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ORIGINAL ARTICLE

The training of a ‘stone doctor’

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KEYWORDS

Decision making;
Skills;
Research;
Competence-based definitions of physician roles;
Educational matrix

ABBREVIATIONS

EM, educational matrix; U:P, urologist:population (ratio)

Abstract ***Objective:*** To propose alternative models of training for doctors treating patients with stones, and to identify their relative value, as such doctors are trained through urology programmes which sometimes cannot be expanded to meet the need, are short of teachers, too comprehensive and lengthy. This review explores new pathways for training to provide competence in the care of patients with stones.

Methods: Previous reports were identified and existing training models collectively categorised as Model 1. Three alternative models were constructed and compared in the context of advantages, acceptability, feasibility, educational impact and applicability in different geosocio-political contexts.

Results: In Model 2, urological and stone training diverge as options after common basic courses and experience. In Model 3, individuals access training through a common educational matrix (EM) for nurses, physicians, etc., according to the match between their capacities, entry requirements, personal desires and willingness for further responsibility. Stone doctors with no urological background cannot fulfil other service and educational commitments, and might create unwelcome dependence on other colleagues for complex situations. Programmes involving a common EM affect professional boundaries and are not easily acceptable. There is a lack of clarity on methods for medical certification and re-certification. However, the lack of technically competent stone experts in developing worlds requires an exploration of alternative models of training and practice.

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Conclusions: The ability to provide exemplary care after abbreviated training makes alternative models attractive. Worldwide debate, further exploration and pilot implementation are required, perhaps first in the developing world, in which much of the ‘stone belt’ exists.

Introduction

Worldwide there is a shortage of trained urological manpower, which is much worse in developing regions, where up to half of a tertiary-urology unit’s work could be stone-related. India has identified a shortage of urologists [1]. In Pakistan, general surgeons still use open surgery for stones [2]. The shortage is likely to continue, because there are insufficient training sites and a paucity of teachers; current training programmes leading to competence in stone management are prolonged, often preceded by general surgery training, and are embedded in a urological training programme.

The number of urologists needed for any country is difficult to determine in a world with widely disparate cultures and educational levels. In the USA, morbidity does not improve with increases in urologist:population (U:P) ratios >1:50,000 (in the context of urological cancers). Many (34% of metropolitan and 60% of non-metropolitan) counties in the USA do not have a urologist [3]. There is a lack of a standard U:P ratio, with ratios varying widely across countries (Table 1) [4–8].

Even for populations where the U:P ratio is thought to be adequate more urologists might be needed as the stone-related workload is likely to increase for many reasons, e.g., lifestyle, dietary [9] and climatic changes [10], and increasing longevity and access to diagnostic technology. Currently each patient with stones requires more time from the urologist as many treatment options have to be explained to patients and then to relatives. Treatment can leave residual stones (now increasingly detected by CT) which might promote recurrences and require follow-up treatment. Imaging methods require more time, even just to review the image, and new toxins (similar to melamine) might suddenly increase the incidence of stones.

Against this growing demand the supply of urologists remains static and might even be declining. A long lead time from schooling to productive deployment as a urologist makes the speciality an unattractive career option everywhere. In the USA the supply of urologists decreased by 1.3% [4] per unit population between 1981 and 2009, and training posts decreased by 20% (from 1982) [11]. Thus is a matter of concern, as in 2009, 18% of urologists were aged >65 years, their average age being 52.5 years [4].

Although the number of training posts decreased the total number of residents in training has increased. This might be because training a high-quality comprehensive urologist localises the programmes to major units, because of the fear that expanding programmes to ‘lesser’ hospitals might compromise quality [11]. Professional bodies need to continue to assure society of the excellence of the products of training, more so as surgical errors are now the leading category of medical errors which are currently and collectively the seventh leading cause of death in the USA [12].

Can we increase the production of urologists? Given the current constraints detailed above, it appears imprudent to do so. New pathways for training for competence in stone care need to be explored. If more urologists cannot be trained, is it possible to accelerate preparation for the service by reducing the comprehensiveness, and train only for stone disease? Can a programme be developed divorced from urology residency programmes?

This review assesses the problems that arise from requiring comprehensive urological training before a Fellowship in stone disease, examines the environment and suggests directions for change. Throughout this article the term ‘training’ is used to mean education, implying that any training must include the development of cognitive abilities, psychomotor skills and social responsibility.

