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Four-year follow-up on a gynecologic laparoscopic skills curriculum and discussion of its implementation

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ABSTRACT

Objective: Simulation-based training of surgical skills is transferable to the operating room, but implementation of a specific skills curricula is still challenging. Ongoing efforts serve to identify and implement the optimal curriculum for ensuring patient safety. In 2013 the validated 'basic laparoscopic skills curriculum' was introduced for first-year residents in obstetrics and gynecology in Eastern Denmark. The aim of this study was to follow-up on implementation of the curriculum through a four-year period and identify facilitators and barriers.

Methods: The 'basic laparoscopic skills curriculum' comprises four steps encompassing theoretical education (step 1 & 2), proficiency-based technical skills training on virtual reality simulators (step 3), and a one-day surgical course with participants practicing procedures on sedated pigs (step 4). All participants were first-year residents in obstetrics and gynecology in Eastern Denmark from September 2014 to August 2018. The 'basic laparoscopic skills curriculum' was administered by the Copenhagen Academy for Medical Education and Simulation (CAMES). Dropouts were asked to complete an electronic questionnaire on why they did not finish the curriculum.

Results: During the four-year follow-up, 107 first-year residents participated in the curriculum. One-hundred completed step three (93%) and 99 (92.5%) step 4. Participants spent a median of 249, IQR 164 minutes (min. 64, max. 630) on the virtual reality simulator. Median time for completing all four steps of the curriculum was 56 days, IQR 98 (min. 14, max 253).

Conclusion: Completion rates were continuously high over four years in this basic laparoscopic skills curriculum for residents. One likely reason is that the curriculum was partially mandatory, combined with a supportive management that allotted participation time. Self-directed learning, self-study and flexible booking are also considered as playing a crucial role.

Keywords: Curriculum, Laparoscopy, Resident training, Virtual reality Simulation, Gynecology

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INTRODUCTION

There is a continued need for research on simulation-based education to ensure both patient safety and competent surgical clinical training. Over the past decades, this research has provided substantial evidence supporting simulations-based training, the transfer of skills and, consequently, better outcomes (1–6). The optimal simulation-based training is proficiency-based with feedback and distributed over time (7).

Simulation-based training of laparoscopic procedures early in surgical residency accelerates the acquisition of technical skills compared to conventional surgical training (8–11). As a result, the development of surgical curricula using simulation-based training is a high priority for surgical communities. Implementation has proven difficult, even though access to simulation-based training facilities in Scandinavia is high (12).

The optimal surgical skills curriculum should consist of theory, technical and non-technical skills components, and supervised training in a clinical setting with time specifically allotted for studying (9,10). To increase the likelihood of participation and completion, it is essential to incorporate goal-oriented training, variable practice and self-directed learning, which is a leaning strategy that allows learners take charge of their own learning process, in this project referring to the students planning the time and length of the simulation training. Proficiency-based training (also sometimes called competency-based training or performance-based training) is preferred since it ensures that participants reach the same skill level upon completing training, motivates the learner and has shown superior outcomes in terms of transfer and retention of skills (10,11,13). Additionally, proficiency-based training obviates the need for allocating predetermined amounts of time for practice and focuses solely on performance in contrast to time-based learning where all participants have the same amount of time to learn a skill.

In 2013, a validated laparoscopic skills curriculum (11,14–17) was introduced to residents in obstetrics and gynecology (OBGYN) in Eastern Denmark. Implementation of the curriculum was carried out in agreement with the program director of OBGYN in Eastern Denmark, local OBGYN departmental managers, and local education managers. The term 'curriculum' was used because it covers all elements associated with education and can set the course of a planned educational activity.
The aim of this study was to follow-up on implementation of the curriculum and identify obstacles to completion of a simulation-based skills curriculum.

