ORIGINAL CLINICAL REPORT

OPEN

Virtual Reality Tailored to the Needs of Post-ICU Patients: A Safety and Immersiveness Study in Healthy Volunteers

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OBJECTIVES: ICU treatments frequently result in long-term psychologic impairments, negatively affecting quality of life. An effective treatment strategy is still lacking. The aim of this study was to describe and evaluate the safety and immersiveness of a newly designed ICU-specific virtual reality module.

DESIGN: A randomized controlled healthy volunteer trial.

SETTING: ICU of the Franciscus Gasthuis & Vlietland Hospital (Rotterdam, the Netherlands), a large teaching hospital.

PARTICIPANTS: Forty-five virtual reality–naive healthy volunteers.

INTERVENTIONS: Volunteers were randomized to three arms: the head-mounted display virtual reality group ($n = 15$), the 2D group ($n = 15$), and the crossover group ($n = 15$). Safety was assessed by changes in vital signs and the occurrence of simulator sickness (Simulator Sickness Questionnaire). Immersiveness was assessed using the Igroup Presence Questionnaire.

MEASUREMENTS AND MAIN RESULTS: Volunteers in the head-mounted display virtual reality group experienced more mild symptoms of simulator sickness, expressed as symptoms of dizziness ($p = 0.04$) and stomach awareness ($p = 0.04$), than the 2D group. Nevertheless, none of the individual Simulator Sickness Questionnaire items were scored as being severe, no changes in vital signs were observed, and no sessions were prematurely stopped. Volunteers in the crossover group experienced a higher total presence ($p < 0.001$) when using head-mounted display virtual reality, expressed as a higher sense of presence ($p < 0.001$), more involvement ($p < 0.01$), and more experienced realism ($p < 0.001$).

CONCLUSIONS: ICU-specific virtual reality appears safe and more immersive than 2D, implicating that ICU-specific virtual reality is feasible for clinical use. One should however be aware of simulator sickness-related symptoms. Future research is needed to confirm these findings in survivors of critical illness.

KEY WORDS: postintensive care syndrome; posttraumatic stress disorder; simulator sickness; virtual reality

Advances in critical care medicine have considerably increased the survival rate of critically ill patients (1, 2). Up to 70% of this growing population of ICU survivors develops long-term physical, cognitive, and psychologic impairments, leading to social isolation and decreased health-related quality of life, collectively referred to as the postintensive care

DOI: 10.1097/CCE.0000000000000388

syndrome (3–5). The psychologic component of the postintensive care syndrome, that is, anxiety, depression, and/or posttraumatic stress disorder (PTSD), is considered the most important determinant for a self-reported unacceptable outcome and a decreased health-related quality of life (6–8). Despite this growing awareness, several interventions, such as ICU follow-up clinics, ICU diaries, and early in-ICU psychologic interventions, appeared ineffective in improving psychologic sequelae of the postintensive care syndrome (9–11).

Virtual reality (VR) mitigates some of the limitations of traditional exposure therapies and is extensively implemented in the clinical psychology field to treat mental health disorders, including PTSD and anxiety (12, 13). A recent meta-analysis demonstrated that VR, in the form of exposure therapy, significantly reduced PTSD symptoms in a non-ICU setting (14). In a hospital setting, head-mounted display VR (HMD-VR) is effective in delivering information to patients, resulting in increased patient satisfaction and better postoperative outcomes (15, 16). Recently, a commercial meditative app using HMD-VR improved patient experiences and lowered pain perception during an ICU stay (17).

After the ICU, VR-based modalities are lacking, whereas patients have an unmet healthcare need for more information and support in mental recovery (18, 19). VR-based informative exposure could therefore be a promising tool to improve psychologic well-being after an ICU stay.

As such, an important challenge for VR to gain widespread acceptance is to make it suitable for specific types of patients, for specific needs, and to determine potential discomfort (20). To overcome such hurdles for critical illness survivors, ICU-specific VR (ICU-VR) is needed. To date, there are no virtual ICU scenarios available, and concerns about VR-related simulator sickness, also known as "cybersickness," remain (e.g., bodily discomfort associated with exposure to VR content due to discordance between the visual and vestibular systems) (21–24). Careful evaluation is crucial since sensory overload and a high demand on cognitive capacity might increase the risk for mental fatigue and stress responses.