Defining the ‘stone doctor’

Whilst beginning with the concept that a ‘stone doctor’ must be an MD or MBBS, the focus should be on defining terminal competence rather than thinking of the stone doctor in the confines of professional boundaries. This is because there are many aspects of the management of stone disease that can be conducted to a variable extent by individuals with different training backgrounds, depending on the setting, i.e., primary or secondary, rural or urban tertiary, or in the transporting

Table 1 The U:P ratio for various countries.

Country	U:P ratio
Europe	6800–120,000 [5]
USA (2009)	9775 active urologists, one per 31,253 [4]
USA	Cann [6] suggests 5.1 urologists for hospitals serving 400,000.
Rwanda	Two urologists [7] for 10,624,005 [8]

ambulance. Thus the urologist, nurse, nursing assistant, first surgical assistant, primary-care physician, general surgeons and ambulance drivers could all participate in the care of the stone patient. Who will qualify for the title 'stone doctor'?

Within the concept of a stone doctor, should one also separate the development of a 'stone research' scientist stream? Who will opt for such training? Society views the 'poorer' researcher negatively, even though their work reduces the numbers of patients to be treated. However, when designing new curricula measures must be included which increase the interest in research, and consequently decrease the ineffectiveness of strategies to prevent the recurrence of stones.

Research must be an integral part of the stone doctor's development, especially if we are to address the WHO supported goals of equity, responsiveness and elimination of the accumulating burden of disease. Perhaps it is possible to re-ignite the enthusiasm to develop the clinical scientist who defines and addresses research questions that arise during the course of work and in whom, as Wells states, 'clinical and research interests are integrally bound' [13].

Defining broad areas of competence

What capacities will need to be developed in and by segregated stone-training programmes? Any alternative programme must produce well-trained stone doctors acceptable to the society, efficiently and effectively; such doctors should be able to reduce the inequities in treatment between the 'haves and have-nots', through critical decisions and judgement, and they should be interested in research that would reduce the burden of disease, and instigate the innovations that reduce the cost of treatment. Any programme must develop the capacity of the doctor to survive in changing, chaotic and disorderly environments. Above all, the graduand from the new programme must have the capacity to 'recognise, adapt to and manage the change' and when necessary, to take the leadership to bring about change [14].

These elements of training are particularly important as economically comfortable countries economise and cut education budgets. Equally important as factors to be considered are capacities that cope with the environmental forces which are shaping all surgical education (Appendix A). Clinical competence needs to be developed in its broadest sense, inclusive of attitudes and behaviours. However, two special areas deserve separate consideration, i.e., decision/judgement, and innovation.

Decision and judgement

The basic capacity which has to be developed is clinical competence, which in its broadest sense will include diagnosis and management, and hence decision-making and judgement. In every phase of stone management the ability to make a correct decision (at times on the basis of incomplete information) is the major determinant of success. Therefore the brain's capacity to make decisions must be developed.

Educational research by Buckner and Caroll [15] suggests that it might be possible to accelerate the development of decision-making skills by targeted interventions. They state that, as 'envisioning the future, remembering the past, conceiving the viewpoint of others... (all) reflect the workings of the same core brain network'; and as these abilities '...share a common functional anatomy in the frontal and medial temporal systems that are traditionally associated with planning, episodic memory and default (passive) cognitive states' and which 'rely on a common set of processes by which past experiences are used adaptively to imagine perspectives and events beyond those that emerge from the immediate environment'. When constructing the educational strategies the questions are 'can we improve decision making through perceptive exercises which develop these parts of the brain?', and 'is there a generic way of improving brain function?'

Innovation

In economically advanced countries stone disease is firmly positioned as the urologist's activity, and management is delivered efficiently across socio-economic strata when supported by government or public/private insurance. By contrast, South Asia is unable to provide appropriate investigation and care for its poorer population. As a result, their stones are neglected or treated by open surgery [2], and renal failure is common. Partly due to the unavailability of urologists this inequity is also to a large extent fiscal in origin.

This drives the question of whether the urological or 'stone doctor' curriculum can address this inequity. Formalised inclusion in the curriculum of practice and observation in low-cost settings, alongside role models, is an effective means of learning. In India, rural general surgeons perform laparoscopy with no gas insufflation, using a special 'towel lift' procedure, because CO_2 was unavailable [16]. Here a change was initiated, and an alternative solution was necessary; a basic understanding of physics and flow related to pressure gradients, coupled with incidental observation during open surgery, taken together produced the required result. What was it in the training of these Indian doctors that allowed such ingenuity? Therefore, what should be included in the curriculum in addition to work in low-cost environments? Is it sufficient to promote the generic capacity to persistently pursue an objective, or should an understanding of physics and engineering now become essential for urological/stone training? Or should trainees be exposed to wide reading which might include

Drucker [17] who advised that innovation does not always mean higher technology, and that one should rather look at ‘new ways to manage an organization, to *change a process*, to bring a service to customers...’. Will fostering of imagination and thoughtful, safe and ethical experimentation in the laboratory lead to innovation, which is the most important need of the day?