MATERIALS AND METHODS

All first year OBGYN residents from 2014-2018 (n=107) participated in completing the previously validated surgical curriculum. The curriculum consisted of four steps (figure 1) encompassing theoretical education, proficiency-based technical skills training on virtual reality simulators, and a one-day surgical course with participants practicing procedures on sedated pigs (14). All steps except step 4 was hosted by CAMES. When proficiency on the virtual reality simulator was obtained the participants could move on to the surgical pig course which was feedback based. All parts of the curriculum included instructor feedback and time allotted specifically for training. Participants were also given a previously validated multiple-choice questionnaire on basic principles of laparoscopy (15). However, this was not a mandatory part of the curriculum.

Proficiency-based training sessions on simulators has been mandatory since 2013 for OBGYN residents before performing surgery on real patients, in accordance with nationally stated aims. Departments are obligated to allocate and incorporate time in residents' work schedules which is protected from clinical responsibilities. All residents had one day off for the course and one or two days off for step to, the simulation training. The Copenhagen Academy for Medical Education and Simulation (CAMES) was the course provider and the simulation center for the laparoscopic training sessions (18). Courses at CAMES are primarily developed based on research projects, and instructors are physicians or technical assistants (19).

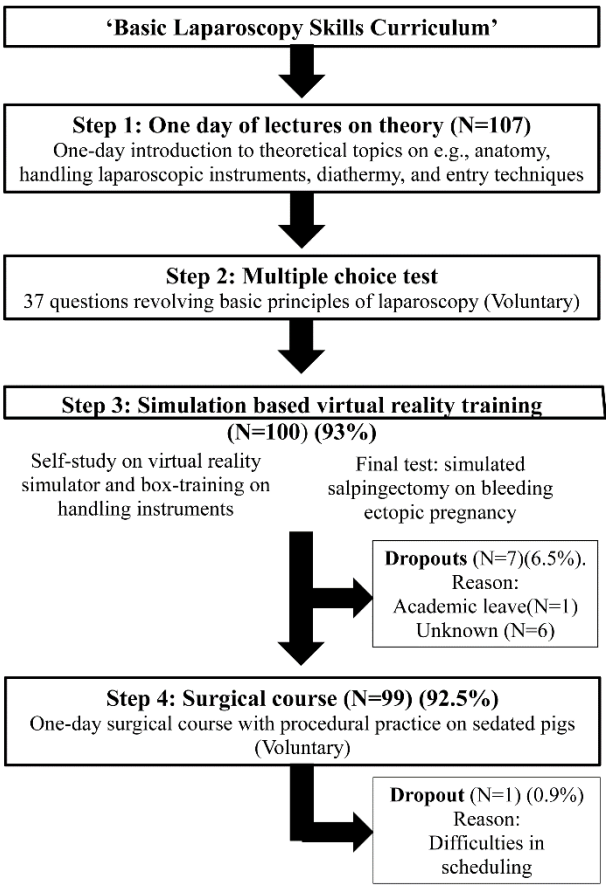

Figure 1. Flowchart of the four steps in the Basic Laparoscopic Skills Curriculum with participants and dropouts.

Part of the technical skills training was proficiency-based virtual reality simulator training comprising basic skills and a procedural module simulating a bleeding ectopic pregnancy that requires residents to perform a salpingectomy. This module has previously been shown to improve skills in the operating room (11).

The participants were all first-year residents in one of the seven OBGYN departments in Eastern Denmark. They participated in the basic laparoscopic skills curriculum from September 2014 till August 2018. All participants were given a minimum of six months to complete the curriculum. CAMES extracted data on participation and completion, and results were anonymized for the author group. Participants who had not completed the curriculum within six months received a voluntary web-based anonymized questionnaire (SurveyMonkey Inc., San Mateo, California, USA) asking their reason for dropping out.

Ethical approval

This project was evaluated at Danish National Committee on Health Research Ethics in September 2019 and reviewed unnecessary to need specific ethical approval due to neither use of biological material or influence on patient treatment. All data from participants was pseudo-anonymized.

