a fully editable element of the training, such that the overall curriculum can be used across any surgical specialty.

Our initial draft curriculum was iteratively reviewed and commented upon by the Steering Group (Phase 3), who found the content and delivery mechanisms consistent with best evidence and relevant to resident audiences. Through the review process we incorporated stronger patient and public involvement element in the training. Further feedback reflected the need to evaluate post-training levels of QI activity that the trained residents lead or contribute to; and the quality of that activity – i.e., the quality of the QI projects the trainees lead and/or deliver. This was thought of a major milestone of the EQUIP project, such that we develop a formal appraisal system for residents' projects, which will allow their educational supervisors (Attendings) to formally approve and 'sign-off' the projects. This is a key implementation requirement, as trainees are required to deliver at least one approved QI project (and also an audit and a closed-loop audit) as part of their specialist training. The consensual stakeholder view on this was that it should be evaluated as a further step of the EQUIP program, following initial proof-of-concept testing.

The draft curriculum was further reviewed by the program directors (Attending urologists, N = 2) of the National Urology Simulation Bootcamp, an annual residential course for early career urology residents, to establish feasibility of delivery as part of the

Table 2
Summary of the characteristics and key findings of the included systematic reviews (Phase 1).

Source & year	Study type	N Studies and Participants	Characteristics of participants	Intervention	Teaching methods	Educational content	Reported outcomes
Boonyasai et al., 2007	Randomized controlled trial 8 (21%)/non-randomized controlled trial 14 (36%)/pre-post time series 17 (44%)	39 studies 688 + participants	Trainees 10 (11%)/ non-trainees 81 (89%- physicians, paediatricians, nurses, admin staff, surgeons, anaesthesiologists, engineers, technicians and scientists)	Curriculum that teaches QI theory to clinicians with comparative evaluation	Printed materials 15 (38%); self-reflection 2 (5%); lectures 24 (36%); QI project participation 34 (90%); audio-visual or web-based materials 4 (10%); seminars 20 (8%); workshops 6 (20%); 1:1 mentoring 5 (10%)	Customer knowledge 6 (15%); measurement and variation 21 (54%), leading, following and making change 39 (100%); developing new, locally useful knowledge 39 (100%); healthcare as a system 11 (28%); collaboration 26 (67%); social context and accountability 5 (13%); specialised and professional knowledge 22 (56%)	Participation 11 (28%); Attitudes 6 (15%); Knowledge 10 (26%); Skills/behavior 6 (15%); Process 27 (69%) and patient 17 (44%)
Windish et al., 2009	Single group 5 (28%); single group pre- and post-test 9 (50%); non-randomized 2 groups 3 (17%) and randomized controlled trial 1 (5.5%)	18 studies 1493 participants	Medical students 5 (28%); Internal medicine residents 5 (28%); family medicine residents 4 (22%), paediatric residents 1 (5.5%); surgery residents 1 (5.5%); internal medicine and paediatric students 1 (5.5%) and internal medicine, family medicine, preventive medicine fellows and nursing students 1 (5.5%)	Curriculum for teaching QI theory to medical students or residents with an evaluation	Small-group work 17 (94%); lectures 14 (78%); brainstorming 4 (22%); audio/visual material 3 (17%); mentoring 2 (11%); clinical practice combination 8 (44%)	Single Root Cause Analysis (11%); Plan-Do-Study-Act cycle (50%); self-study (11%); lectures (78%); small-groups (94%); 1:1 mentoring (17%); web-based (11%); conceptual QI models (59%); role-playing (5.5%); video (11%); brainstorming (22%); learners teaching others (17%); audit or change improvement (22%); guideline development or process evaluation (11%), case-studies (5.5%); self-reflection (5.5%), self-study (17%).	Attitude (82%); participation (59%); knowledge (47%); behavior/process (41%); patient/ healthcare outcomes (18%)
Wong et al., 2010	Pre/post 11 (42%); non-randomized controlled 5 (19%); randomized controlled 2 (8%)	27 studies 2645 + participants	Medical students 14 (34%); residents 24 (59%); both 3 (7%)	Curriculum includes QI concepts with specific teaching methods	Didactic lectures 31 (76%); small-group discussion 16 (39%); case discussion 12 (29%); experiential learning 33 (80%) and web-based module 6 (15%)	Quality of care 15 (37%); Continuous Quality Improvement e.g. PDSA 21 (51%); audit and feedback 7 (17%); process mapping 7 (17%) and change management 9 (22%)	satisfaction (51%); attitudes (81%); knowledge acquisition (85%); behavioural change (18.5%); changes in clinical practice (48%) and benefits to patients (7%)
Medbery et al., 2014	Curriculum blueprints 31 (62%); opinion papers 9 (18%); consensus statements 3 (6%); systematic reviews 5 (10%); evaluation tool 1 (2%) and needs assessment 1 (2%)	n/a	Interns PGY1 3 (10%); PGY2 9 (29%); PGY3 3 (10%); lab residents 2 (6.5%); chief residents 1 (3%); fellows 1 (3%)	Surgical curricula	Didactic lectures 26 (84%); small-group sessions 6 (19%); web-based modules 6 (19%); QI projects 6 (19%); experiential teaching 5 (16%); not specific 3 (10%)	QI principles (Continuous Quality Improvement, risk management) 10 (32%); PDSA 12 (39%); RCA 5 (16%); Lean Methodology 2 (6.5%); DMAIC (Define, Measure, Analyze, Improve, Control) and Six-Sigma 1 (3%); nonspecific 11 (35.5%); patient safety 9 (29%); error prevention and risk management 4 (13%)	QIPAT, patient outcomes, satisfaction, QI completed projects, improved knowledge
Jones et al., 2015	Controlled trials 2 (5%); pre-post studies 18 (46%); case reports 10 (26%); time series 7 (18%); interrupted time series 1 (2.5%)	39 studies 1587	Residents 27 (69%); medical students 3 (8%); fellows 3 (8%); residents and fellows 3 (8%); medical students and residents 2 (5%) and	Interventions (clinical or educational) that engage trainees in QI work, where they are involved in changes to the delivery of care	n/a	Patient care improvement (not trainee educational-focus) (54%); QI principles towards patient care and system performance	49% of studies reported educational outcomes (knowledge, skills, participation, QIKAT (Quality Improvement

