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Simulating success – virtual reality training for tomorrow's operating theatre nurses: A discussion paper

Abstract

The operating theatre represents a complex and critical environment, characterised by the interplay of specialised skills, advanced technology and the demand for seamless teamwork and smooth operational flow. However, some operating theatre facilities face significant challenges, including understaffing and insufficient educational support, which hinder the effective training of operating theatre staff in new specialties and surgical procedures. This gap in training can lead to suboptimal patient outcomes, increased patient risk and surgical complications.

To address these challenges, virtual reality technology emerges as a transformative solution. It provides immersive and hands-on training experiences that can be accessed regardless of staffing levels or resource constraints. Through realistic simulations of surgical procedures, virtual reality allows staff to practice and refine their perioperative skills in a safe and controlled environment, thereby enhancing their competency and confidence. It enables individualised learning, accommodates various surgical techniques, and allows for repeated practice without the risks associated with live surgical procedures.

Virtual reality enhances skill retention and procedural confidence among surgical teams, contributing to improved performance and workflow in the operating room. Through virtual reality integration, healthcare institutions can bridge the gap in training, empowering operating theatre staff with the expertise needed to adapt to evolving surgical demands. It not only fosters professional development but also enhances overall patient safety and surgical outcomes.

Furthermore, as the complexity of surgical procedures continues to advance, leveraging virtual reality in the operating theatre can provide a pathway to overcoming staffing and resource limitations. Through virtual reality integration, healthcare systems can ensure that operating theatre teams are well-equipped to deliver high-quality care, benefiting both practitioners and patients. This discussion paper aims to explore the impact of virtual reality in training operating theatre nurses, highlighting its effectiveness in facilitating skill acquisition, improving operating theatre nurses' confidence and reducing their anxiety, and its potential to enhance situational awareness and improve patient safety.

Keywords: virtual reality, operating theatre, operating theatre nurses, instrument and circulating nurses, patient safety, situational awareness

Introduction

Operating theatre nurses are essential to the surgical process; they are responsible for ensuring patient safety, maintaining sterile fields and providing critical support to the surgical team¹. Instrument and circulating nurses require specialised sets of technical and non-technical skills and knowledge to competently assist in complex surgical procedures².

Training operating theatre nurses in new specialised fields is essential yet challenging due to time and resource constraints inherent in the operating theatre³. The preparedness of operating theatre nurses can be compromised by the scarcity of opportunities for hands-on, real-time training⁴. Staff shortages and lack of labour resources result in insufficient training opportunities, leaving many operating theatre nurses

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underprepared for the complexities of their roles⁵. This scenario not only brings about undue pressure on existing staff but also raises significant concerns about patient safety and the overall effectiveness of surgical procedures⁵.

The existing training model for operating theatre nurses relies heavily on the availability of surgical cases, leading to an unpredictable and inconsistent educational experience⁴. This approach often results in protracted orientation periods, as instrument and circulating nurses must wait for specific procedures to occur prior to gaining hands-on experience⁴. Another training modality, used around the world and practiced in Australia, is double scrubbing where a senior instrument nurse assists a less experienced colleague during a surgical procedure⁶. However, staffing shortages and difficulties associated with new and complex specialties and unfamiliar equipment and instrumentation further complicate this learning process^{6,7}.

Integrating virtual reality into training operating theatre nurses offers an effective strategy to address the challenges associated with limited training opportunities and educational resources⁶. It not only enhances skill acquisition but also develops operating theatre nurses' confidence and competence, thereby improving patient safety and situational awareness of operating theatre nurses⁶.

Nevertheless, despite its potential, the integration of virtual reality is not without challenges. High implementation costs, limited access to hardware, the need for faculty training and variable institutional support are significant barriers to its widespread adoption⁸.

This discussion paper aims to investigate the impact of virtual reality technology on training operating theatre nurses, particularly instrument nurses. The paper will examine virtual reality training for instrument nurses specifically focusing on the following themes in the literature – the effectiveness of virtual reality in improving skill acquisition, its role in improving the instrument nurses' confidence and reducing anxiety, and its role in improving patient safety and situational awareness. Through an examination of key themes of virtual

reality training for instrument nurses, this paper aims to provide a comprehensive overview of how virtual reality can transform into an innovative training tool for instrument nurses and contribute to the overall improvements in patient care and safety.

Discussion

Virtual reality is an advanced technology that involves three-dimensional interactive environments that can be customised to mimic surgical scenarios and real-life operating theatre settings⁹. It employs a headset and motion-tracked controllers to immerse users in a simulated environment, fostering the perception of physical presence within this virtual space¹⁰. The virtual realm offers an engaging multisensory environment that integrates visual, auditory and tactile feedback in real-time simulations⁴. The application of virtual reality in training junior surgeons has already demonstrated remarkable results, enhancing the surgeons' technical skills and knowledge and leading to reductions in operative time and errors⁶. Several recent studies have also examined the use of virtual reality in training instrument nurses, finding similar outcomes and enabling virtually acquired surgical skills and competence to be applied to the physical environment^{6,11}.

Effectiveness of virtual reality in improving skill acquisition

In the context of operating theatres, virtual reality aims to improve the training environment through immersing operating theatre nurses in hands-on virtual experience circumventing the need to be exposed to live complicated surgeries¹². Complex surgical procedures demand a thorough understanding of the advanced equipment involved⁶ and, due to the infrequency of this type of surgery, opportunities for learning prior to assisting are limited⁶. A small prospective cohort study involving fifteen instrument nurses demonstrated substantial post-training gains following virtual reality exposure for revision of total knee arthroplasty procedures⁶. The average performance score increased from 11.3 to 83.5 per cent, with concurrent reductions in operative time (47%), procedural errors (47%), and the need for assistive prompts (75%)⁶. These results underscore

the efficacy of virtual reality training in enhancing procedural competence⁶.

