

# A step forward in surgical education?

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Traditionally, surgical education was imparted through intensive work, practice, and, most importantly, experience. It was estimated that a trainee would work over 30,000 hours before becoming a consultant<sup>[1]</sup>. The training curriculum has changed substantially on numerous occasions to meet the requirements of the European Working Time Directive. Despite these perceived thefts from surgical experience, there is still little evidence to support a claim that we are producing worse surgeons<sup>[2]</sup>.

We have also seen a shift in the responsibilities of a surgeon. Over time, the field of medicine has become increasingly super-specialized. This has led to surgeons with very specific skillsets, in stark contrast to surgeons of the past, who were able to perform a vast multitude of procedures. This has partly been driven by improvement in patient care, and a desire to become an “expert” in a particular field<sup>[3]</sup>.

In addition, the advancements made in the surgical field have led to a greater number of procedures to learn and master. Therefore, rather than focusing on being competent in a large number of specialties, surgery has changed so that surgeons now focus on maximizing the effectiveness of the tools they have<sup>[4]</sup>.

This has stimulated the need for a new surgical training curriculum, and new educational methods. With a combination of super-specialization and legislative restrictions, we need to develop new ways to train new surgeons to an appropriate level so that they can practice independently. One of these key tools is simulation.

Simulation has been used in clinical training from as long ago as 600 BC in ancient India<sup>[5]</sup>. The rapid development of technology in the past few decades has led to the production of simulations in settings similar to real clinical environments. These scenarios can be used to educate surgical trainees on the method of performing a procedure, allowing them to practice a procedure in a safe, nonthreatening environment before applying it in a supervised clinical setting; this type of education is recommended by the Department of Health<sup>[6]</sup>.

There are numerous advantages to the use of simulations. It enables trainees to safely monitor their progress, and it allows

trainees to develop an understanding of these clinical scenarios before they are involved with patients. In addition, from a learning point of view, people tend to learn from their mistakes, and simulation provides an artificial environment to make them. This minimizes the risk to the patients and allows the surgeons to learn and perfect new skills.

Simulations also allow for a more accurate assessment of a surgeon’s technical abilities. Logbooks from normal practice can be heavily influenced by the conditions under which the procedure is performed (the patient’s condition, the theater environment), whereas simulation allows for a standardized situation and has greater validity in assessing a trainee’s skill<sup>[7]</sup>.

However, it has been difficult to assess the difference in efficacies between animal and artificial simulations because of a gap in the literature. Pantelidis and colleagues addressed this issue in an article recently published in the *Annals of Medicine and Surgery*. They ran a “Fundamentals in Laparoscopic Surgery” module in both a laparoscopic simulator and an “in vivo” model. They used 2 groups of students, and had them participate in both groups, either in vivo first or the dry-lab simulation first. They concluded that high-fidelity in vivo simulation does not significantly improve results in comparison with dry-lab simulation<sup>[8]</sup>.

This finding is key for planning surgical education in the future. There are many factors to be considered when introducing dry-lab simulation into the surgical training curriculum. Though Pantelidis and colleagues conducted their study at the undergraduate level, they showed that the same level of expertise can be provided following either pathway. This has an impact in multiple ways. In the long run, the time required to set up the simulations will be reduced to the push of a button, and it eliminates the unnecessary death of animals for the simulations when there is a viable alternative.

There are potential implications when the artificial route is taken. These simulation suites can be expensive in comparison with animal models. There is also the question of whether these simulations are realistic. Pantelidis et al<sup>[8]</sup> showed that these dry-lab simulations can be as efficacious as porcine models, and this is corroborated by Shaharan and Neary<sup>[7]</sup>. In addition, at the undergraduate level in particular, haptic feedback is not necessary for the development of a similar skillset, as evidenced by Pantelidis and colleagues.

One significant issue that has not been addressed by these studies, or by many other studies, is how transferable the surgical skills are from the dry-lab simulations to real theater experience<sup>[7]</sup>. See and colleagues conducted a systematic review of evidence for endovascular simulation training. The review found that observed metrics within the simulations do improve with repeated practice (as one would expect), but there is not enough evidence to predict that simulations will improve patient outcomes, or whether simulation is a superior training method in comparison with traditional “apprenticeship” models<sup>[9]</sup>.

Recent Cochrane reviews in Gastrointestinal Endoscopy, ENT, and Laparoscopic Surgery also corroborate the findings of See and colleagues. They all found that, though simulation is a vital tool in

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terms of supplementation, there is still no reliable or accurate way to compare their translatability to the operating theater<sup>[10–12]</sup>. This is a vital area that needs addressing in future surgical education research.

Another issue with simulations is that there is a lack of haptic feedback—the sensation of pulling tissues that you feel when operating on a patient or using one of the animal studies. Interestingly, there is no consensus on the importance of haptic feedback in minimally invasive surgery simulations<sup>[13]</sup>. There is also no denying the fact that, psychologically speaking, it will be a very different experience for the trainee to be operating on a person for the first time compared with a simulation.

However, the translatability of skills, the importance of haptic feedback, and psychological impacts have not been researched in enough detail or validity to fairly comment on. The relevance of Pantelidis and colleagues is clear: dry-lab simulation can be as effective as wet-lab simulations. If further studies corroborated these findings, this could lead to the implementation of more simulation centers throughout the country with the knowledge that similar skills can be gained without the need for a wet lab.

The advantages of repeated practice, objectively monitoring your progress, and gaining a solid foundation in surgical practice in a stress-free environment lends one to think that this is the way forward, and that dry-lab simulations are going to become more pervasive with time—more so considering the implementation of virtual reality as a way to augment the simulations.

Future studies in surgical education need to address this lack in the literature regarding translatability—to ensure that investments are not made in technologies that do not effectively improve surgical skills. More importantly, however, research needs to stay in touch with the latest simulation devices, as some have started introducing haptic feedback, and these may have a much greater impact on surgical skill development.

Nevertheless, it is important to understand the importance of the study. It has shown that two different surgical teaching tools develop a similar skillset, and educational research should focus on the translatability of these skills. Even if there is a difference between the modalities, skill translation is the most important factor that has not been addressed thus far<sup>[7]</sup>.

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