(*continued on next page*)

Table 2 (*continued*)

Source & year	Study type	N Studies and Participants	Characteristics of participants	Intervention	Teaching methods	Educational content	Reported outcomes
	and qualitative 1 (2.5%)		medical students, residents and fellows 1 (2.5%)	to patients within the clinical setting		(trainee educational-focus) (46%) e.g. audits, RCA or near-miss cases, collaboratives, QI projects, critical care measures and medication adherence.	Knowledge Application Tool) scores, satisfaction, improved behaviours, increase of publications and presentations, improved QI curriculum)
Starr et al., 2016	Pre-post (67%); non-randomized controlled (21%); randomized controlled (11%)	99 studies n/a	Trainee physicians (44%); non-trainee physicians (41%); both non-trainee and trainee physicians (9%); trainee nurses (8%); non-trainee nurses (37%), other team members (41%) and inter-professional learners (49%)	Curriculum that teaches QI methods, tools or theory targeting healthcare professionals and their trainees/ students and included a comparative evaluation	Didactic lectures (72%); interactive experiences (70%); audio-visual materials (14%); self-study and/or review of materials (34%)	QI tool (PDSA 67%; Lean 10%; Six Sigma 6%; change management 7%); specific QI collaborative models (IMPROVE/IDEAL 2%; Institute for Healthcare Improvement (IHI) Breakthrough Collaborative model 16%; other 4%); Curriculum attributes: IHI content areas (healthcare as a process (88%); variation and measurement (79%); customer/beneficiary knowledge (13%); leading, following, making change (45%); collaboration (61%); social context and accountability (9%); developing new, locally useful knowledge (29%); professional subject matter (31%)	Highest reported outcome level (Barr-Kirkpatrick hierarchy): level 1 (3%); level 2a (13%); level 2b (27%); level 3 (3%); level 4a (31%); level 4b (22%)

annual bootcamp. This was necessary as we were seeking a regular implementation mechanism for the training. The timeline available within the bootcamp was a half-day session; this was reflected in the curriculum design and contents.