RESULTS

A total of 107 first-year residents from the seven OBGYN departments in Eastern Denmark participated in the curriculum, 93% (n=100) of whom completed the first three steps, and 92.5% (n=99) of whom completed all four steps (figure 1), leaving a total dropout of eight residents which equals 7%.

The median time spent on training on the virtual reality simulator was 249 (IQR 164) minutes, minimum 64 minutes and maximum of 630 minutes, figure 2 panel A. Median days from completion of step1 (one-day course) to completion of step 4 (surgical course on sedated pigs) was 56 days (IQR 98), minimum 14 days and maximum of 253 days, figure 2, panel B. Two participants spent 386 and 461 days due to maternity leave, which is why they were considered outliers and not included in calculation of the median.

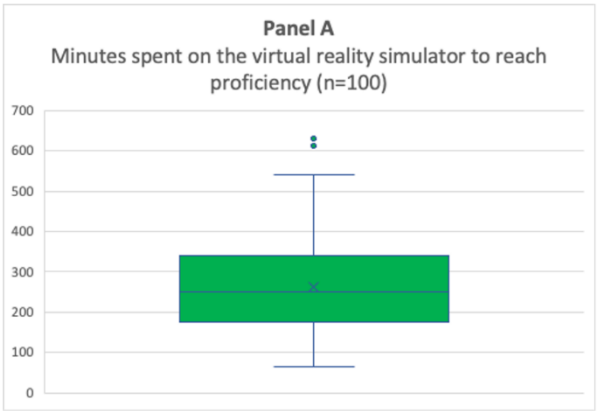

Figure 2. Box plot.
Panel A: Minutes spent on the virtual reality simulator to reach proficiency (n=100), median 249 (IQR 164). *IQR*=Interquartile range.

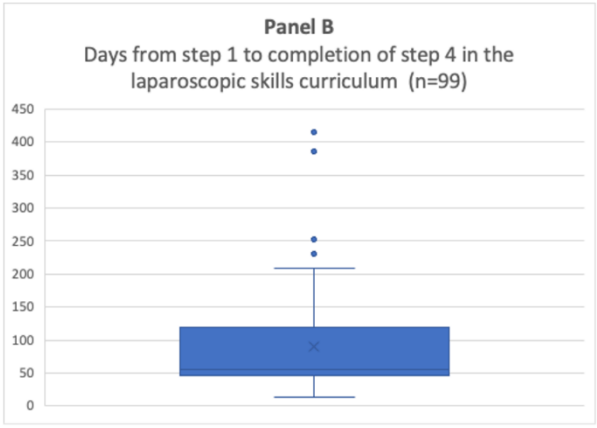

Figure 2 continued. Box plot. Panel B: Days from step 1 to completion of step 4 in the laparoscopic skills curriculum (n=99), median 56, (IQR 98).

Two participants provided feedback on reasons for dropout; one did not complete step 3 due to academic leave and the other did not finish step 4 due to a lack of availability. The remaining six dropouts did not return the questionnaire.

DISCUSSION

Participation and completion rates in this four-year follow-up study of a partly mandatory OBGYN laparoscopic skills curriculum in Eastern Denmark was high.

Adoption of a curriculum relies on a supportive environment at an organizational level that can motivate and engage people (20). Moreover, it is important that educational institutions and health care regulators accept and recognize the educational initiative; otherwise, it is unlikely to last (21,22). Our study indicates that a well-designed training program with designated training time and feedback-based training sessions will achieve high participation and completion rates, which can only be interpreted as a good thing. However, we do not know exactly what motivated the residents to attend and what parts of the program that accounted for this. We believe that a mixture of designated time to participate and mandatory training is essential and a part of the explanation (23). Figure 3 sums up our recommendations for successful development and implementation based on our observations and experience.

A lack of designated time to train and departmental support have previously been described as a factor for dropout (14,24), which is in accordance with other studies showing attendance rates increasing more than ten-fold when courses become mandatory and time is specifically allotted to training (25,26). Another essential factor for participation is trainee motivation, which this study did not investigate, although the high participation rate in the voluntary steps of the curriculum may reflect this. The low response rate from dropouts prevented us from sufficiently analyzing reasons for dropping out.

