A Cross-Sectional Analysis of a Novel Virtual Reality Tool for Hotspotting

Beth Ann Swan, PhD, RN, FAAN*, Nicholas A. Giordano, PhD, RN
Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, GA 30322, USA

**KEYWORDS**
Virtual reality; Hotspotting; Social determinants of health; Care transitions; Interprofessional care

**Abstract** Virtual reality (VR) has emerged as a promising tool for clinical training of nursing and other health professional students. This pilot study examined the feasibility of a novel VR experience to aid nursing students in understanding the impact of social determinants of health (SDOH) on patients’ care transitions using hotspotting. Ten prelicensure nursing students utilized VR head mounted displays to participate in data-derived prototype VR simulations representing super-utilizers of diverse backgrounds. Additionally, participants completed surveys assessing usability and workload burden. Participants’ reported ease in engaging in the VR experience and low workload burden. Results indicate utilizing VR to aid nursing students’ understanding of the impact of complex SDOH on care transitions is feasible. Results underscore the potential impact of VR on nursing education, particularly for teaching about the implications of complex SDOH factors on care transitions, health outcomes, and health disparities regardless of learners’ geographic location.


© 2023 International Nursing Association for Clinical Simulation and Learning. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/)

---

Virtual reality (VR) is increasingly utilized in clinical nursing, for both educational and training purposes. Researchers have found VR simulation to be effective in promoting learning outcomes, specifically among nursing students (Ferguson, Davidson, Scott, Jackson, & Hickman, 2015; Howard, Gutworth, & Jacobs, 2021). Compared to in-person, resource intensive nursing simulation training, VR simulation is high quality and low cost to disseminate after initial production (Giordano et al., 2020). Most studies involving health care professionals and VR focus on psychomotor skills. Yet, VR can potentially expand the reach of education on emerging priority areas to students not in proximity to or without access to simulation resources. Nursing students must be prepared to competently assess and address the underlying causes of poor health, often termed social determinants of health (SDOH), in their clinical practice (National Academy of Sciences, Engineering, and Medicine, 2021). Yet barriers to teaching about this emerging priority area across institutions may be limited based on expertise, geography, and resources. Future nurses will need to process complex data, including clinical records to identify patient care needs, specifically, those with frequent hospital admissions, a process known as hotspotting when done at a systems level, and also understand the SDOH that contribute to high utilization of care resources.

---

* Corresponding author: bethannswan@gmail.com (B.A. Swan).
VR has emerged as a promising tool for nursing education. Immersive VR (e.g., the use head mounted displays) remains a relatively new learning approach in nursing but has been shown to improve learning outcomes (Foronda, Fernandez-Burgos, Nadeau, Kelley, & Henry, 2020). Immersive VR opportunities enable participants to experience being in different environments, enabling them to learn and practice in various settings that would not be safe or possible in their physical environment. As VR use increases, it is imperative to ensure that the context depicted in the VR environment “mirrors both the sensory and the task requirements of the real-world situation” (Goldsmith, Flash, Holdnack, & Brennan, 2022). Research examining the use of VR to deliver key content on care transitions and SDOH to nursing students is warranted. For example, hotspotting is one opportunity for teaching students about the multifaceted drivers of patients’ health experiences that impact their care transitions. Hotspotting involves the strategic use of data to identify and allocate resources to address “super-utilizers” of the health care system while improving the quality of care (Alder & Conklin, 2022). For the learners’ hotspotting experience, demographic data, diagnoses, admission date and location, and discharge disposition were provided on each students’ virtual lectern.

A school of nursing in the Southeastern United States built, implemented, and evaluated a collaborative education model that leveraged VR to instill interprofessional and SDOH competencies during transitions of care via VR hotspotting experiences. Prior to this VR experience, all students at the institution routinely received lectures on SDOH content in their courses, including how to define and assess the cultural, social, environmental, and political influence of SDOH on illness and wellness in health care at the individual, family, community, and societal levels. Across their curriculum, students applied SDOH principles and learner outcomes were measured in personal reflections, journal article critiques, and end of course evaluations (Hamilton, Swan, & McCauley, 2023). The purpose of this pilot study was to create, test, and assess the feasibility of a novel, VR experience to aid nursing students in understanding the impact of complex SDOH on care transitions and help patients navigate SDOH-related barriers. Specific objectives were to assess the usability and workload burden of the VR simulation experience.

**Participants**

Ten prelicensure nursing students were recruited utilizing convenience sampling. Participants provided signed consent and received $25 prepaid gift cards. Ten was an ideal number for feasibility testing in order to facilitate two groups of five students with the number of head mounted displays available.

**Measures**

Participants completed surveys, including self-reported demographic characteristics. Additionally, feasibility related metrics were captured through the validated System Usability Scale (SUS) and the National Aeronautics and Space Administration Task Load Index (NASA TLX) immediately after the VR experience. The SUS is a ten-item questionnaire designed to assess overall use and burden of technology (Bangor, Kortum, & Miller, 2008). SUS measures intended frequency of use, complexity, ease of use, need for technical support, integration of components, consistency within the system, quickness of learning to use the system, cumbersome, and overall confidence in using the system. A score of 68 is considered average usability (Hyzy et al., 2022). The NASA TLX, an instrument designed to measure the workload of an experience or task, captures six dimensions of mental demand, physical demand, temporal demand, effort, performance, and frustration levels (Devos et al., 2020). Respondents score each field from 1 to 20, and once totaled, lower scores indicate lower burden.