Phase 4

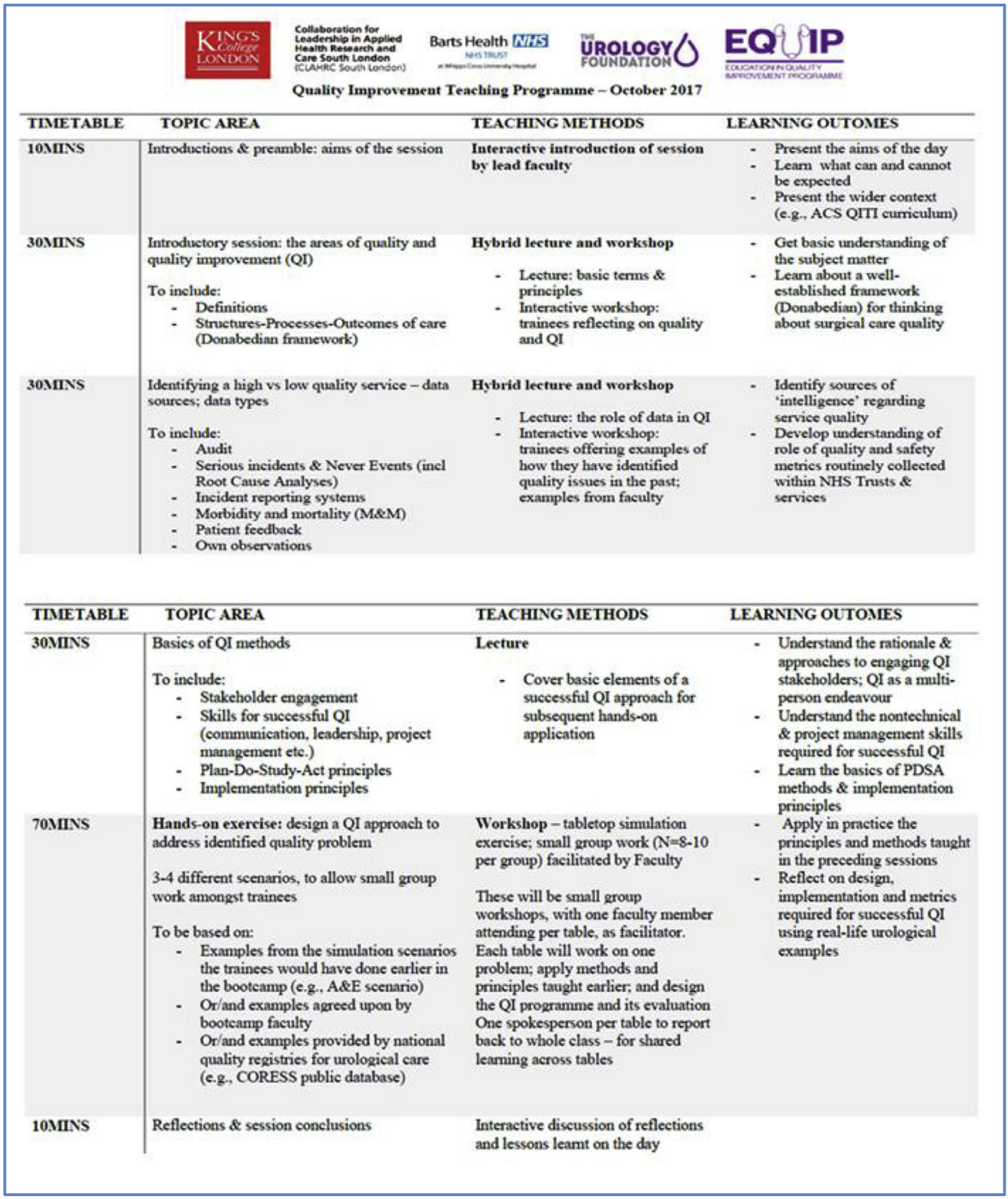
This was a prospective pre-post pilot of the QI curriculum, delivered to the entire 2017 cohort of urology residents attending the annual Urology Simulation National Bootcamp (n = 43; Leeds, UK; October 2017). All UK countries and all training regions of England except two were represented amongst the residents, including trainees from abroad (see Table 3). Here we report the residents' satisfaction scores and themed comments (which represent Kirkpatrick level 1 data; the entire knowledge-skills-attitudes Kirkpatrick dataset requires further data collection to allow enough statistical power for psychometric analyses to be feasible; and was not the primary endpoint of the testing). Residents scored the curriculum highly in terms of both the taught content and the delivery methods. The lowest scoring item was their response to whether the curriculum should be taught over a full day in the future – which we believe was affected by the fact that the teaching took part on the last day of a 5-day intensive bootcamp, alongside formal skills assessments that they underwent (and thus their appetite for more teaching was reduced). We further found that their overall enthusiasm for QI remained modest (just over 50% of them expressing strong or very strong agreement with the item) – a finding worth further exploration (see Fig. 3).