Re-designing the curriculum: three alternatives

There are at least three alternative paths (Appendix B) by which the problems stated in the introductory paragraph can be overcome. This article does not focus on the current option, option 1, as stone management is embedded in the comprehensiveness of full urological training and the many other urological problems. Nevertheless, it is possible to consider whether the increasing demand can be managed by increasing the number of training sites and trainees, replicating the current excellent programmes in the US and UK, just one example of which is in Stanford [18]. The present article uses Model 1 as a reference standard against which to measure new programmes.

Model 1. Continue the status quo

Current training models across the world have considerable variations. The different pathways in European and Indian urological education are summarised in Appendix C [5,19]. A closer examination of the current programmes (in Model 1) shows that the ‘excellent’ programmes are not easily replicable even across sophisticated countries and ‘Unions’. First, standards are not guaranteed because of variations (Table 2) in levels of supervision, case load and number treated by endoscopic procedures where indicated, even within the European Union [5,20]. In a general Urology unit, if a urologist performs eight radical prostatectomies a year, and 0.5 radical cystectomies/year, he is in the top 10th percentile of case volume [21]. Is that level of volume enough to train others? Will such units have adequate volumes of stone patients? Will the resident have time to manage an adequate number of cancer and stone patients? Bellario et al. [22] found that 30% of trainees responding to a questionnaire reported that programmes had too many residents, and that 33% and 36% of residents have poor or no experience in major surgery and endourology, respectively. Also, half of the respondents had no support from a tutor in their clinical practice.

Restricting the development of a stone doctor to units that handle adequate volumes in programmes that focus on stones would increase the capacity to train such people and the strength of the graduands, but would limit the available training spaces.

Expansion of existing or creation of additional residency programmes in Model 1 is not easy, as across the world there are too few trainers, many of whom are ‘still learning on the job’... and programmes lack PhD scientist trainers required to develop residents’ research skills. Also, there is no protected research time for residents and faculty [19].

Table 2 Variations in urological training (derived from data in Parkar et al. [5]).

Characteristics	% of countries which comply/ include this
Rotation between different institutions	78
Theoretical or practical courses	63
Personal training programmes for residents	59
Log book used	78
Examinations during residency to allow progression	41
Examination before board certification	78
Research integrated into residency training	33
Urologist to resident ratio, mean (range; median)	6 (2–28; 7.5)
U:P	6850–120,000
Residents within a country	5–1600
Time to board certification (years)	2 (Ukraine) to 9 (UK)

Within existing programmes the emerging limitation is now time, increasingly unavailable because of the speed at which changes in practice occur, the complexity of the cases, the increasing documentation and workload, the push towards larger case volumes seen by the urologist, the need to earn salaries, and new ‘working-time’ directives for residents and associated penalties for infringing those rules. The last of these shorten the time of exposure to practice and training just as the complexity of cases is increasing [23]. Donohoe et al. [24] suggest the need to transform ‘the way in which surgeons are trained, if current standards are to be maintained’. Model 1 should therefore be slowly modified or phased out.

Model 2: Develop generic capacities in programmes common for all surgeons, then focused on stone-related training

In this model, after generic training, in common with perhaps urologists or even with general surgeons or all surgeons, the individual undertakes technical, research and training in clinical competence for stone-related disease. The essential generic modules required before entry into a stone-training programme are explained below.

In Model 2 the trained stone doctor will be ignorant about e.g., urological cancer and infertility. Will the advantages of a shorter course for the development of stone-doctors be offset by disadvantages? At present, in any hospital or group practice, every urologist will be asked to ‘cover’ for a stone surgeon, and therefore in reverse, every stone surgeon should be able to cover for urological colleagues. If that service requirement is maintained, ipso facto, then the stone surgeon must be a urologist.

However, because it is not easy to increase the production of urologists the prospect for training a pure stone-doctor is attractive. Once clearly defined, the educational elements to develop these competences could also be used by practising general surgeons to make them competent in modern (e.g., endoscopic) stone management. This would improve the situation in India and Pakistan, where general surgeons treat stones mostly by open surgery.

