

How to develop a simulation programme in urology

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Fixed performance-based outcomes of inanimate trainers and simulators have been praised as useful adjuncts in urology for reducing the learning curve associated with the acquisition of new technical and non-technical skills without compromising patient safety. Simulators are becoming an integral part of the urology training curriculum and their effectiveness is totally dependent on the structure of the programme implemented. The present paper discusses the fundamental concepts of centralized urology centres and their potential to serve as key adjuncts in the certification and validation process of urologists. In summary, proficiency-based curricula with well structured endpoints and objective tools for validating

What's known on the subject? and What does the study add?

Inanimate trainers and simulators have been shown to facilitate the skill acquisition of urologists. However, there are significant challenges to integrating standalone simulation programmes into mainstream urology curricula.

This study provides a framework to overcome these challenges and discusses the advantages of centralised urology simulation centres and their potential to serve as key adjuncts in the certification and validation process of urologists.

proficiency are critical in developing a simulation programme in urology. We conclude that more educational research into the outcomes of integrated urology curricula followed by trainee/trainer opinion surveys will help address some of these criteria.

KEYWORDS

urology, simulation, training, assessment, lifelong learning, revalidation

INTRODUCTION

Urology training, like most surgical specialties, has traditionally adopted a volume-based apprenticeship structure to facilitate skill acquisition and ensure competence [1]. Extensive exposure to theatre and other clinical settings, combined with knowledge-based examinations, have generally produced safe and technically competent surgeons [2,3]. Conversely, premature exposure to patients, for either the early trainee or the trained surgeon who is developing a new skill, has often resulted in increased complication rates because of suboptimal technical skills [2,4,5]. Worldwide, urology training is confronting the myriad pressures facing surgery as a whole, which include the reduction in training duration and ever growing demands to assure patient safety [5–9], and this is at a time in urology where novel techniques are continuously emerging and operators are required to stay abreast of the

evolving laparoscopic and robotic approaches [10]. Such contingencies are at 'odds with the inherent imperfection associated with procedural learning curves' [9] and stimulate the need for adjuncts to existing urology training programmes.

The fixed performance-based endpoints of inanimate trainers and simulators have been praised as useful tools in reducing the learning curve associated with the acquisition of new surgical skills without compromising patient safety. In the field of urology, research has shown the benefit of simulators of varying grades of fidelity, both as learning tools and also as assessment tools [4,10]. Further, there is evidence of skill transfer from the simulated environment to the operating theatre [2,8–15]. Perhaps the greatest advantage of simulation use in surgical training is its 'ability to provide a reusable template from which trainees can learn in a time-independent, stress-free

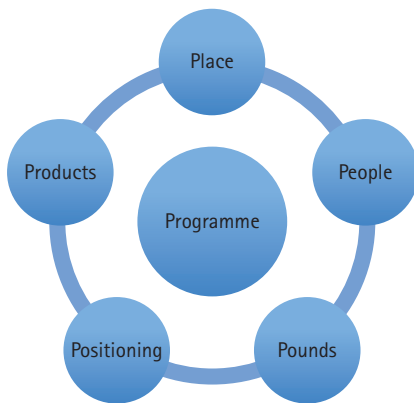
manner that does not endanger patients' [9]. However, simulators themselves will not determine the quality of urology programmes, rather the structured curricula into which they are integrated [9].

Such compelling grounds demand effective ways of comprehensively integrating standalone simulation programmes into established urological curricula [4]. Whilst this endeavour is not a novel concept in surgery, research has shown that institutions have struggled with it [2].

FUNDAMENTALS OF A SIMULATION PROGRAMME

The present paper uses the 'P's of the 'marketing mix', place, people, pounds, programme and positioning (Figs 1,2), as a fundamental framework within which viable and sustainable urology simulation programmes can be developed [16].

FIG. 1. Critical success factors in developing and sustaining an excellent urology simulation programme.