Free text feedback was provided by 30 of the residents (all verbatim quotes are available upon request). The comments on the course strengths were around the following themes:

- presenters' teaching style (n = 14), sample quotes: *"Interactive, good introduction and facilitated group discussion"; "Interesting and engaging"*
- curriculum content (n = 14): *"Very helpful to run through [...] theories and models"; "good to be taught the theory"; "Group discussions and real-time case scenarios"*
- course structure (n = 8): *"Interactive, good introduction and facilitated group discussion"; "Good structure of the course. Very useful info which can be easily applied to any QI project"*
- comprehension and applicability beyond the course (n = 5): *"Provides systematic approach to quality improvement projects"; "Trainees are often expected to do QI projects, but little guidelines/ guidance are usually given. It's good to have a framework to work with"*

Suggestions on how to improve the course and its delivery in the future (n = 19) focused on:

- course structure (n = 13): *"Timing not optimal-on the last session of the course. Everyone was tired"; "More opportunity (e.g. role*



Collaboration for Leadership in Applied Health Research and Care South London (CLAHRC South London)

Barts Health NHS NHS TRUST

THE UROLOGY FOUNDATION

EQUIP EDUCATION IN QUALITY IMPROVEMENT PROGRAMME

Quality Improvement Teaching Programme – October 2017

TIMETABLE	TOPIC AREA	TEACHING METHODS	LEARNING OUTOMES
10MINS	Introductions & preamble: aims of the session	**Interactive introduction of session by lead faculty**	- Present the aims of the day - Learn what can and cannot be expected - Present the wider context (e.g., ACS QITI curriculum)
30MINS	Introductory session: the areas of quality and quality improvement (QI) To include: - Definitions - Structures-Processes-Outcomes of care (Donabedian framework)	**Hybrid lecture and workshop** - Lecture: basic terms & principles - Interactive workshop: trainees reflecting on quality and QI	- Get basic understanding of the subject matter - Learn about a well-established framework (Donabedian) for thinking about surgical care quality
30MINS	Identifying a high vs low quality service – data sources; data types To include: - Audit - Serious incidents & Never Events (incl Root Cause Analyses) - Incident reporting systems - Morbidity and mortality (M&M) - Patient feedback - Own observations	**Hybrid lecture and workshop** - Lecture: the role of data in QI - Interactive workshop: trainees offering examples of how they have identified quality issues in the past; examples from faculty	- Identify sources of 'intelligence' regarding service quality - Develop understanding of role of quality and safety metrics routinely collected within NHS Trusts & services

TIMETABLE	TOPIC AREA	TEACHING METHODS	LEARNING OUTOMES
30MINS	Basics of QI methods To include: - Stakeholder engagement - Skills for successful QI (communication, leadership, project management etc.) - Plan-Do-Study-Act principles - Implementation principles	**Lecture** - Cover basic elements of a successful QI approach for subsequent hands-on application	- Understand the rationale & approaches to engaging QI stakeholders; QI as a multi-person endeavour - Understand the nontechnical & project management skills required for successful QI - Learn the basics of PDSA methods & implementation principles
70MINS	**Hands-on exercise:** design a QI approach to address identified quality problem 3-4 different scenarios, to allow small group work amongst trainees To be based on: - Examples from the simulation scenarios the trainees would have done earlier in the bootcamp (e.g., A&E scenario) - Or/and examples agreed upon by bootcamp faculty - Or/and examples provided by national quality registries for urological care (e.g., CORESS public database)	**Workshop** – tabletop simulation exercise; small group work (N=8-10 per group) facilitated by Faculty These will be small group workshops, with one faculty member attending per table, as facilitator. Each table will work on one problem; apply methods and principles taught earlier; and design the QI programme and its evaluation One spokesperson per table to report back to whole class – for shared learning across tables	- Apply in practice the principles and methods taught in the preceding sessions - Reflect on design, implementation and metrics required for successful QI using real-life urological examples
10MINS	Reflections & session conclusions	Interactive discussion of reflections and lessons learnt on the day	

Fig. 2. Quality improvement skills training curriculum for urology residents.