We therefore developed an ICU-VR module tailored to the needs of post-ICU patients to improve treatment understanding. As a first step, we tested its safety and immersiveness in healthy volunteers and hypothesized that it is safe and more immersive than a 2D view.

METHODS

Study Design and Participants

This randomized healthy volunteer study was conducted at an urban teaching hospital in Rotterdam, the Netherlands. We recruited 45 healthy volunteers between 45 and 75 years old with no history of ICU admission or previous experience with medical VR. Healthy volunteers who suffered from active schizophrenia, who were known to have epilepsy, or who were currently pregnant were not recruited. The Medical Ethics Committee United, Nieuwegein, the Netherlands, approved the study protocol (Medical Ethics Committtee number NL57641.101.16, February 2, 2017), and written informed consent was obtained from all volunteers. Volunteers did not receive any financial compensation for participation.

ICU-VR Script

We designed a film script tailored to the needs of critical illness survivors. The content was determined based on previous studies and two interdisciplinary team meetings consisting of three intensivists, a psychologist, a psychiatrist, two ICU nurses, a critical illness survivor, a VR director, and a VR engineer (19, 25, 26). The ICU-VR script was designed to offer relevant and factual information to patients regarding their ICU treatment. Six items were selected to be included in the module: 1) introduction and tour around the ICU guided by a voice-over; 2) explanation of all devices and noises in an ICU room; 3) information regarding mechanical ventilation, intubation, and tracheal tube suction; 4) explanation about central/peripheral catheters, IV drips, and the gastric tube; 5) explanation regarding the treatment team and ICU workflow; and 6) an sepsis explanation. The film script can be found in **Supplement 1** (http://links.lww.com/CCX/A577).

ICU-VR Module

The VR film, based on the novel ICU-VR script, had a final length of 10:55 minutes and was filmed using an Insta360 Pro camera (a standard prolevel 360-degree 3D camera; Shenzhen Arashi Vision, Shenzhen,

China). Real ICU nurses and ICU physicians were used to reenact a typical day/treatment for a mock patient in intensive care. The point of view for the camera was the field of vision of the mock patient lying in a hospital bed (**Fig. 1**). Procedures were animated using computer-generated imagery.

The module can be watched via HMD-VR glasses (Oculus Go, Irvine, CA) and via the 360-degree platform on YouTube (YouTube; LLC, San Bruno, CA) through a 2D MacBook flat screen (Apple, Cupertino, CA).

Objectives, Outcomes, and Procedures

We pragmatically used randomization with a 1:1:1 ratio to allocate volunteers across the 2D group, the HMD-VR group, and the crossover group. The primary objective was to assess the safety of the newly developed ICU-VR module in terms of simulator sickness and changes in vital variables. The major safety endpoint was defined as early cessation based on physiologic variables or simulator sickness-related symptoms. Simulator sickness requiring the session to be stopped prematurely was considered unsafe.

Healthy volunteers who watched the ICU-VR module in a 2D manner (2D group; $n = 15$) (**Fig. 2*A***), the gold standard for delivering visuoacoustic information, were compared with volunteers who watched the ICU-VR module using HMD-VR (HMD-VR group, $n = 15$) (**Fig. 2*B***). Simulator sickness was assessed using the Simulator Sickness Questionnaire (SSQ), a self-report tool assessing the occurrence and severity of simulator sickness-related symptoms (27). Vital variables that reflect indices of autonomic nervous system activity linked to simulator sickness-related symptoms were heart rate, oxygen saturation, respiratory rate,