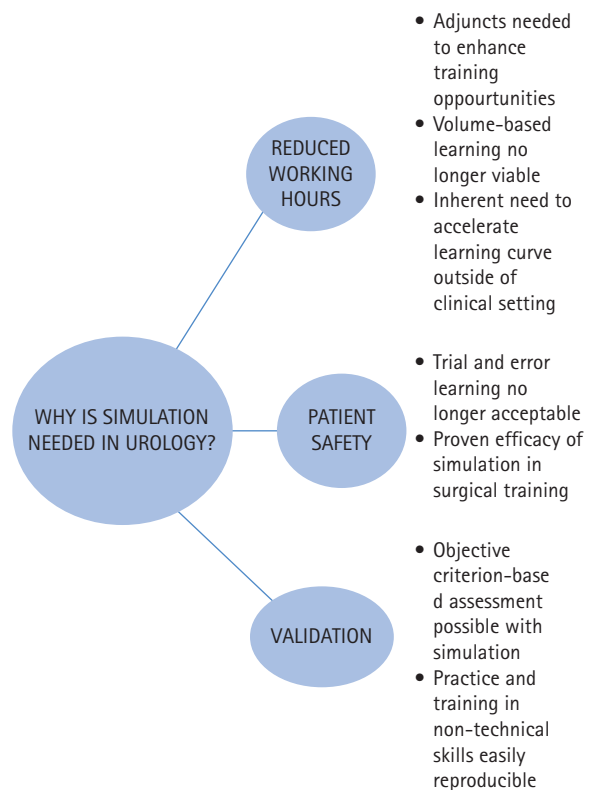
PLACE

Hub-and-spoke service models, where peripheral teaching hospitals have access to centralized simulation centres, are used to good effect in areas such as London; junior trainees from across the region are invited to a centralized simulation centre for interactive training days in resuscitation scenarios on a high-fidelity mannequin [17]. These institutions are well positioned to offer such a centralized simulation programme for urology owing to their functioning simulation laboratories, which include an extensive range of suitable equipment, but only a few institutions are providing these services. Pilot studies on this inter-organizational setup have been promising. The setup has noteworthy benefits; the central allocation of resources offsets the significant barriers to entry to the field associated with the large initial capital required to purchase the hardware and also to design balanced simulation programmes that fit into the training timetables of trainees [12]. A central focus of investment and efforts is more likely to result in consistent trainee flow to the centre to justify such capital investments. Higher volumes would ensure that the faculty itself has more competent trainers and assessors, which in turn ensures better facilitation of the skills acquisition of trainee urologists.

PEOPLE

Centres of excellence in urology simulation need robust leadership to champion the

FIG. 2. Requirements for simulation programmes in urology [15].



cause of simulation, not only to force through the agenda for integrating simulation into urological curricula, but also to negotiate competitive funding from public (departmental, regional and national) and private (philanthropic) purses [2,11]. Leaders of these centres should ideally be urologists with credibility amongst local and collegiate leadership. As at Guy's Hospital (London), the centres require significant interdisciplinary collaboration and stakeholder buy-in to ensure the sustainability of the programmes. Collaboration with other surgical and medical specialities would enhance access to laboratories, funding streams and cross-speciality fertilization. This is critical for developing non-technical aspects of curricula.

Simulation centres require at least one dedicated full-time faculty member who not only facilitates the management of the centre but who also has a critical role in timetabling and running training sessions through acting as a skills coach [12].

The most important stakeholders in these proposed curricula are the residents (or trainees) themselves. Encouragingly, a study

of >500 surgical residents found the majority accepted and appreciated virtual reality simulation for surgical training and would be motivated to use simulators on a regular basis if these were available to them [18].

POUNDS

Research has shown that it is difficult to quantify a viable return on investment for surgical education centres in pure financial terms [2]. Large simulation centres have the economies of scale to maximize end user benefits from given investments. Large teaching centres also have capacity in terms of physical space, infrastructure and information technology. Urology simulation centres should ideally be allied to other academic surgical departments for two reasons. First, to ensure curricula are evidence driven with the research capacity to generate new insights into educational urology based on the development of trainees. This will enable the definition of competency standards to permit continuous improvement of the curriculum [12]. Second, to capture some of the value that naturally flows to such facilities through private and non-private mechanisms. At the outset,

TABLE 1 High-fidelity training models for incorporation in a proposed curriculum [10]

Model	Manufacturer	Task	Model type
Uroscopic trainer	Limbs and Things, Bristol, UK	Ureteroscopy	Bench
Scope trainer	Mediskills, Northampton, UK	Ureteroscopy	Bench
UROMentorTM	Simbionix, Cleveland, OH, USA	Ureteroscopy	Virtual reality
Bristol TURP Trainer	Limbs and Things,	TURP	Bench
PERC MentorTM	Simbionix	Percutaneous nephrolithotomy	Virtual reality
Procedicus MISTM nephrectomy simulator	Mentice, Gothenburg, Sweden	Retroperitoneal radical nephrectomy	Virtual reality
Porcine kidney model	–	Percutaneous open renal surgery	Animal

programme leaders must be realistic as to the facilities and capability that can be offered in the gestation period of the programme and the choice of simulators and modules must be made accordingly [12].

