Conclusion & Discussion

1. Conclusion

The studies in this thesis were conducted to answer the main research question: "*To what extent and in what manner are training models currently integrated in endoscopic urological educational programmes; what is the status of their validity; and how can skills be transferred from the training model to performance in patients?*

A systematic review of papers on training models and their validation published between 1980 and 2008 revealed thirty different models and 54 validation studies. The study populations were small and the quality of the studies in terms of the Oxford Centre for Evidence-Based Medicine (OCEBM) classification score and Kirkpatrick's levels relatively low. Future publications should describe models in greater detail and also examine the scientific value of training models. In particular the criterion validity of models should be determined by examining the transfer from simulator to patient.

When course directors of postgraduate training were surveyed, it appeared that endoscopy skill training was offered in over half of all the hospitals where programme directors of gynaecology, general surgery, orthopaedics and urological training were based in 2007. The courses varied from training with video instruction to simulator-based training. The majority of the programme directors thought that not enough hours of endoscopic training were offered to postgraduate trainees. There was general agreement among programme directors that endoscopy training should be an integral part of urology training.

The studies in this dissertation investigated the validity of URO Mentor and Uro Trainer. Studies of the face, content, construct and criterion validity of URO Mentor for urethrocystoscopy generally showed positive results, suggesting that the use of this model is to be recommended for urethrocystoscopy training. However, the face and content validity of the current version of Uro Trainer proved to be unsatisfactory with regard to usefulness and realism. Consequently, it appears inadvisable to continue to investigate the validity of this model before improvements have been made.

The results of a study examining the transfer of novices' flexible urethrocystoscopy skills from simulator-based training on URO Mentor to performance in real patients revealed a positive effect from training on the model considering respect for tissue, procedural knowledge, flow of procedure and forward planning. Using the URO Mentor to train handling of instruments and time and motion may be less beneficial for interns with a specific interest in a surgical specialty. Apart from the effects of simulator-based training, the study also identified potential effects related to students' stress and their interest in a speciality (surgical/non-surgical) for their future profession.

In order to enhance the transfer of simulator-acquired skills to performance in real patients, it is important to examine training needs and the requirements to be met by a simulator. An analysis of the pitfalls related to TURBT, TURP, and URS procedures in the operating theatre demonstrated that it is important for future simulators and

training programmes to focus on 'planning/anticipation on new situations' and 'handling instruments.'

2. General discussion

2.1 Description of simulators

In the literature, thirty different simulators have been described for UCS, URS, TURBT, TURP and percutaneous endourological procedures (chapter 2). The largest number of models was developed for URS procedures (a total of nine), whereas only one model was described for TURBT. This raises the question why more simulators have been developed for certain procedures than for others. There are various possible explanations. First of all the characteristics of procedures and their frequency are likely to play a role. The complexity of performing a procedure in patients as well as the amount of potential injuries caused by novices performing a procedure in a real patient are bound to affect the experienced need to develop training models for procedures. Another aspect of procedures that is relevant for decisions on the development of training models is the technical feasibility of simulating a real-time procedure in a model.

A second explanation for the differences between procedures in the number of available simulators may well be related to the interests of companies producing medical instruments and simulators. A simulator offers companies a chance to demonstrate their equipment and manufacturers of simulators have an economic interest besides facilitating the training of doctors. It is not intrinsically objectionable for manufacturers of medical instruments or simulators to develop simulators, because this requires funding and equipment. However, there is always the risk that companies do not focus on educational considerations when developing a model and as a result neglect essential components of simulators while paying too much attention to educationally less relevant aspects. This problem might be resolved when stakeholders from industry cooperate with medical specialists, postgraduate trainees and medical education experts in developing simulators for training purposes.

Obviously, some simulators developed for certain procedures may not have been reported in the literature. We believe that it is important that users and designers of training programmes are informed of newly developed simulators because this will prevent that hospitals, universities and industry invest time and money in the development of models that are already available.

2.2 Validating simulators

In this dissertation we take a critical view on a number of factors which we encountered in relation to the validation of simulators. The descriptive terminology used in validation studies is not uniform and there is no consensus on which method is to be preferred for determining a simulator's subjective validity. There is also considerable variation in the parameters considered in studies examining objective validity. So far, only few studies have examined the transfer of skills from simulator to patient. This may be due to the ethical dilemmas raised by such studies and to a lack of consensus on the criteria to distinguish between novices and experts.

These difficulties do not deny that it is important to examine the value of simulators for training purposes and whether simulator-based training does not result in inappropriate skills or simulator specific skills that are not transferable to performance in patients. The quality of patient care requires extensive testing of new medications and instruments before they can be used routinely. The same reasoning applies for the training of medical specialists, where it is of vital importance to test and validate training methods before they can be incorporated into training programmes.

2.3 Simulators in urology training programmes

Novices need to practice, practice and practice some more, in order to acquire good procedural skills [1]. The survey described in this dissertation showed that this view is shared by urology programme directors. Opinions differ, however, with regard to the (type of) simulator that is most suitable and the place of simulators within (endo)urological skills training. Differences of opinion in this regard are found among programme directors but also among trainees, medical education experts and designers of simulators.

There are differences between disciplines in ideas and interests with regard to the use of simulators in medical education. While one discipline may be particularly interested in the quality of patient care, another discipline may be more concerned with educational considerations or scientific value, and yet another discipline may be preoccupied with factors relating to the organisation and the cost effectiveness of training programmes. If we are to determine the best possible way to use simulators in medical education, we will have to take account of all these points of view and interests.

