Università degli Studi di Genova
DISC
Dipartimento di Scienze Chirurgiche e Diagnostiche Integrate

Titolo: **Simulazione in chirurgia**	**SSD: chirurgia**	**Responsabile della ricerca: Marco Frascio**
Finanziamento (NO PROFIT – NOME DELLA CONTROPARTE)	Proposto come PRIN Marco Frascio responsabile gruppo di ricerca	
Riassunto	**Abstract** The European Society for Translational Medicine (EUSTM) defines Translational Medicine (TM) as an interdisciplinary branch of the biomedical field supported by three main pillars: benchside, bedside and community". The aim of TM is to enhance prevention, diagnosis, and therapy. Translation describes "translating" laboratory results into potential health benefits for patients. Research on medical education contributes to translational science because its results enrich educational settings and improve patient care practices. Simulation-Based Medical Education has demonstrated its role in achieving such results. In April 2004, the Food & Drug Administration became involved in the discussion about the didactics of young surgeons, demanding the development of a learning program based on simulators that were primarily tested and validated by industry experts, thus sanctioning the start of the "Simulation era". Surgery requires learning in a simulated and safe area before operating on the patient, also to respect ethical and social implications. For these reasons, the Accreditation Council for graduate medical education has stipulated that all structures accredited for surgical teaching must include simulation. At present, many centers are equipped with simulation areas, but there is still significant disagreement about how to develop training programs: efforts are needed to standardize these training paths. To this purpose, in the United States, standardized training courses (e.g. FLS - Fundamentals of Laparoscopic Surgery) are needed to acquire "American Board of Surgery" certification. The new Italian medical specialization teaching system was approved in 2017, but the integration of simulation into training programs is not mentioned. Despite this gap, many surgeons are aware that proper simulation training is of mainstream importance for the education of young surgeons: to this purpose, dedicated programs are being set up, but only in a few settings. These programs can be supported following two main paths: 1) using devices that are already on the market (the more expensive option) and/or 2) with research projects aiming to develop custom-built surgical simulators. Two main simulator models are currently available: physical and virtual platforms. Physical simulators (box trainers) were the first to be introduced. They are cheap, and the haptic feedback is authentic. They reproduce basic gestures but do not allow to reproduce entire surgical procedures or intraoperative complications. These	

	restrictions have been overcome by the introduction of virtual platforms that allow to simulate, in addition to basic skills, more complex and realistic surgical scenarios. Several studies have demonstrated the effectiveness of virtual platforms on surgical training, but their high costs and unrealistic haptic feedback do not allow their diffusion in the departments involved in teaching programs. Haptic feedback is a key feature of a mixed physical/virtual simulator because its realism is essential for the correct learning of laparoscopic gestures. Nevertheless, it is often the most neglected part of the system mostly because of the lack of a mathematical algorithm that can calibrate the real feedback force during the interaction with virtual organs and tissues. To improve the surgical training program, a team of general surgeons and engineers of the University of Genoa developed a mixed (virtual/physical reality) robotized surgical simulator (elaparo4D) focused on two essential features: the lowest possible cost and a realistic haptic feedback. As established by the FDA's protocol, the validation study performed to verify if the simulator was able to discriminate surgical abilities demonstrated that eLaparo4D allowed to differentiate young surgeons (residents with limited surgical experience) from students that had no experience in laparoscopic surgery. The main implementation of eLaparo4D, and the focus of this project, is a totally new approach to teach surgical gestures, inspired from what happens in a real surgical setting, where the teaching surgeon "moves" the hands of his apprentice to favor the movements the way he prefers. The "Puppet Mentoring" is a scenario where a virtual machine can record the movements of the surgeons and the assistants in a real surgical operation and is able to reproduce and "induce" them in a simulated environment, driving the young surgeon toward a correct performance of his movements and, finally, of his surgery. Fine motion tracking of each surgical act is possible within a controlled area (the simulated operational scenario) where kinematic and dynamic data of tools, instruments and people involved in the scenario are collected using an IoT (Internet of Things) based low-cost infrastructure.
Link al protocollo	