The increasing use of robotic adjuncts in urology warrants their provision in simulation programmes, but the availability of such adjuncts for training is limited by extensive clinical usage, high costs for training-dedicated machines and the fact that many seniors are themselves on learning curves. Only the largest centres could justify the acquisition of training robots such as the Da-Vinci (Intuitive Surgical, Inc., Sunnyvale, CA, USA) [19], but high-fidelity robotic simulators, such as the MIMIC dV-Trainer (Mimic Technologies Inc., Seattle, WA, USA), offer more economical solutions to this problem for smaller centres [19].

PROGRAMMES AND PRODUCTS

Although the first three variables, place, people and pounds, are critical to the sustainability of any urology simulation centre, the entire mission must be geared around a comprehensive integrated curriculum which best serves as a powerful adjunct to existing training in a safe environment [2,9,12]. In current curricula, competency is in part defined by performing a minimum number of frequently performed cases. Whilst useful in establishing an overall competency level, it does not accurately assess a urologist's proficiency in specific individual cases [9].

As arguably the most fundamental aspect of any proposed simulation programme [9], the syllabus must be written in collaboration with faculty heads of stakeholder organizations and experts in urology

education. This will both facilitate consensus on the weighting to be given to necessary parts of the curriculum based on calculated or anticipated learning curve times, as well as foster buy-in [9,20]. The overarching theme must be intimate alignment to the evidence base, which justifies the positioning of the simulation centre within an academic surgical unit. In doing so, one ensures the programme is based on sound educational principles [11] whilst remaining up to date with evolution in techniques and technology in urology.

Once evidence-based endpoints are clearly defined in a curriculum, the faculty must then choose how to ensure residents achieve those endpoints. McClusky and Smith [9] and Grantcharov and Reznick [21] have described the process by which surgeons acquire technical skills. This invariably commences with an orientation or cognitive phase where new tasks to be learnt are demonstrated to the trainee, enabling them to understand the 'mechanics of the process' [9]. Practice, often using a training adjunct, is continued until the complex set of manoeuvres necessary to accomplish tasks becomes one fluid sequence. Proficiency is achieved when the surgeon can perform the tasks 'autonomously' or without thinking, permitting their attention to be placed upon other variables [9]. Acknowledging this process, two studies have drawn on the literature base to propose a proficiency-based curriculum with trainees progressing to sequential modules only once proficiency has been demonstrated [9,20].

Much can be learnt in this quest from the work of Aggarwal *et al.* [20] who designed an evidenced-based curriculum for training novice laparoscopic surgeons. In their study, expert laparoscopic surgeons were used to map tasks and procedures involved in

proficiently performing a laparoscopic cholecystectomy on a simulator. Stages with the longest learning curve were identified and performance criteria established to create a proficiency-based curriculum with clearly defined endpoints that included time, error scores and path lengths [9,20]. The authors propose that the curricula commence with orientation and the definition of baseline knowledge and expected standards [21]. A basic urological skills module should follow. Time limits should be set to determine which tasks, skill-sets and eventually procedures should be mastered within the time frame of specific modules. Modules must proceed in order of difficulty; commencing with simple tasks on bench simulators (e.g. Uroscopic trainer) and progressing to virtual reality-based systems (e.g. UROMentor™). Intrinsic to the programme must be robust evidence-based measures of objective assessment [9,10]. End-of-module examinations can assure competency targets are being met. With improving proficiency, defined according to metrics such as error rates, timing and distance travelled [9,20] candidates can progress to tackling more complicated procedures on virtual reality simulators, e.g. the Bristol TURP Trainer and the PERC Mentor [4]. Well-funded centres may have capacity for robotic or animal models (Table 1 [10]).

The simulation programme must ensure that constructive feedback is available. At the outset of any new module, this must be external in nature, to shape behaviours and ensure good habits are formed and maintained. McClusky and Smith [9] cite the importance of external cues guiding '*conscious, voluntary behaviour that gradually translates into internal proprioceptive cues controlling a less conscious behaviour*'. Once good habits have been learnt, the unique selling point of

FIG. 3.
Flowchart outlining the development of an integrated urology simulation programme.