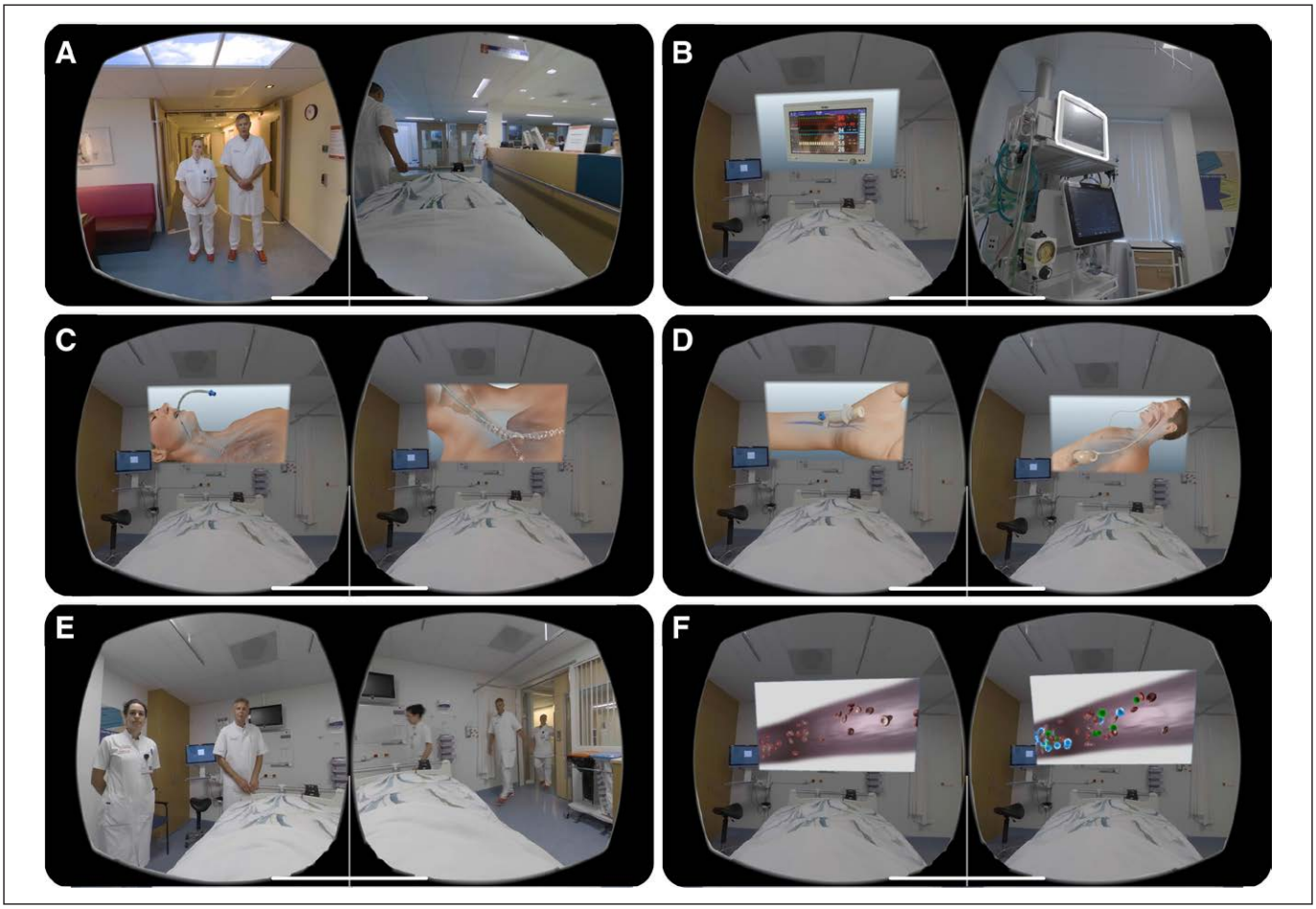

Figure 1. Impressions of the newly designed ICU-specific virtual reality module. The modules consisted of (**A**) an introduction and tour around the ICU guided by a voice-over, (**B**) explanation of all devices and noises in an ICU room, (**C**) information regarding mechanical ventilation, intubation, and tracheal tube suction, (**D**) explanation about central/peripheral catheters, IV drips, and the gastric tube, (**E**) explanation about the treatment team and ICU workflow, and (**F**) sepsis explanation.

Figure 2. Pictures of the study setup. **A**, A healthy volunteer watching the ICU-VR module using a standard notebook 2D flatscreen. **B**, A healthy volunteer watching the ICU virtual reality (ICU-VR) module using head-mounted display virtual reality. Both volunteers are wearing a pulse oximeter to monitor heart rate and oxygen saturation.

and blood pressure. Heart rate, oxygen saturation, and respiratory rate were monitored prior to the module and every 2 minutes during play. Blood pressure was monitored prior to and after the module, as continuous monitoring of blood pressure would distract volunteers from the content. If a volunteer had a heart rate greater than 150 beats per minute, respiratory rate greater than 30 breaths per minute, oxygen saturation less than 90%, a systolic blood pressure greater than 175 mm Hg during the module, or a change of greater than 20% from baseline, this was considered unsafe, requiring the session be stopped.