Table 3
Urology residents' demographic information (Phase 4).

		N	%
Gender	Female	14	33
	Male	28	65
	Unknown	1	2
UK training region	East of England	3	7
	East Midlands	3	7
	Kent, Surrey and Sussex	1	2
	North Central and East London	0	0
	North East	3	7
	North West	6	14
	London (North West/South)	3	7
	South West	0	0
	Thames Valley	0	0
	Wessex	1	2
	West Midlands	8	19
	Yorkshire and the Humber	1	2
	Wales	4	9
	Scotland	5	12
	Northern Ireland	1	2
Non-UK trainees	Republic of Ireland	1	2
	Europe	2	5
	Rest of the World	1	2
Trainee (resident) level	**Core training (CT) level**	**13**	**30**
	CT2	13	100
	Surgical training (ST) level	**27**	**63**
	ST3	22	81
	ST4	2	7
	Clinical Fellow/ST of unspecified level	3	11
	Unknown	**3**	**7**

% values have been rounded up to the nearest decimal for ease of reading.

play) to practice implementing quality improvement projects"; "May need a bit more time"

- curriculum content (n = 4): *"[More] Examples of urology projects"; "Wasn't sure how QI differs from [clinical] audit … seem very similar"*
- comprehension and applicability in practice (n = 2): *"Recognition that this is difficult to achieve as trainees. Identified key people/mentors in regions that you can contact for support"; "Would be very useful if this course could be conducted at all England Hospitals and also aiming non-trainee doctors [i.e. Attendings]"*

These data were consistent with the global bootcamp satisfaction data obtained by the bootcamp directors (due to the anonymization of the bootcamp satisfaction dataset further comparison between our evaluation and the global bootcamp satisfaction datasets was not feasible).

Discussion

To the best of our knowledge this is the first evidence-based and stakeholder-informed curriculum for teaching basic QI skills to urology residents in the UK in a feasible and pragmatic manner. The curriculum content and delivery methods are based on existing best evidence and informed by established frameworks, a range of stakeholders, including practising residents and senior surgeons, experts in improvement science and medical education as well as patients. The proof-of-concept testing revealed that the curriculum is implementable and feasible to deliver and evaluate through integrating it within an established annual course – in the form of the BAUS-supported Urology Simulation National Bootcamp.

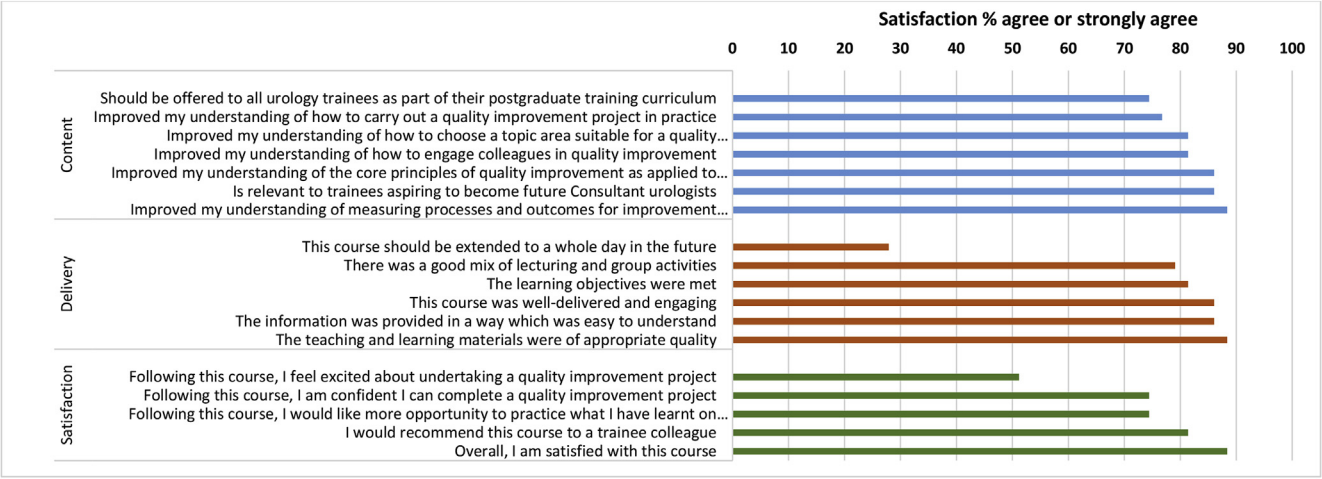


Fig. 3. Urology residents' satisfaction with the novel QI skills curriculum (N = 48); all items scores on Likert scales (1 = strongly disagree, 5 = strongly agree).