Departments are expected to allocate designated time for training, and this study shows that overall participation in the curriculum is distributed across an average of three months, with just over four hours of effective time spent on the virtual reality simulator. The initial development and implementation of the curriculum was comprehensive and included cooperation with the head of education and management from each department. Mutual agreement and investment in the curriculum design on an organizational level appears to be a crucial factor for its success and supports the finding that a lack of involvement from key stakeholders, such as hospital management, can be a barrier for implementation (27).

In Eastern Denmark, the curriculum is pooled centrally across specialties at CAMES, making it possible to have up-to-date virtual reality simulators, flexible booking sessions and specialized medical student assistants available to provide feedback. A well-functioning simulation center with skilled staff and both high and low fidelity training models is essential for engagement. Virtual reality simulators have an advantage when training more complex procedure modules, but in smaller settings where virtual reality simulators and supervisors are not readily available, modern box training with standardized scoring systems can serve equally well as a part of training curriculum for basic skills training (8,28).

No calculations are available on the cost effectiveness of a comprehensive surgical curriculum compared to traditional apprenticeship training, nor have any studies been conducted on the transferability of the CAMES basic laparoscopic skills

- Development
  - Evidence-based approach, i.e. using proficiency-based training and self-directed learning.
  - Involvement of all organizational levels, i.e. head of education and head of department in order to make sure time is allocated to training at a simulation center (2-3 days)
  - Implementation in the state of aims of a specialty, to gain organizational responsibility, this will make it clear that simulation training is taken seriously as an educational strategy

- Designated training time
  - Dedicated supervisors both for the skills and knowledge modules
  - Centralized simulation center or pooling of resources in order to elevate organized and structured training for all residents in a specialty and geographical area

- Follow-up/research
  - Compilation and report of data to be able to publish relevant studies and make enhancements
  - Ongoing evaluation and update of curriculum to keep up with technological advances and new educational methods

Figure 3. Recommendations for successful development and implementation of a curriculum in basic laparoscopy.

curriculum to real surgeries. However, previous studies have shown that simulation-based laparoscopic training can result in higher performance scores on assessment scales and shorter operation times from 17-50% for the surgeon (10). Our study shows an average of slightly more than four hours spent on the virtual reality simulator, ranging from one to ten hours to achieve proficiency. This supports proficiency-based training, which increases efficiency by using self-regulated, deliberate practice, which secures that a uniform skill set is achieved.

Initial surgical skills training should be performed on simulators to protect patients from unnecessary risks. It is an ongoing process to refine surgical educational skills curricula with the newest technological advancements, and to continue to develop a safe, optimal skills curriculum based on simulation-based training (29). In a high income country like Denmark, with a well-organized public health care system, we should always aim at providing the best care for patients but also the best training options for surgical residents – both in regard to simulation technology and standardized and continuously education. Previous studies have shown that resident's retention of skills persists the first six months but after 18 months laparoscopic skills had returned to the pre-training level which emphasizes the importance of continuity of simulation training (30).

Strengths and limitations

One of the strengths of this study is the long period of data collection, indicating that the curriculum is sustainable throughout the years. Additionally, the high participation support acceptance from all gynecological departments in Eastern Denmark.

A limitation of this study is the missing collection of data form the multiple-choice test which would have contributed with insight to the knowledge taught in the curriculum. Thoughts are currently put into whether the test could be online and become mandatory.

We conducted this follow up study over a two-year period, which was longer than anticipated and mainly due to COVID-19 obstacles, continuous follow up is anticipated.

CONCLUSION

Completion rates were continuously high in our regional curriculum in basic laparoscopy consisting of both knowledge and skills. We believe this is due to protected participation time, self-directed learning,

and flexible booking of training sessions. Implementation of a successful validated laparoscopic skills curriculum calls for designated training time, organizational responsibility, and follow-up over time.

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