Model 3

In Model three, the individual navigates through a series of courses available as an 'educational matrix' (EM). The entry requirements and terminal competences of each course are clearly stated, the outcome competences allowing specific service requirements to be fulfilled. In the EM a nurse or technician could undergo suitable well-sequenced modular training to gain skills in various aspects of stone disease, e.g., cystoscopy (already being done by nurses in the UK for haematuria cases) and ureteroscopy.

Model 4

Another option for consideration but which is not a focus of this article is to develop technical stone doctors trained in technique-related parts of stone management. This is possible, if appropriate curricula are defined to develop a technical line of high-class surgical first-assistants who develop into full operators functioning under a urologist's supervision. Excellence in technical skill is a talent and it has been shown that avid video-game players can show enhanced visual-attention skills [25] and enhanced memory [26], and that avid players made 37% fewer errors and were 27% faster in completing a simulated laparoscopic procedure and suturing [27]. Individuals (surgical first assistants and operating-room technicians) chosen for their eye-hand-video screen coordination, and with an appropriate educational background and concern for humans, could be trained for the technical parts of the competences required of a stone doctor.

This model should not be discarded as 'bad', although the fear is one of perpetrating a mechanistic approach to the patient, but this need not be so if an entry requirement were to be courses to develop the essentially required general broad competences expected of a good citizen, a good doctor, nurse or indeed any health worker. That module could become an essential for training of any doctor or nurse.

The advantages and disadvantages of the two newer models 2 and 3, compared to the extant model 1, are listed in Table 3.

Phasing in the required changes in the training of a stone doctor

Transforming the way in which a stone doctor is trained

Earlier reference was made to grafting additional competency modules onto a practising general surgeon, to improve the outcomes and safety. As an extension, a modular concept of education could be developed with a common general trunk for both stone doctors and urologists, and a variety of additional elective courses for each stream.

The modular concept is worthy of note, has been already adopted and has come to stay in the form of training in the skills laboratory. Here a variety of skills are taught in separate modules. No one now doubts the value of these evidence-based interventions that have reduced the need to learn operations in the operating room. The skills laboratory has also 'driven a change in thinking from numbers of operations done to exquisite assessment of competences' [28].

The underlying concept is one of pre-training (in this case, in skills) before functioning as a service provider. It is also applicable to low-income countries, as even low-fidelity equipment is effective in enhancing the novices' technical skills [29].

Pre-training in a segregated period of intense focused learning without distractions from interrupting emergency calls, admirably 'prepares' an individual for a service mode of function. During the period of 'pre-service' study before working in 'the real world', a host of additional competences could be developed. This concept could lead to the restructuring of residency into two phases of learning, and this could easily be introduced into even Model 1 training programmes.In Phase I, the individual would be 'learning for (future) service'. The resident would be prepared for function in the service mode.

In Phase II, the resident prepared through Phase I would provide exemplary service and show advanced skills in the operating room, wards and clinics. This phase could aptly be called 'learning through practical experience in real life'.

The differences in the two phases are shown in Table 4. Safer, quicker, efficient and effective throughputs would result from the deployment of Phase 1. In this phase, involvement in patient care would only be at certain designated times, e.g., in clinic and community settings. With the individual almost wholly dedicated to learning, several methods of learning could be deployed to great advantage (Table 5).

The ultimate objective of Phase I is to produce a powerful individual, knowledgeable and skilled in surgical techniques, who is innovative, yet knows the norms of society and ethics, and has begun to develop a social network outside of the closed urological (or stone)

Table 3 Comparison of four models.