Similarly, a mixed methods study assessed the effectiveness of virtual reality training among instrument nurses using the objective structured assessment of technical skill (OSATS)¹¹, a widely recognised tool for evaluating procedural skills among surgical residency trainees¹³. Five instrument nurses exhibited surgical skill improvement from 40 to 62.9 per cent on the OSATS following virtual reality training¹¹. The triangulation of performance data with user feedback provided robust support for virtual reality as an effective training method¹¹.

While findings are encouraging, both studies have methodological constraints. The cohort sizes were small ($n=15$ and $n=5$), limiting statistical generalisability. Furthermore, the short-term nature of the outcome assessments limits insight into long-term skill retention and clinical impact. Moreover, the use of surrogate measures, such as procedural error rates and confidence scores rather than patient outcomes, restricts the evaluation of virtual reality training's real-world effectiveness.

Influence on levels of confidence and anxiety

Frequent specialty rotations, combined with labour and time constraints in the operating theatre environment, contribute to the lack of confidence and heightened anxiety among inexperienced theatre nurses, as they have limited exposure to the specialised surgical procedures for which they are required to provide effective assistance⁶. Virtual reality presents a viable and innovative solution by enabling independent, repeatable and immersive training¹⁴. Unlike conventional methods, virtual reality does not require staff supervision, allowing for independent practice and increased exposure to specialised surgeries¹⁵. This flexibility not only enhances technical proficiency but also supports emotional preparedness by building confidence and reducing anxiety¹⁶.

Evidence from recent studies support these benefits. A feasibility and acceptance study involving seven instrument nurses found that confidence in assisting craniotomies and anticipating intra-operative needs increased from

57.2 to 85.0 per cent following virtual reality training⁴. Notably, participants reported that this improvement could not have been achieved through theoretical instruction alone, underscoring virtual reality training's practical value⁴.

Similarly, a small prospective cohort study of ten instrument nurses demonstrated significant improvements in confidence and reductions in anxiety after virtual reality training for revision of total knee arthroplasty⁵. Confidence scores rose from 1.8 to 3.8 out of 5, while anxiety scores dropped from 3.3 to 2 out of 5⁶. These findings highlight virtual reality training's effectiveness in improving emotional readiness and procedural familiarity, especially in complex surgical procedures.

Impact on patient safety and situational awareness

Virtual reality significantly enhances patient safety by providing theatre nurses with immersive training experiences that deepen understanding of procedural steps and enhance competence and confidence which, in turn, facilitate a smoother workflow and foster situational awareness that contribute to safer surgical environments¹⁷. Situational awareness involves the perception and understanding of potential hazards and awareness of the roles and responsibilities within the surgical team¹⁸. It is a critical non-technical skill that enables instrument nurses to anticipate and respond to intra-operative challenges, thereby reducing the risk of errors and adverse events⁹.

The literature provides supportive evidence of virtual reality's impact on situational awareness and patient safety. A non-randomised comparative study found that virtual reality training significantly improved situational awareness among instrument nurses compared to manual training¹⁶. Participants in the virtual reality group reported higher self-assessment scores across multiple domains, including perceived realism ($p=0.001$), spatial awareness ($p=0.001$) and understanding of instrument assembly ($p=0.014$)¹⁶. These outcomes suggest that virtual reality is critical for developing perceptual and anticipatory skills necessary to maintain procedural flow and reduce intra-operative errors, which is key to patient safety¹⁶.

Complementing this, a small prospective cohort study ($n=8$ expert instrument nurses, $n=18$ instrument nurse students) demonstrated improved error recognition following virtual reality simulation training, with participants identifying more potential hazards in subsequent sessions¹⁷. Participants detected a mean number of approximately nine errors in the first session, increasing to approximately 12 in the second¹⁷. This indicates improved situational awareness and a stronger understanding of team roles and risk factors, which are vital in fostering proactive communication and safe surgical environments¹⁷.

Nevertheless, despite positive findings, current evidence for virtual reality training in the operating theatre is limited by small sample sizes and reliance on self-reported or surrogate outcomes. To support broader adoption, further high-quality studies are needed. Research should focus on objective clinical outcomes, cost-effectiveness and implementation strategies to validate virtual reality training's long-term value and integration into operating theatre nursing education.

Conclusion

In conclusion, virtual reality is a transformative training tool for instrument nurses, effectively reducing reliance on senior staff and avoiding the constraints of traditional training methods. Its immersive nature enhances skill acquisition, enabling instrument nurses to practice complex procedures in a controlled environment, which reinforces technical competencies.

Virtual reality training not only enhances skill but also boosts confidence and reduces anxiety levels among instrument nurses, contributing to a better equipped workforce. Virtual reality enhances situational awareness, empowering instrument nurses to identify potential hazards and respond proactively, which is critical for patient safety. The substantial reduction in procedural errors associated with virtual reality training highlights its potential to enhance clinical practice.

The integration of virtual reality into training instrument nurses is essential for cultivating a competent, confident and safety-conscious nursing workforce,

leading to improved patient outcomes in surgical settings. This approach represents a vital advancement in preparing operating theatre nurses for the complexities of modern health care.

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