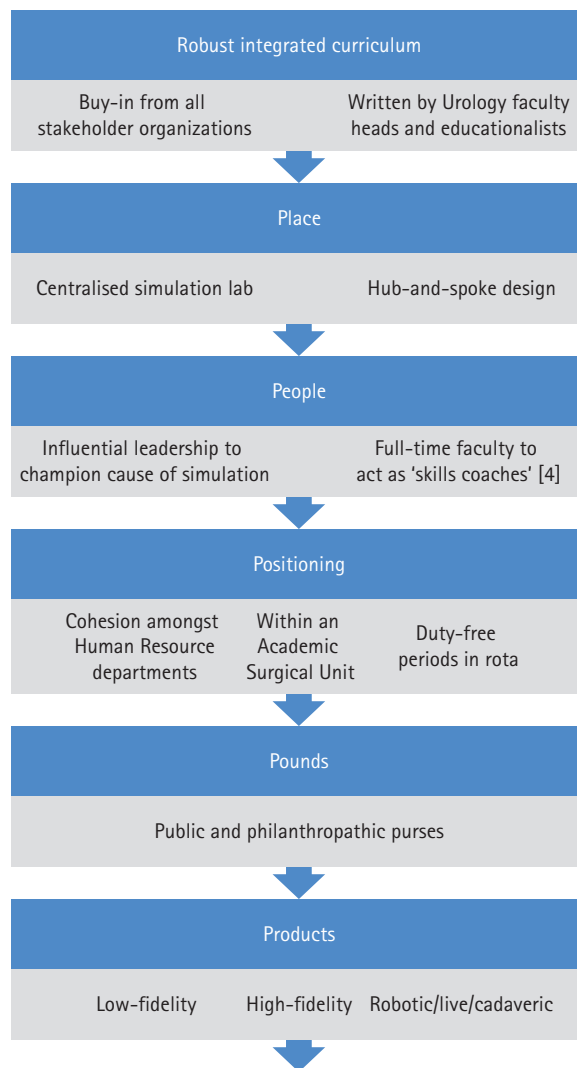
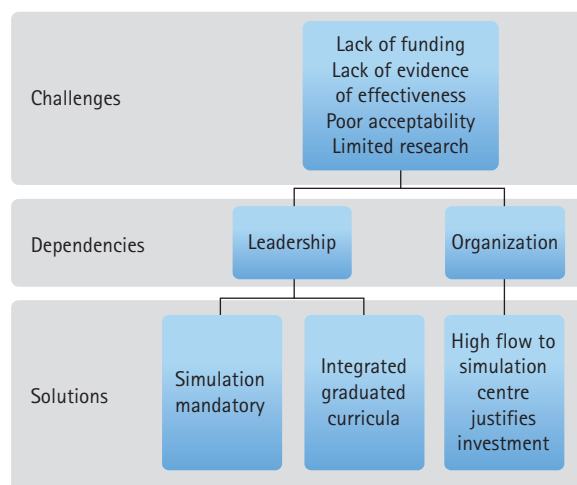


FIG. 4.
Anticipated challenges in developing a sustainable urology simulation programme [11].



simulators is that they are a platform for safe and deliberate practice. Not only are the scenarios reliable and reproducible, they can also be performed in the absence of human trainers through their ability to offer feedback [9].

As in aviation training, curricula should also incorporate tools for transferring and validating non-technical skills [22]. The simulated environment is a suitable domain where team communication, patient safety scenarios and leadership skills can be practised effectively [10,12].

POSITIONING

Urology simulation centres should not only be well positioned geographically but also require cohesion amongst human resource departments from diverse organizations. This is so that they schedule 'duty-free periods' in the rotas of trainees so that regular attendance is permitted. Buy-in from programme heads ensures that simulated training is mandatory and is therefore taken seriously by all stakeholders [11]. At an organizational level, a decision must be taken as to whether the centre is to be dedicated to urology alone or whether cross-speciality collaboration is more suitable [12].

Whilst there are several options in terms of timing of the programmes, it would be sensible to run a simulation programme in parallel with the course of a residency or registrar training. This in itself presents several opportunities for structuring the course. One might opt for one or two-week blocks at the start of a rotation to pre-expose residents to anticipated urological procedures and only permitting operating theatre exposure once proficiency checks have been reached. Alternatively, the modules could be run over a longer period of time on a more regular basis. Any option should ideally provide scope for deliberate practice to tailor the learning process to the individual needs of the student and facilitate high performance before progressing stepwise along the curriculum [2,12,23,24].

CONCLUSIONS

Successful integration of simulation into urology training requires a determined

approach to structure suitable and available simulators into a well designed urological curriculum [8] (Fig. 3). The concepts of centralized urology centres discussed in the present paper present a compelling argument for their potential to serve as key adjuncts in the certification and validation process of urologists (Fig. 4). The creation of such centres and their programmes requires visible leadership that can align the needs of trainees with those of the centre. The creation of nationally agreed curricula based on solid educational principles justifies the acquisition of often costly simulators through sufficient trainee numbers [2]. As discussed, proficiency-based curricula with well structured endpoints and objective tools for validating proficiency are critical in developing a simulation programme in urology [9,10,20]. The challenges involved in the successful development of a simulation programme in urology are the lack of evidence of its effectiveness, financial constraints and prevailing resistance to the acceptance of simulation amongst certain faculties. Further educational research into outcomes of integrated urology curricula followed by trainee/trainer opinion surveys will help address some of these concerns.

CONFLICT OF INTEREST

None declared.

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