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Virtual Reality in the Intensive Care Unit: State of Play and Future Prospects

An overview of the practical uses of virtual reality in the ICU and the benefits it can provide.

One way of defining virtual reality (VR) is as the set of techniques and systems required for human beings to enter computer-generated synthetic worlds. VR techniques are based on real-time interaction with an artificial immersive world using behavioural interfaces that enable both physical and emotional perceptions of a number of sensations (including visual, auditory and haptic perception).

It is difficult to pinpoint the source of the concept of virtual reality. Indeed, as far back as antiquity Plato reflected, in the Allegory of the Cave (The Republic, Book VII), on the persuasive powers of images and their ability to deceive the senses. It was not until 1938 that the term virtual reality was published for the first time by the writer Antonin Artaud in The Theater and Its Double. In 1935 S. Weinbaum, the science-fiction author of Pygmalion's Spectacles, first depicted glasses bearing an uncanny resemblance to modern-day VR headsets (allowing the wearer to experience a fictional world through holograms, smell, taste and touch).

From a technical perspective, the ancestor of virtual reality dates back to the mid-19th century and the invention of the first stereoscopes that were able to generate three-dimensional photographs from two-dimensional images. In 1957, Morton Helling invented the first immersive cinema (the Sensorama simulator), enabling immersion in short films by harnessing a range of senses (using stereo sound, vibrating seats, smell diffusion, and fans).

The first VR headset dates back to 1968 and featured the Sword of Damocles (Ivan Sutherland). But it was not until the 1980s that the VR experience became more widely available via Jaron Lanier, using more ergonomic headsets and gloves (the DataGlove) that provided total immersion. Since then, NASA, the armed forces and the video game industry have been contributing to a significant evolution in VR technology for industrial and commercial use.

The scope of activity of VR has broadened since the early 2000s. This technology is widely employed in many sectors such as law, architecture, communication and industrial design.

One of the first ideas behind VR applied to the medical field comes from Eccleston et al. in 1999 and their work on pain's cognitive modulation through attention, which was strengthened by Bantick et al. in 2002 with their original study using functional MRI to assess those neurocognitive changes.

Since then the scientific literature has become increasingly extensive, encompassing cognitive behavioural therapies in psychiatry and addiction care, the effects of VR on pain pathways and anxiolysis in pain management and palliative care, surgeon training in surgery, Parkinson's patients in neurology, physical therapy, and alongside locoregional anaesthesia or simply when anaesthesia is administered in anaesthesiology.

Recently its applications have developed to reach biofeedback therapies and preventing pain catastrophisation in chronic pain. In 2018 a meta-analysis by Chan et al. (2018) pointed a beneficial effect for VR versus control groups in 16 well conducted randomised controlled trials with analgesia as their primary outcome, including various medical units.

What are the implications for intensive care medicine in 2019? The literature is unfortunately rather sparse. And yet the scope for VR in intensive care is, in our view, considerable.

Patients admitted in the intensive care unit are subjected to a multitude of unpleasant sounds, lights and nociceptive pain which can be perceived as a hostile environment. They predominantly recount feelings of anxiety and discomfort generated by both an unfamiliar and stressful surrounding and numerous care-related procedures that are liable to induce cognitive dysfunction accounting for delirium in up to 31% of cases (Aruguman et al. 2017), post-intensive care syndrome in between 17% and 43% (Needham et al. 2013; Pandharipande 2013; Davydow et al. 2013) of cases and post-traumatic stress disorder in between 15% and 40% (Righy et al. 2019) of cases according to scientific studies. These complications are known to be associated with an increase of the average length of hospital stay, morbidity and mortality.

Turon et al. (2017) investigated the use of VR and its safety using a system comprising a television screen and a motion sensor for patient interaction. The results seem promising since it showed that critically ill patients mostly considered the sessions enjoyable and relaxing without being overly fatiguing.

The use of VR in intensive care units is ostensibly beneficial in reducing anxiety by immersing patients in a soothing, comforting environment. It could potentially be employed in critical patients to help tolerate mechanical ventilation, enhance physical therapy to combat sarcopenia and exert an anxiolytic and analgesic effect during painful procedures (catheter insertion, painful dressing changes, or progressive drain removal). Moreover, it can be a determining tool in restoring the patient's sense of purpose in the healing process.

In our view, it is of interest to assess the feasibility of using a VR headset to intensify the degree of patient immersion within this context.

Standardised protocols are therefore required to undertake feasibility and safety studies of VR headsets to determine their use and efficacy in intensive care units. Regarding feasibility, use of VR headsets should be assessed in terms of accessibility to this technology (purchase price and maintenance), ease of bedside installation, training of the care team and implications for healthcare.

In terms of safety, we believe it is important to catalogue any significant adverse effects that may arise from a session. These may be neurocognitive (delirium, anxiety, agitation) or physical (nausea/vomiting, removal or displacement of medical devices, incidence of falls or trauma). Furthermore, it is important to assess tolerance since the headset involves not only visual but auditory isolation. In our view the risk of cross infection between patients should also be assessed since it could be seen as a drawback (assessment of disposable sanitary eye masks and headset disinfection procedures).

At the dawn of a constantly evolving technology and an increase access to affordable devices that can become of everyday usage, it seems legit to focus on the practical uses of Virtual Reality in the ICU and the benefits it can provide. Given that the literature on this topic is quite sparse, further clinical studies are required to assess the efficacy of using this type of technology, knowing that it can be hard to assess some minor changes in the above-mentioned criteria. ■

References

For full references, please email editorial@icu-management.org or visit https://iii.hm/ygw