The secondary objective was to assess presence (the feeling of being in the virtual environment) and immersiveness (the feeling of being involved in the virtual environment). Immersiveness can properly only be compared when volunteers are familiar with both experiential platforms. We therefore conducted a within-subject analysis comparing the outcomes of healthy volunteers who first watched the module in a 2D manner and thereafter using HMD-VR (crossover group, $n = 15$). Volunteers first watched the 2D version because initial exposure to VR could negatively affect the perception of 2D exposure; we hypothesized that primary exposure to the content of ICU-VR would result in higher immersiveness, regardless of familiarity with the content. Immersiveness and presence were assessed using the Igroup Presence Questionnaire (IPQ). The IPQ was developed to determine the realism of and level of perceived presence in a simulated experience and comprises a list of 14 self-reported items (28). To assess preexisting differences in volunteers' immersive tendencies, the Immersive Tendencies Questionnaire (ITQ) was administered before the start of ICU-VR (29). This 29-item self-report tool measures volunteers' involvement in many different daily activities such as watching television, reading books, or enjoying movies. Those who have the ability to become more involved or engrossed in these activities will also have greater immersive tendencies and will more easily feel present in virtual environments (30).

An exploratory objective was to evaluate the perspectives of volunteers on the suitability of the ICU-VR module using a questionnaire. Questions were "Was the content of the ICU- specific video, in your opinion, informative?" and "Would you recommend VR or 2D to show this module to patients after intensive care (i.e., which modality do you find more valuable?)" for patients in the crossover group.

Volunteers watching the 2D version of the module, in either the 2D or crossover group, were not allowed to use the 360-degree interactivity of the YouTube platform. To acclimate volunteers to the virtual environment, all HMD-VR sessions were preceded by two 90-second VR preexposure sessions in a random nature environment, together with a standard spoken instruction by a researcher (J.H.V.) on how to behave in the virtual environment (**Supplementary Table S1**,

http://links.lww.com/CCX/A578; **Supplementary Fig. S1**, http://links.lww.com/CCX/A578).

Statistical Analysis

Baseline demographics were analyzed using descriptive statistics. To assess intrasubject differences, that is, differences in immersiveness scores between 2D and HMD-VR within the crossover group, a Wilcoxon signed-rank test was used. To assess intersubject differences, that is, differences in vital variables or simulator sickness between the 2D and HMD-VR groups, a Wilcoxon rank-sum test was used.

To assess inter- and intrasubject changes in vital variables during the module, a linear mixed regression model was used with time, randomization (only HMD-VR and 2D group), its interaction (time × randomization), and baseline vital variables as independent variables. To assess intersubject differences in categorical outcomes, that is, the outcomes of the individual SSQ items between the 2D and HMD-VR groups, a Fisher exact test was used.

All data were gathered using Castor electronic data collection (Castor EDC, Amsterdam, the Netherlands). Analyses were performed using R for Statistics (R Foundation for Statistical Computing, Vienna, Austria, 2015). A p value of less than or equal to 0.05 was considered statistically significant.

RESULTS

The median age was 61 years (range, 45–74 yr), and 30 volunteers (67%) were female. There were no missing data. Volunteers' characteristics are reported in **Table 1**. The study flow diagram is presented in **Figure 3**.

Safety

No session was interrupted or stopped prematurely due to side effects. Vital signs did not differ between groups (**Supplementary Fig. S2**, http://links.lww.com/CCX/A578). None of the individual SSQ items were scored as being severe. Volunteers in the HMD-VR group experienced more mild symptoms of simulator sickness,

TABLE 1.
Baseline Characteristics of Healthy Volunteers Per Group

Characteristics	2D Group, $n = 15$	Head-Mounted Display Virtual Reality Group, $n = 15$	Crossover Group, $n = 15$
Age, mean (SD, range), yr	61 (7, 47–74)	54 (7, 45–65)	58 (6, 48–67)
Sex, male, *n* (%)	4 (27)	4 (27)	7 (47)
Race/ethnicity, Caucasian, *n* (%)	13 (87)	15 (100)	12 (80)
Educational level, *n* (%)			
Primary education	0 (0)	0 (0)	0 (0)
Intermediate vocational education	4 (27)	6 (40)	8 (53)
Higher vocational education	10 (67)	7 (47)	7 (47)
Academic education	1 (7)	2 (13)	0 (0)
Body mass index, mean (SD), kg/m^3	27.1 (6)	26.4 (4)	27.4 (5)
Employment status, currently working, *n* (%)	10 (67)	15 (100)	13 (87)
Total Immersive Tendencies Questionnaire score, mean (SD), *n* (%)	83 (9)	79 (15)	74 (11)

Continuous variables are presented as mean (SD), ordinal variables are presented as count (%). Immersive tendency is measured using the total score of the Immersive Tendencies Questionnaire. This score determines one's ability to be immersed in a virtual environment using involvement in daily activities.

that is, symptoms of "dizziness with eyes open" (mild symptoms, *n* [%]: HMD-VR, 5 [33%] vs 2D, 0 [0%]; $p = 0.04$) and "stomach awareness" (5 [33%] vs 0 [0%]; $p = 0.04$) (**Table 2**).