Feature	Model			
	1	2	3	4
	Current Model	Common stem splits off urological and stone training as separate streams	Individuals choose courses from within an EM	Develops technical skills as a separate entity
Program's ability to train doctors competent in stone care	Deficiencies in case burden may be a problem Otherwise intellectual training strong	Excellent intellectual and skill training	Aim will not be comprehensiveness in stone care, rather in developing individual skills; trans-specialty e.g., Laparoscopist for all abdominal work	Aim is not to be comprehensive in stone care, but excellent in operative skills. Given a supporting urologist, such a 'stone doctor' would produce excellent zero-defect results through surgical technique refinement
Improvement of equity?	No hope. The investigational and operative procedures and guidelines do not allow treatment in financially poor patients/countries	Very probable	Excellent opportunities	Excellent opportunities for lowering costs through efficiencies in training and manpower employment.
Educational impact	Old curriculum continues with modifications	Requires support from curriculum development experts. Impact on learning enhanced because of focus and limited expected acquisition of fact and skills	Requires special expertise in meshing the various courses into a sequence, and linking the entry requirements with courses available and society's level of development. Impact on motivation and learning exceptional as the learner chooses courses.	Minimal additional work required. A talented 'skills' person enhances the field in which they do best. Exceptional educational impact. Threat: risk of producing mechanistic individuals
Impact on professional boundaries	Promotes the thought that nursing and medicine are two different disciplines	Supports closer working in teams and increased appreciation of what more can be done by nurses etc.	Disruptive of professional boundaries and territories. This model works towards considering competence, not professional title.	Urologists may not like sharing of their revenues with technicians
Improves concern for stone prevention?	No; but addresses these issues in training	Yes	Possibly no, unless the individual takes up research or stone clinic related courses as a choice	No; does not address these issues
Increases chances of developing a clinical research minded scientist	Yes	Yes, integrally binds research and clinical work	Possibly	No; does not address these issues
Need for more teachers?	Yes	Yes	Yes	Yes

Table 4 Differences in approaches to learning in Phase I and Phase II.

Approach	Phase I	Phase II
Purpose	Preparatory for more efficient function when in the service mode	Allows educational refinement; resident plays the role of a service catalyst
Principle/concept	Laying the foundation for practice	Practice as a foundation for learning; learning through accountability
Theoretical foundations	Heavy emphasis	Learning on basis of treated patients; reading to the clinical problem encountered
Practical experience:		
Extent	(Restricted)	Heavy and broad ranging
Nature	In labs, communities and in consulting clinics	Through real world work
Real world case-based learning	Experience in case collections	High direct learning through service and accountability
Responsibility	High for only a limited number of tasks	High for larger selection of tasks

Table 5 Long term effect of modes of learning and 'charging the capacitor', the human brain.

Concept	Activity	Long term outcome
Contemplation and self generated thought	Thinks and evolves ideas and experiments; considers alternatives	Innovations; improved decision making
Social learning	Work in community settings	Knowledge of what people can afford, what they feel and why they act the way they do
	Participates in the culture of the city	Develops right brain and social networks?
	Makes friends outside of urology	Develops network with entrepreneurs, engineers, etc
Expository learning	Presentations to peers; developing the power of language	Clarity of thought and expression, reinforcement of the need to define accurately, be able to defend one's opinion
Didactic teaching	Text book learning Learning from Internet	Knowledge base
Skills laboratory learning	All forms of skills	Technical and humane doctor

environment. Most importantly, a concern for society and a cognisance of how little most people can afford will also be developed.

Various modes of learning (e.g., learning by doing, contemplative generated thought, social learning and networking, expository, didactic and other modes of learning) will hopefully empower residents with additional advantages (Table 5). Thus social learning will develop a social network, hopefully with entrepreneurs. Generative thoughts will mature to become ideas to explore in later life. Learning by doing will strengthen skills. The ultimate objective is to establish a social domain and thus to be very effective in real life and to be able to work with maximum efficiency.

Towards an Educational Matrix (EM)

Learning from initial experiences with modifications in courses and the use of skill laboratory settings, an EM of (i) entry requirement courses (e.g., one on civics), (ii) common trunk basic/generic courses (for general surgeons, urologists and stone doctors), and (iii) a variety of specialist courses (for those interested in technical clinical and research aspects of stone, or those opting for comprehensive urology) could be built in stages.

After the first step of segregating the skills laboratory training, and adding educational content to Phase I, yet additional courses could successfully be added to this phase. All educational stages would be delivered as modular courses.

Any of the modular courses would be open to all individuals fulfilling their specific entry requirements. As an example, the course on physics and functions of a laser could be taken by physics students, students in liberal arts, gynaecologists, urologists and general surgeons; the technical module on JJ stent removal would be taken by nurses who are already trained in evaluating haematuria and cystoscopy. MBBS physicians and technicians could be trained in lithotripsy.

Such a path would aid in assessing terminal competence and the level of independent practice achieved, when deciding who does what part of stone management, rather than restricting actions on the basis of professional designation. No longer could the clinician say: 'Oh, he or she is a nurse and therefore should not be allowed to....' Training needs to be defined by the outcome of competency to be achieved and not by the profession undertaking a task.

A matrix of linked courses, each with defined entry requirements, is easy to imagine; an EM is therefore possible.

