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Simulator training in gastrointestinal endoscopy – From basic training to advanced endoscopic procedures

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Abbreviations: OGD, oesophagogastroduodenoscopy; EMR, endoscopic mucosal resection; EMS, ERCP mechanical simulator; ESD, endoscopic submucosal dissection; ERCP, endoscopic retrograde cholangiopancreatography; EUS, endoscopic ultrasound; GI, gastrointestinal; VR, virtual reality.

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A B S T R A C T

Simulator-based gastrointestinal endoscopy training has gained acceptance over the last decades and has been extensively studied. Several types of simulators have been validated and it has been demonstrated that the use of simulators in the early training setting accelerates the learning curve in acquiring basic skills. Current GI endoscopy simulators lack the degree of realism that would be necessary to provide training to achieve full competency or to be applicable in certification. Virtual Reality and mechanical simulators are commonly used in basic flexible endoscopy training, whereas *ex vivo* and *in vivo* models are used in training the most advanced endoscopic procedures. Validated models for the training of more routine therapeutic interventions like polypectomy, EMR, stenting and haemostasis are lacking or scarce and developments in these areas should be encouraged.

Introduction

During the last decades simulation-based training has gained more acceptance in teaching basic endoscopy skills to novice endoscopists. Traditionally, trainees learn to perform endoscopy by hands-on training in a clinical setting under the supervision of a trained endoscopist, the so-called master apprentice model. The main benefit of this teaching method is on-the-job training under one-on-one supervision by an experienced endoscopist offering immediate feedback. However, taking the first steps in flexible endoscopy while performing procedures on actual patients has certain drawbacks. It is learning by 'trial and error', which potentially increases patient discomfort and risk of complications. It also adds extra time to each procedure affecting capacity and economics [1]. An important drawback of such an approach is that with this type of training it is difficult for novices to appropriately process feedback in a stressful situation with an overload of new information. The approach of 'see one, do one and teach one' therefore seems outdated and no longer appropriate in the modern education of medical professionals, in particular in their early learning curve. Skillslabs and simulators offer the potential to train in a dedicated 'learning environment'. This is a safe environment for trainees where no possible harm can be done to patients. Stress factors related to doing a procedure in a live patient are eliminated to create an optimal setting for training. In this particular learning environment, it is also entirely possible to combine hands-on training with thorough theoretical teaching. Exercises can be repeated multiple times in small building blocks or specific scenario's until fully mastered.

In recent years, a number of studies have been published on simulator training, usually describing the benefit of simulator training in the early learning curve towards competency. A recent systematic review demonstrated moderate quality evidence for simulator-based training in forward viewing flexible endoscopy and ERCP. The review reveals that the use of virtual reality simulators in the early training setting accelerates the learning of practical skills [2]. However, the literature on simulator training for more advanced therapeutic procedures is scarcer, aside from studies on managing acute gastrointestinal bleeds or advanced endoscopic resection in *ex vivo* or *in vivo* animal models. A realistic simulation model for polypectomy, one of the most frequently performed therapeutic procedures, is still lacking among currently available simulators. Compared to the aviation or automotive industry, we can only acknowledge with envy that we are miles behind when it comes to realistic medical simulators.

In this chapter we will outline the well-established role of simulators in basic endoscopy training and elaborate on the role of (virtual reality (VR)) simulators, mechanical models, *ex vivo* and *in vivo* models for training in advanced endoscopic procedures.