Volunteers exposed to HMD-VR scored low on the total SSQ score with a median of 3 of 48 (range, 0–6), the nausea SSQ score with a median of 1 of 21 (range, 0–3), the oculomotor SSQ score with a median of 1 of 21 (range, 0–6), and the disorientation SSQ score with a median of 1 of 21 (range, 0–4) (**Fig. 4*A***). Despite these low SSQ scores, the total ($p < 0.01$) and the disorientation ($p < 0.001$) SSQ scores were higher in the HMD-VR group than in the 2D group.

Immersiveness

Volunteers in the crossover group rated immersiveness higher after HMD-VR than after 2D (IPQ total score, median [interquartile range (IQR)]: HMD-VR, 4.9 [4.7–5.2] vs 2D, 2.0 [1.7–2.3]; $p < 0.001$). Volunteers felt themselves more involved (IPQ Involvement score, median [IQR]: HMD-VR, 4.8 [4.3–5.3] vs 2D, 2.0 [1.4–2.3]; $p < 0.001$) and more present when using HMD-VR (IPQ sense of presence score, median [IQR]: HMD-VR, 5.2 [4.8–5.7] vs 2D, 1.8 [1.1-2.4]; $p < 0.001$) and found HMD-VR more realistic (IPQ experience realism score, median [IQR]: HMD-VR, 5.0 [4.4–5.8] vs 2D, 2.5 [2.0–3.0] $p < 0.001$) (**Fig. 4*B***).

Suitability

Thirty-four of 45 volunteers (76%) rated ICU-VR as informative. In the crossover group, 14 of 15 volunteers (93%) found ICU-VR through HMD-VR more valuable for clinical implementation than through a 2D flat screen, whereas one volunteer remained indifferent (**Supplementary Table S2**, http://links.lww.com/CCX/A578).

DISCUSSION

We demonstrated that ICU-VR is safe in healthy volunteers. Although volunteers in the HMD-VR group experienced more simulator sickness-related symptoms than volunteers in the 2D group, symptoms were mild, and volunteers did not experience substantial physical arousal. Additionally, volunteers were more immersed within the context of HMD-VR and favored this modality for clinical implementation.

In line with previous findings on VR modalities in the intensive care, our results show that this newly designed ICU-VR module is safe (31–33). As noted previously, a VR meditative intervention can be implemented during an ICU stay (17). Although the authors nicely demonstrated that meditation VR could improve sleep and reduce pain, their findings relied on subjective measurements. Furthermore, such VR usage depends on companies to produce applications that are not specifically designed for ICU patients—that is, they employ a "one size fits all" approach. As such, VR to specifically treat post-ICU trauma remains limited, and it remains unknown whether VR tailored to the needs of ICU patients is safe and suitable.

Turon et al (33) demonstrated that a nonimmersive VR-based neurocognitive intervention was feasible and safe during intensive care. Notably, Turon et al (33) employed a nonimmersive desktop system, which is less immersive and leads to less neurophysiologic performance enhancement than immersive HMD-VR (34). A recent study by Gerber et al (32) demonstrated that HMD-VR using nature environments might reduce physical stress and can be safely used in healthy volunteers in an ICU environment. Safety is determined using vital markers of physical stress, that is, oxygen saturation, respiratory rate, heart rate, and blood pressure. Indices of autonomic nervous system activity offer reliable measures of the stress response. An increased response is linked to both presence and simulator sickness and might be due to sensory mismatch (35). A high-magnitude stress response to a virtual environment is often considered an indicator of increased presence (indirect evidence) (36). In our study, vital signs did not change substantially during the intervention despite increased presence and immersiveness during HMD-VR. Furthermore, no session had to be stopped prematurely because of side effects. These findings suggest that our module is immersive but does not meaningfully invoke sensory mismatch and therefore can be considered safe. Because VR therapy is becoming increasingly available and used for the assessment and treatment of mental disorders, quantifying the risk of adverse effects and assessing immersiveness and suitability are important.