2.4 Transition from simulator to patient

It may seem simple … but it is not simple at all. It may seem plausible and self evident that novices who have learned procedural skills by training on a simulator do better when performing these skills in patients compared to a control group who did not participate in simulator-based training. This was the outcome of a study we performed on the effects of simulator-based training of urethrocystoscopy skills. However, the same study showed that good performance also depended on students' interest in surgery as their future profession. Additionally, significant differences were found between the participants in the amount of stress they experienced and this may be caused by personal as well as environmental factors. The literature provides evidence that the performance of procedural skills is not only affected by technical but also by personal and context-related factors [2]. This may suggest that the transfer of skills from simulator to patient will be more efficient and effective when these factors are integrated into training programmes.

Ethical dilemmas play a dominant role in the transfer of skills learned on a simulator to performance in patients and in the use of training sessions. In the Netherlands, the general view is gaining ground that it is ethically unacceptable to use patients as training models for specialist trainees [3-6]. It is probably better for trainees to first learn procedural skills on simulators in a skill training centre before performing procedures in real patients. But how long should they train on simulators and on which simulators for that matter? When have they reached a skill level that justifies the performance of a procedure in a real patient? Because patient safety and specialist training are inextricably intertwined, the interests of both should be carefully weighed. Clearly, this dilemma is not unique to medicine. For airline pilots and drivers of vehicles it is equally essential that the right moment is chosen to move from simulator to their first real flight or ride with passengers.

3. Perspectives for the future

Like all dissertations, this one offers not only answers to questions but it also raises new ones. We will describe some future perspectives and recommendations for further studies based on a critical appraisal of validation studies (chapter 11) and personal experiences in developing, evaluating and validating simulators (chapters 1-10).

1. Integration of 'needs analysis' and 'programme design' in the development of training facilities
   In the military and in education in general, it is recognised that the efficiency, quality and cost effectiveness of simulators benefits from a needs analysis and

programme design prior to the actual development and validation of a simulator [7-9]. To put it differently, for operative skills in particular it is important to first analyse the potential pitfalls of current training methods (usually the apprenticeship model) and to define learning objectives. Once this analysis is completed, the training programme can be designed and it can be decided which simulators or training facilities are most appropriate for which part of the procedure, based on a sound knowledge of educational methods. A model of the (sub)-stages is schematised in chapter 11. Only when the needs analysis and the programme design have been completed, can the simulator be validated and subsequently implemented as part of the training programme.

2. <u>Integration of non-technical factors that influence procedural skills</u>
    The acquisition of procedural skills is a complex process in which various factors play a role. Although various studies have shown that non-technical (human) factors strongly influence the appropriate performance of procedural skills [2; 10-22], surgical training programmes today are still largely focused on technical skills. Based on the assumption that not only the task but also the person and the context are crucial for successful performance of operative skills, it is to be recommended that future studies should not be limited to the technical aspects of skill training (task) but also focus on personal, context-dependent factors [2].

3. <u>Cooperation between consultants, specialist trainees, educational experts and industrial designers</u>
    Designing a training programme or a simulator requires input from a diversity of expertise and knowledge. Specialist trainees are generally trained by senior doctors, who have no professional training in teaching. The ability to perform a procedure in a patient competently does not automatically imply competent teaching of the required skills. Knowledge of a procedure is of vital importance to the design of a simulator but constructing the simulator relies on industrial knowledge and knowledge of materials, hardware and software as well. Consequently, a multidisciplinary approach is the only way to develop simulators and training programmes.

4. <u>Development and evaluation of assessment</u>
    Objective Structured Assessment of Technical Skills (OSATS) is currently the most common and most extensively researched method to assess procedural skills. Despite its apparent suitability, this type of testing is strongly dependent on subjective assessments. As early as 1990, Miller claimed that "No single assessment method can provide all the data required for judgment of anything so complex as the delivery of professional services by a successful physician."[23] This means that it seems advisable to further develop the currently available alternative assessment

methods, such as objective assessment by virtual reality and augmented reality simulators, motion tracking and error analysis of video recordings, and to use a combination of different assessment methods to evaluate procedural skill performance.

5. Assessment of learning curves

    Individuals differ in learning styles and learning curves [24]. If a sound training programme is to be developed for a certain procedure it is desirable to know the average learning curve as well as the extremes of the learning curves of the group of learners in question [25-27]. The number of procedures that is generally sufficient to complete the learning curve has been given for some procedures and some studies have investigated learning curves, [26-28] but for endourological procedures this type of information is scant or absent. Moreover, it is questionable whether the number of procedures performed is an appropriate criterion of quality of performance. Examining learning curves is a difficult but also a challenging and necessary step in optimising (endo)urological skill training.

6. Cost effectiveness analysis

    Although training in skill laboratories and the development of training methods that do not involve real patients appear to improve operative skills training as an addition to the apprenticeship model, there is no denying that this type of training requires time, money and organisation. Training urethrocystoscopy on URO Mentor may be desirable but from a cost perspective it seems undesirable for all training hospitals in the Netherlands to purchase this simulator. An analysis of procedures and training programmes will have to establish whether low cost and low fidelity models are adequate for certain (parts of) procedures and whether for other (parts of) procedures training on more extensive virtual reality (high fidelity) simulators is preferable. It is important to carefully weigh the costs and benefits of different training modalities.

Finally, skills laboratories and simulators are facilities. Simulators alone will never suffice to turn novices into competent surgeons unless training programmes are developed based on sound educational knowledge, specialists who are motivated to teach and trainees who are motivated to learn.

Acknowledgement statement

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