This curriculum is being designed with sustainable implementation and scalability in mind – we are aiming to deliver a training intervention that is deliverable across the UK on a longer-term basis. Integrating with existing education and training infrastructure; aligning the educational aims of the new QI curriculum with the national standards required of trainees (i.e., to present a completed QI project approved by their educational supervisors to be able to complete their residency); and working in close collaboration with the national body (BAUS) are all implementation and sustainability drivers for the EQUIP programme. Early scalability of the training is ensured through integration with the bootcamp: as of 2018, and in light of the emerging evidence of its educational value,[17,19] including the present study, the bootcamp has been designated as mandatory part of year 1 urology residents training, which means ongoing delivery of our improvement science training to eventually all urology residents in the UK, longitudinally.

Challenges certainly remain – some became apparent during this research. Integrating QI into an existing bootcamp limited the amount of time available and hence forced us to be selective in our coverage. Resident fatigue was evident in the feedback we received; and time pressure meant we did not have the capacity to use role-play and further interactive QI exercises. Further, we need to balance the need for adequate assessment of educational impact (though the Kirkpatrick framework) with the time it takes to deliver multiple assessments.

Some of these limitations affect this study more broadly. There is a tension between designing a curriculum for optimal content coverage and aiming to keep it to a predefined duration (half-day). Although we did achieve coverage of core evidenced QI approaches, more depth in the training would have been desirable. The last part of our evaluation was limited in this early stage of the research in a 'proof-of-concept' pre-post training study, which was overall small in size and relied heavily on trainee satisfaction. As QI is becoming ever more prominent within the NHS, trainees will be typically exposed to some QI theory or knowledge; without a control group our evaluation cannot identify with certainty what trainees may have been familiar with prior to attending the course. Our plan for immediate follow-up of the current study from an educational evaluation standpoint is to deliver the training to larger numbers of residents, which will increase our sample size and will allow us enough statistical power for prospective evaluation of whether the residents' knowledge and attitudes improve immediately post-training and longitudinally (i.e. Kirkpatrick level 2 evidence). Lastly, we do not have data at this stage on post-course activity – i.e., whether and to what extent the curriculum allows trained residents to return to their programs and develop their own QI projects or contribute to existing ones. We are exploring what data collection systems need to be in place nationally for such a prospective and longitudinal evaluation of actual resident skills and QI activity levels within their own hospitals (which would in time produce Kirkpatrick level 3 and potentially level 4 data).

Further developmental work of the EQUIP research program should address these limitations. We will be seeking further inputs from urology Attendings and program directors regarding how best to address QI needs within urologic surgery training in the UK. As part of this research, a major objective is to develop the capability to follow up residents longitudinally after the training. Our interest is in both longitudinal evaluation of their knowledge of and attitudes towards quality improvement (as commented above), but also on objective metrics – in other words, we would like to track the number and subsequently the quality (i.e., robustness) of the improvement projects that residents who have attended our training subsequently lead or contribute to. To do so requires a number of further research developments, which are interlinked. Firstly, we aim to develop evidence-based and agreed criteria for urologist educational supervisors (Attendings) to allow them to evaluate the quality of the QI projects that the residents undertake. This will offer clear criteria for quality assurance and appraisal – and as such will facilitate further implementation as the program will offer the supervisors what they are currently lacking in order to approve and 'sign-off' their residents' projects. Secondly, we will further explore the development of capacity to deliver the QI curriculum regionally – so that reliance on a small number of experts (e.g., ourselves) does not create a 'bottleneck' and barrier to scalability of EQUIP. A train-the-trainers approach for urology Attendings, delivered nationally and/or locally is a viable option. Lastly, there is no current system to allow us to track the QI projects residents launch or contribute to in their own hospital/training rotations following our training, and the quality/robustness of these projects; or to allow residents to have an overview of QI projects underway locally, regionally or nationally. This is a substantial barrier to large-scale improvement. An IT platform is required to achieve the above, at national level. As part of our research program, we are exploring the specifications of such an IT online portal that will allow trainees to post ongoing or completed high-quality QI projects – so resident QI activity can be tracked and appraised. This will serve both as a library of exemplar QI case studies for future resident cohorts; but also as a means to link residents into ongoing QI programmes, such that perhaps fewer in number but bigger in scale, less fragmented QI projects are undertaken by residents.