Although vital signs are a circumstantial measure of potential simulator sickness during VR, direct assessment of simulator sickness can be determined using the SSQ questionnaire (27). Although we did not observe

TABLE 2.
Outcomes of the Individual Simulator Sickness Questionnaire Items

Symptoms	Answer Options	2D Group, *n* = 15	Head-Mounted Display Virtual Reality Group, *n* = 15	*P*
General discomfort, *n* (%)	None	15 (100)	11 (73)	0.10
	Mild/moderate	0 (0)	4 (27)	
Fatigue, *n* (%)	None	15 (100)	14 (93)	1.00
	Mild/moderate	0 (0)	1 (7)	
Headache, *n* (%)	None	15 (100)	15 (100)	[a]
	Mild/moderate	0 (0)	0 (0)	
Eye strain, *n* (%)	None	15 (100)	13 (87)	0.48
	Mild/moderate	0 (0)	2 (13)	
Difficulty focusing, *n* (%)	None	13 (87)	12 (80)	1.00
	Mild/moderate	2 (13)	3 (20)	
Salivation increase, *n* (%)	None	14 (93)	15 (100)	1.00
	Mild/moderate	1 (7)	0 (0)	
Sweating, *n* (%)	None	14 (93)	15 (100)	1.00
	Mild/moderate	1 (7)	0 (0)	
Nausea, *n* (%)	None	15 (100)	11 (73)	0.10
	Mild/moderate	0 (0)	4 (26)	
Difficulty focusing, *n* (%)	None	12 (80)	15 (100)	0.22
	Mild/moderate	3 (20)	0 (0)	
Fullness of the head, *n* (%)	None	15 (100)	14 (93)	1.00
	Mild/moderate	0 (0)	1 (6)	
Blurred vision, *n* (%)	None	14 (93)	9 (60)	0.08
	Mild/moderate	1 (7)	6 (40)	
Dizziness with eyes open, *n* (%)	None	15 (100)	10 (66)	0.04
	Mild/moderate	0 (0)	5 (33)	
Dizziness with eyes closed, *n* (%)	None	15 (100)	15 (100)	[a]
	Mild/moderate	0 (0)	0 (0)	
Vertigo, *n* (%)	None	15 (100)	14 (93)	1.00
	Mild/moderate	0 (0)	1 (7)	
Stomach awareness, *n* (%)	None	15 (100)	10 (67)	0.04
	Mild/moderate	0 (0)	5 (33)	
Burping, *n* (%)	None	15 (100)	15 (100)	[a]
	Mild/moderate	0 (0)	0 (0)	

[a]No *p* could be calculated, as there were no differences between groups.

Values represent the *n* (%) of volunteers who rated each Simulator Sickness Questionnaire (SSQ) item as no discomfort or mild/moderate discomfort. Ratings of severe discomfort on the SSQ items are not included in the table as they did not occur in any of the volunteers. *p* values were calculated using Fisher exact test for the 2D group and head-mounted display virtual reality group.