Participants completed open-ended questions to elicit qualitative feedback regarding their experience with the VR experience: (a) Please describe your experience with the VR exercise; (b) What aspects of the experience did you enjoy? (c) What aspects of the experience did you NOT enjoy? Were there any parts of the exercise that were frustrating to utilize or understand? (d) How could your experience have been improved? (e) Have you seen VR utilized by students and faculty during your nursing career? If so, how or where? Prior to today, have you had any experience with VR? Participants completed a survey after participating in the VR experience regarding their understanding and confidence about SDOH. Items included whether participants thought the VR experience was effective in delivering SDOH content, providing opportunities to assess and address SDOH, enhanced understanding of SDOH, and if the experience enhanced confidence in assessing SDOH. Respondents were asked if they agreed with each item on a scale from “not at all” to “very much.”

**Statistical Analyses**

Given the pilot nature of this cross-sectional feasibility work, descriptive and nonparametric statistics were uti-
lized to summarize the sample’s demographic characteristics as well as SUS and NASA TLX results. A one-sample Wilcoxon test was used to compare the median SUS scores and national usability metrics.

Results

Sample Characteristics

Half of the sample identified as African American and 50% identified as White. All were master’s level, prelicensure nursing students with an average age of 33.8. There were nine females and one male. No participants reported having any prior experience with VR in an educational setting.

Usability and Burden

On the SUS, 70% of respondents agreed with the statement, “I think that I would like to use VR experiences frequently.” Similarly, 70% disagreed with the statement, “I found the VR experience unnecessarily complex.” Lastly, 50% of respondents agreed with the statement, “I felt confident using the VR experience” and another 40% were neutral regarding that statement. Results from the SUS demonstrated positive feedback regarding participants’ frequency, ease, and confidence in using the VR experience. The median SUS score was 67.5 (interquartile range: 58.8–73.8), which was not statistically significantly different than national benchmarks for usability (p = .683). Outcomes from the NASA TLX questionnaire revealed low (e.g., favorable) scores for all six dimensions of workload burden. The overall task burden was low as evidenced by the median NASA TLX score of 25.5 (interquartile range: 14.3–34.2).

Open-Ended Feedback and SDOH

Students shared they enjoyed “Ability to walk around the living space,” “classroom setting that turned into more in depth scenes with info on the patient,” “The neighborhood and home was great for identifying potential health hazards and SDOH disparities… made understanding the background of each patient easier.” “I enjoyed hearing their stories, and “the teamwork aspect.” One student responded that, “I would’ve liked more direction on how to use the triggers and move around in the VR setting,” and “I would like to have a longer virtual experience. The majority (80%) of participants indicated that they would recommend the VR learning experience to others, and 70% of participants felt confident in understanding the utility of hotpotting to promote patient-centered care after participating in this VR learning experience. These results are of note given that this was the first time all participants had used VR technology in an educational setting. Eight participants completed the SDOH follow-up survey. The majority of respondents agreed somewhat to very much that the VR experience provided content on SDOH (75%), that the experience was an opportunity to assess and address SDOH (88%), provided them a better understanding of SDOH (63%), and increased confidence in assessing SDOH (50%).

Conclusion

This feasibility pilot study found that utilizing VR to deliver content related to the impact of complex SDOH on care transitions to nursing students is feasible. Participants reported that the usability of VR was high and that cognitive load was not a barrier when learning SDOH. Further, the VR hotpotting experience provided students with an immersive experience examining challenges patients may face as they transition from high acuity settings back to their communities. These hypothesis generating results contribute to the growing bodies of literature calling upon nurse educators to prepare nursing students to engage in addressing drivers of SDOH, as well as the emerging literature examining the usability of VR in nursing simulation education (National Academies of Sciences, Engineering, and Medicine, 2021). Ultimately, enhanced understanding of SDOH will enable nurses to improve health care delivery and reduce health disparities in interprofessional, team-based settings. Results of the study underscore the potential impact of VR technology on nursing education, particularly for teaching students about the implications of complex SDOH factors on transitions of care, health outcomes, and disparities regardless of geographic setting. The study illustrates the feasibility of using VR to incorporate student centered training around hotpotting for super-utilizers.

This study found that nursing students are interested in interacting with VR experiences as part of their learning and are comfortable using VR. Despite the small sample size, which hinders generalizability, this pilot found the VR prototype was very usable and required low task burden. Based on feedback provided in the open-ended questions, several improvements can be made to future VR experiences. Specifically, VR experiences will need to be more interactive, include play and pause functionality, and incorporate expert faculty to deliver a guided discussion throughout the experience. There is also a need to create a “how to” guidebook for faculty to ensure a common understanding and standardized practices for pre-briefing, the VR experience itself, and debriefing. There are also future opportunities to use the VR as an assessment tool for nursing student competencies related to care coordination, identification of SDOH needs, and working in collaboration with students in other disciplines as part of interprofessional teams.
Declaration of Competing Interest

No conflict of interest to report.

Funding

This work was supported by a grant from the Woodruff Inc. Fund.

Acknowledgment

The authors thank all participants for their time and contributions.

References