Conclusions

We have developed and conducted proof-of concept testing on a novel, pragmatic QI skills curriculum for urology residents. Further research will develop implementation and scalability pathways for the EQUIP program and deliver larger-scale evaluation of the impact that EQUIP has on improvement skills learning and QI project delivery.

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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.

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Appendix 1. Search strategy

The search was carried out 10 databases. A typical search as follows:

#1	MeSH descriptor: [Quality Improvement] explode all trees
#2	quality improv*:ti,ab,kw (Word variations have been searched)
#3	"quality improvement":ti,ab,kw (Word variations have been searched)
#4	#1 or #2 or #3
#5	MeSH descriptor: [Education] explode all trees
#6	"education":ti,ab,kw (Word variations have been searched
#7	educat*:ti,ab,kw (Word variations have been searched)
#8	teach*:ti,ab,kw (Word variations have been searched)
#9	"teaching":ti,ab,kw (Word variations have been searched)
#10	MeSH descriptor: [Teaching] explode all trees
#11	train*:ti,ab,kw (Word variations have been searched)
#12	"training":ti,ab,kw (Word variations have been searched)
#13	simulat*:ti,ab,kw (Word variations have been searched)
#14	"simulation":ti,ab,kw (Word variations have been searched)
#15	MeSH descriptor: [Simulation Training] explode all trees
#16	"skill":ti,ab,kw (Word variations have been searched)
#17	MeSH descriptor: [Clinical Competence] explode all trees
#18	"competence":ti,ab,kw (Word variations have been searched)
#19	learn*:ti,ab,kw (Word variations have been searched)
#20	prog*:ti,ab,kw (Word variations have been searched)
#21	"program":ti,ab,kw (Word variations have been searched)
#22	"scheme":ti,ab,kw (Word variations have been searched)
#23	"curriculum":ti,ab,kw (Word variations have been searched)
#24	MeSH descriptor: [Curriculum] explode all trees
#25	"syllabus":ti,ab,kw (Word variations have been searched)
#26	#5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or 20 or #21 or #22 or #23 or #24 or #25
#27	"systematic review":ti,ab,kw (Word variations have been searched)
#28	MeSH descriptor: [Meta-Analysis as Topic] explode all trees
#29	"meta analyses":ti,ab,kw or "meta analysis" (Word variations have been searched)
#30	evidence synthesis:ti,ab,kw (Word variations have been searched)
#31	#27 or #28 or #29 or #30
#32	#4 and #26 and #31

Appendix 2. EQUIP program Steering Committee Membership (2017)

Name	Professional role/capacity	Affiliation
Prof Annette Boaz	Professor in Health Care Research, Chief Editor *Evidence & Policy* journal	Kingston University & *Evidence & Policy* peer-reviewed journal
Ms Louise de Winter	Chief Executive	The Urology Foundation
Dr Ann Griffin	Clinical Senior Lecturer/Honorary Consultant in Medical Education, Deputy Director UCL Medical School	University College London
Dr Archie Hughes-Hallett	Urology Specialist Registrar (Resident) & Honorary Clinical Research Fellow	Imperial College London
Mr Simon Lord	Patient/service user	Patient & Public Involvement representative
Dr Roland Morley	Consultant (Attending) Urologist, BAUS Specialist Advisory Committee (SAC Chair) & TUF Trustee	Charing Cross Hospital (London, UK) & British Association for Urological Surgeons Specialist Advisory Committee
Dr Jonathan Noel	Urology Specialist Registrar (Resident), President of SURG (Specialist Urology Registrars Group)	North Central London NHS Trust
Dr Ian Pearce	Consultant (Attending) Urologist, Chief Editor *Journal of Clinical Urology*	Manchester Royal Infirmary & *Journal of Clinical Urology*
Dr Krishna Sethia	Consultant (Attending) Urologist, Past Director of Training for East of England Deanery & Chairman *British Journal Urology International*	Norwich Medical School
Ms Julia Taylor	Consultant (Attending) Nurse & BAUN President	British Association of Urological Nurses
Ms Marnie Williams	Patient/service user	Patient & Public Involvement representative

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