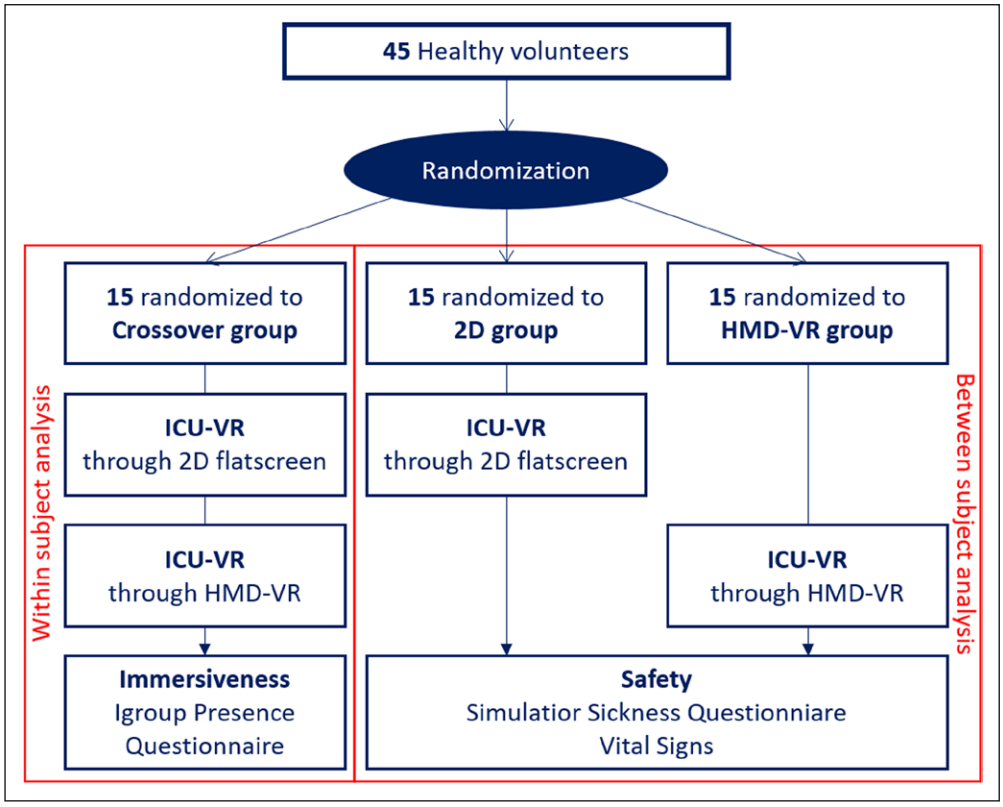

Figure 3. Flow diagram of the study. HMD-VR = head-mounted display virtual reality, ICU-VR = ICU-specific virtual reality.

any safety concerns or severe discomfort using this questionnaire, mild to moderate simulator sickness–related symptoms like nausea occurred in approximately one fourth of HMD-VR volunteers. Despite the experienced "dizziness with eyes open" and "stomach awareness," the total nausea score, in contrast to the disorientation score, was not higher. VR-induced sickness is explained with the sensory conflict theory—a mismatch between visual and vestibular senses. This is dependent on the individual; those who are highly receptive to sensory information are more likely to experience simulator sickness, as are those with higher immersive tendencies. It therefore makes sense that HMD-VR causes some arousal. A recent review nicely demonstrated that presence and simulator sickness are inversely related and that the relationship is likely to be mediated by factors including vection, navigation control, and display resolution. VR-induced simulator sickness could therefore be regarded as a "technical problem" that will disappear as the technology further develops (37). A recent study however demonstrated that advanced VR technology made no significant difference in terms of simulator sickness or sense of presence (38). Future studies will need to overcome these technical challenges in manipulating and assessing sensory mismatch but also should take into account VR developer information (i.e., technological specifications). Other research by National Aeronautics and Space Administration suggests that familiarity and experience with simulator sickness causing stimuli reduces symptoms during spacecraft test flights (39). These considerations are rich ground for future research. To date, VR-induced sickness seems however acceptable, as long as the benefits outweigh any negative effects experienced.

Despite these promising results in volunteers, some may find it difficult to use VR clinically due to a lack of knowledge about the technology or due to commercial limitations, hindering widespread adoption (20, 40). In the current study, we did not use a commercial product but instead designed a new VR film tailored to the needs of our ICU patients. We hope that by making the script freely available, the community of VR experts and medical experts will be stimulated to develop similar scripts and VR films, which eventually will benefit patients and improve long-term outcomes. Another barrier for implementation might be the lack of a VR platform (41). A first step for a solid foundation is making tailor-made VR and knowledge freely available. We are convinced that a study like this is the first step. Second, when virtual care platforms fulfil criteria of privacy and security, and are covered by general health insurance, VR's adoption will be further stimulated.

In the current study, we were able to demonstrate that a newly designed ICU-VR module is safe and immersive, and is as such suitable for future clinical implementation. It should be noted however that volunteers were not previously subjected to stress or traumatic events and had no cognitive limitations similar to those seen in critical illness survivors. Also although

