

Development and Evaluation of a Proficiency-based and Simulation-based Surgical Skills Training for Technical Medicine Students

Dr. Frank R. Halfwerk^{1,2}, Dr. Erik Groot Jebbink^{3,4}, Dr. Marleen Groenier³

¹ Department of Cardio-Thoracic Surgery, Thoraxcentrum Twente, Medisch Spectrum Twente, Enschede, The Netherlands

² Department of Biomechanical Engineering, Faculty of Engineering Technology, University of Twente, Enschede, The Netherlands

³ Technical Medical Centre, University of Twente, Enschede, The Netherlands

⁴ Department of Surgery, Rijnstate Hospital, Arnhem, The Netherlands

Corresponding author:

Frank R. Halfwerk, Department of Cardio-Thoracic Surgery, Thoraxcentrum Twente, Medisch Spectrum Twente, P.O. Box 50 000, 7500 KA Enschede, The Netherlands, f.halfwerk@mst.nl

Keywords: Patient-centred training; proficiency-based training; simulation-based training; reliability; preclinical learning

The supplementary files corresponding to this manuscript are:

- | | |
|-----------------------------------|---|
| ▪ Supplementary File 1.pdf | Text, course overview |
| ▪ Supplementary File 2.pdf | Figure, procedure-specific rating scale for suturing |
| ▪ Supplementary File 3.pdf | Text, questionnaire in English |
| ▪ Supplementary File 4.pdf | Table, results for technical skills assessment |
| ▪ Supplementary File 5.pdf | Figure, student flow diagram of study |
| ▪ Supplementary File 6.pdf | Figure, grading/skill assessment/time slot (drift analysis) |
| ▪ Supplementary File 7.pdf | Figure, performed skills during rotations (gender analysis) |

This supplement file is listed in bold.

Supplement 1: Course overview

Technical Medicine is a 6-year health care education program including two years of clinical rotations. A description of the curriculum and goals can be found in Groenier et al. (Groenier, Pieters and Miedema, 2017) In the master program students take four simulation-based clinical skills courses to prepare them for their clinical rotations: injections and catheterizations, advanced life support, endoscopic skills and surgical skills. This manuscript focuses on the latter of these skill courses.

The surgical skills course includes a theoretical part about the surgical patient flow and rationale of various surgical skills and a practical part where students practice various technical skills in a simulated environment. The theoretical part was assessed with an online knowledge test and the practical part with a procedural skill assessment.

The test covered the following subjects: preoperative optimization of patients, use of evidence based surgery in clinical decision making, operative procedures, skin suture techniques and advanced suturing (anastomosis, tissue sealing, stapling), electrosurgery, wound management, instrument handling, local and general anesthetics and hygiene.

For pre-operative surgical skills, lectures addressed pre-operative assessment (Problem based learning), optimizing patient conditions and anesthesiology. Group meetings included interpretation of medical imaging and surgical guidelines in a multidisciplinary council and dry lab simulation of local anesthesia administration.

For peri-operative care, lectures included surgical time-out procedure, general surgical techniques and surgical complications. Hygiene and safety, scrubbing and electrosurgery were covered in lectures/group meetings. Wet lab simulation on porcine (skin, lung, heart) tissue included instrument handling, suturing and incision/excision. A live heart surgery was attended to experience patient centered care.

The student to lecturer ratio was 1:8 in dry/wet lab sessions. Both knowledge test and skills assessment were weighted each for 50% of the final grade on the Dutch 1-10 scale (Netherlands Organization for International Cooperation in Higher Education (NUFFIC), 2009).

Post-operative care included wound healing and infection management. Assessment was both on technical skills (scrubbing, suturing, local anesthesia, incision/excision) and a knowledge/surgical principles test.

Supplemental references

- Groenier, M., Pieters, J. M. and Miedema, H. A. T. (2017) 'Technical Medicine: Designing Medical Technological Solutions for Improved Health Care', *Medical Science Educator*, 27(4), pp. 621-631. <https://doi.org/10.1007/s40670-017-0443-z>
- Netherlands Organization for International Cooperation in Higher Education (NUFFIC) (2009) '4', *Grading systems in the Netherlands, the United States and the United Kingdom*. Available at: <https://students.uu.nl/sites/default/files/geo-grading-systems-holland-vs-us-uk.pdf>.