In such an EM easy paths to higher level technical skills would allow an MBBS to be trained to do a cystolithotomy, and would then become one of the stone doctors. Physician assistants and nurse practitioners perform admirably in teams with physicians and are accepted by the public [30]. Technicians have been trained in surgery for inguinal hernia, intestinal obstruction and Caesarian section [31] in Africa. Nurses in the UK have been taught to do flexible cystoscopy for haematuria and are now being taught to do hernia operations [32].

The world has limited finances, and health services will probably have to introduce financial and time-use efficiency into education. Cautious advances can be made stepwise, persuading opponents and asking them whether at present a nurse performing hernia surgery in the UK has the comprehensive education of a doctor before being permitted to do the operation, and thus should all stone doctors obtain comprehensive urological training?

What is needed is an EM that interlocks with service requirements for spreading equitable cost-effective stone treatment, prevention and research. Operating the EM, obtaining acceptance by professionals of its use, will be far more difficult than creating it. Whilst already physician's assistants and first surgical assistants perform parts of some operations, the path ahead is likely to be difficult. Operating the EM requires a fusion of thinking between different professions and technical lines 'switching from multiple educational ownership (separate Nursing, Medical and Technician Schools), to a unified matrix.' However, there are advantages: 'Schools for healthcare workers/professionals would, using the economies of scale, require fewer traditional subject teachers and be able to afford mathematicians, ethicists, philosophers, engineers, environmentalists, legalists, and legislators ... to further enrich 'physician' education' [33].

If the common EM route is chosen what will the future hold? No 'stone doctors' or only 'stone treaters', 'stone preventers' and 'stone researchers'? or the abolition of traditional professional boundaries?

The solution will lie in the development of a team appropriate to the setting, one with mutual respect for each member, and respect for what an ambulance driver could do to relieve pain during transport; for how a nurse could easily remove JJ stents; or a stone technical surgeon perform flexible ureteroscopic laser ablation of a stone; the MBBS/MD graduate to perform ESWL; and how an ultrasound-trained haemodialysis technician who inserts double-lumen acute dialysis catheters for dialysis can create a nephrostomy whilst in the village for a patient with obstructed solitary kidney overloaded with fluid and in pulmonary oedema. The team would be successful but will anyone working in it be called a doctor, or will all be entitled to that honour?

Conclusion

Training stone doctors with no strong urological background will not allow the graduand to fulfil other services and educational commitments, such as 'on-call' urology, and will increase the dependence on other colleagues for solving complex problems. More radical programmes involving a common EM will affect professional boundaries and ground, and not be easily acceptable. The exact mode of medical certification and re-certification will require discussion and debate. However, because of the lack of technically competent stone experts in the developing world, the alternative models are attractive because they provide avenues for enhancing the rapid development of appropriately trained comprehensive stone surgeons.

However, worldwide debate, further exploration and pilot implementation are required. This will perhaps occur first in the developing world, in which much of the stone belt exists. On the other hand, Stanford, noted for its innovation, might take the lead in transforming the education of stone doctors and urologists, and surgeons.

Conflict of interest

The author has no conflict of interest.

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Appendix A. *The five environmental forces that are shaping surgical education*

- The **speed** at which change occurs necessitates that academic programmes constantly change and teach new techniques.
- The **increasing workload and reduced time for learning** and the inability to produce more urologists efficiently.

- The **success** of programmes that use **skills laboratories** and protect learning time during which the resident does not have a service commitment.
- The **concern** for providing equitable ethical and compassionate care.
- The **neglected** development of the surgical scientist.

Appendix B. *Current and alternative curricular models*

Model 1. Current model: Embed the development of stone doctors within a comprehensive urological training.
Model 2. Develop a stone doctor outside the ambit of the urology programme
Model 3. Develop an EM: Incorporate a common framework matrix of a variety of modular courses suitable for educating general surgeons, specialist surgeons, stone doctors and urologists, starting with a common trunk, and diverging into different streams of development.
Model 4. Develop 'technique only' surgeons who operate under the guidance of a fully trained urologist.

Appendix C. *Different pathways in European and Indian urological education (data drawn from Parkar et al. [5] and Aron [19]*

Medical College graduates→internship/urology residency (26%);
or→pre-residency elective in a urological department→Uro residency (19%)
→direct entry to urology (44%)
Many urology programmes have a common trunk general surgery (2–4 years) requirement.
In Austria:
Medical College graduates→15 months General Surgery + 3 months gynaecology + 6 months internal medicine→urology residency.
In India:
Medical College→general surgery 3 years→entrance examination for urology (in which candidates demonstrate adequate knowledge and possibly experience of urology)→3 years urology programme.

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