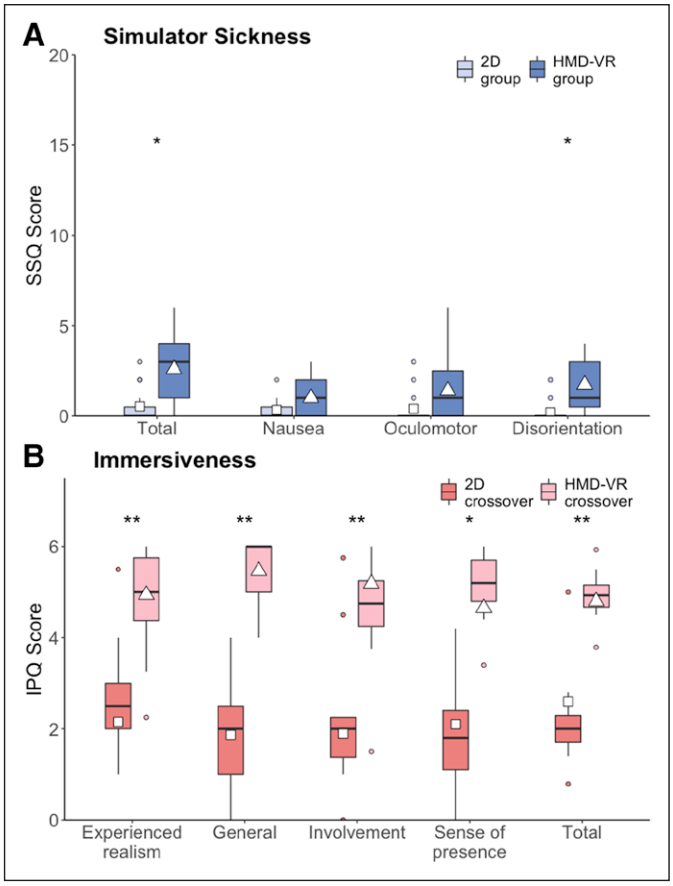

Figure 4. Simulator sickness and immersiveness using 2D and head-mounted display virtual reality (HMD-VR). Boxplot of the simulator sickness scores (**A**), measured using the Simulator Sickness Questionnaire (SSQ), in the 2D group and the HMD-VR group, and boxplot of the immersiveness scores, (**B**) measured using the Igroup Presence Questionnaire (IPQ), during 2D and virtual reality exposure in the crossover group. The *squares* and *triangles* represent the mean values for 2D and HMD-VR exposure, respectively. *p* values were calculated with a Wilcoxon rank-sum test (**A**) and a Wilcoxon signed-rank test (**B**). $^{*}p < 0.01$, $^{**}p < 0.001$.

the results of the current study strongly suggest negligible side effects of our ICU-VR module, it remains to be determined whether these findings will hold in critical illness survivors. A future clinical study is needed to determine VR's safety and efficacy in critical illness survivors with poorer physical, cognitive, and/or psychologic states. Also, volunteers were not guided by a healthcare professional during their VR experience. To date, it is still unknown whether guidance by a healthcare professional when using VR in a clinical context is mandatory. It can be argued that this is dependent on the underlying psychiatric and treatment goals. Future research should aim to gain a better understanding regarding such questions. The current study had a relatively small sample size, which only allowed for identification of common or major potential side effects and safety concerns. No power calculation was possible, since there was no a priori effect estimate, considering that this study was the first of its kind. As such, our results should be considered as exploratory but potentially useful to the field as it develops.

CONCLUSIONS

ICU-VR is safe and more immersive than 2D. The current script and module could provide a blueprint for future ICU-related VR productions and interdisciplinary collaborations between patients, physicians, and VR engineers. Although simulator sickness was mild, awareness is warranted. Future studies are needed to confirm safety and test effectiveness in critical illness survivors.

ACKNOWLEDGMENTS

We would like to thank O. Joseph Bienvenu, MD, PhD, from the Department of Psychiatry and Behavioral Sciences of the John Hopkins School of Medicine, Baltimore, MD, for his help in the article preparation.

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Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's website (http://journals.lww.com/ccejournal).

All authors assisted in study design and reviewed and approved the final article. Mr. Vlake conducted the study and performed the data gathering. Mr. Vlake and Dr. Korevaar performed the data analyses. Dr. van Genderen wrote the video script. Mr. Vlake and Dr. van Genderen wrote the article. Drs. Wils, van Bommel, Korevaar, and Gommers helped to draft the article.

Supported, in part, by Stichting Coolsingel and Franciscus Vriendenfonds.

The authors have disclosed that they do not have any potential conflicts of interest.

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The Medical Ethics Committees United, Nieuwegein, the Netherland, under number NL87641.101.16, approved this study.

All volunteers signed informed consent prior to any study procedure. Written informed consent was obtained for the publication of any information (e.g., images) that could lead to identification of the volunteer.

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request. The code used to analyze data during the current study is available from the corresponding author on reasonable request.

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