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Research Article

Interprofessional Students Learning to Save a Life through Cine-VR Simulation

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Abstract

Background: Deaths resulting from opioid overdose have increased drastically. Cine-VR simulation is a learning format that immerses the user into a virtual reality environment through the cinematic use of 360-degree video.

Objective: Exploring interprofessional students' attitudes and perceptions related to learning how to administer naloxone through a virtual reality lens. This is important as this helps to educate how to potentially save the life of another human being.

Method: A qualitative descriptive exploratory approach was used to conduct focus groups (n = 32) on interprofessional undergraduate and graduate student participants following an immersive Cine-VR experience. A holistic coding approach was used whereas two researchers analyzed the data and identified themes and codes.

Results: Four overarching themes emerged: 1) improved knowledge about opioid and use of naloxone, 2) changed perceptions regarding ability to act during a crisis, 3) realism of learning from Cine-VR simulation and 4) improved learning with the help of Cine-VR simulation.

Conclusion: Participants attitudes and perceptions on the use of naloxone were increased. Cine-VR is a successful modality for learning how to identify an overdose and administer the lifesaving drug, naloxone.

Keywords: *Opioids; Overdose; Naloxone; Virtual Reality; Cine-VR; Cine-VR Simulation*

Introduction

Deaths from drug overdoses are on the rise in the United States among both men and women of all races [10]. Overdose deaths from opioids have increased nearly six times since 1999 [35]. In 2017, there were over 47,000 deaths attributed to opioid overdose in the United States [27]. The percentage of opioid related deaths in Ohio rose from 38% in 2015 to 71% in 2017 [20]. The Appalachian region has not been exempt from these increases but rather has continued to increase as the poverty rates in the Appalachian region continues to increase thus contributing to the opioid epidemic [17]. According to the United States Department of Justice, the ongoing opioid crisis is being driven by the use of the opioid, Fentanyl [32].

Opioids are a class of drugs that include the illegal drug heroin, synthetic opioids such as fentanyl, and pain relievers available legally by prescription, such as oxycodone (OxyContin®), hydrocodone (Vicodin®), codeine, morphine, and others. All opioids are chemically related and interact with opioid receptors on nerve cells in the body and brain to block pain and slow breathing [18]. Due to their effect on the part of the brain which regulates breathing, opioids in high doses can cause respiratory depression, hypercarbia and death. Opioids

combined with alcohol and other sedative medication increase the risk of respiratory depression and death. Combinations of opioids, alcohol and sedatives are often present in fatal drug overdoses [36].

Naloxone (also known by the trade name Narcan®), is an opioid receptor antagonist, which means it binds to opioid receptors and reverses or blocks the effects of other opioids. Narcan, the United States Food and Drug Administration-approved nasal spray could reverse the effects of an opioid overdose, in less than five minutes, whether the overdose is real or suspected. Growing availability and promotion of community-based naloxone administration has led to a need to educate the public on how to recognize an overdose and properly administer naloxone. Naloxone has been available since the 1960's, is generally considered a safe medication and has been administered in hospital and pre-hospital settings by emergency personnel to reverse opioid overdose since its development. In an attempt to expedite treatment and improve outcomes in cases of opioid overdose, naloxone, an opioid antagonist, is being promoted and utilized for community-based use by laypersons as well as first responders and emergency services personnel [35]. From 1996 to 2014, at least 26,500 opioid overdoses in the U.S. were reversed by laypersons using [35]. The success of reversal of opioid overdose by layperson administration of naloxone has been reported to be 75 - 100% [6]. One community-based naloxone distribution program reduced opioid overdose deaths by an estimated 11% in the nineteen communities that implemented it without increasing opioid use [33].

Virtual reality simulation and nursing

Healthcare around the world is becoming more technology driven, with advancements like virtual and augmented reality becoming mainstream [24]. Virtual Reality (VR) is the digital creation of virtual worlds that are interactive and both visually and aurally immersive, meant to simulate aspects of the real world. Virtual worlds offer meaningful potential for nursing students because they can simulate interaction between students, educators, patients and multidisciplinary healthcare professionals in education settings such as classrooms and hospitals [9]. Virtual worlds can be created in at least two ways: 1) through computer animation which creates artificial characters and locations or 2) through the use of 360-degree video, which records human beings within an actual environment. The environment may be real or fictional; similar to making a movie. When 360-degree video is approached cinematically (with actors, lighting, sound design, e.g.) the result is known as Cine-VR, or cinematic VR [37]. Ideally, the audience is meant to view Cine-VR in a head mounted display to increase the immersive nature of the experience. The audience interacts with the environment by turning their head and choosing what to watch within this immersive virtual reality experience (VR).

Immersive virtual reality with head mounted displays (HMD) has proven to be effective in increasing learning and motivation in nursing students [34]. Cine-VR has a number of benefits in nursing education such as being less expensive to develop than animated VR; Cine-VR is also easier to access and requires less space and specialized equipment compared to non-digital simulations. Simulated scenarios based on Cine-VR video could lead to better patient care by healthcare students and interprofessional teams where VR 360 degree education allows for more consistent learning experience [2]. The learner essentially becomes a part of the Cine-VR experience, interacting as if that environment were real and they are an actual observer of the events taking place around them.

Virtual Reality has also found wide implications in areas of pain management. According to a study on virtual reality for management of pain in hospitalized patients, therapeutic virtual reality (VR) has claimed to be used as an effective, non-pharmacological treatment for pain [31]. The findings of the study showed that use of VR in a diverse group of hospitalized patients was well tolerated which resulted in statistically significant improvement in pain in a group of hospitalized patients. Cine-VR is an effective learning experience for both undergraduate and graduate students from eight health professions backgrounds [3]. As a result of increased presence and immersion during Cine-VR simulations, students were able to develop empathy and communication competency.

Virtual reality simulation in fighting the opioid crisis

According to Ted Jones a pain psychologist at the Behavioral Medicine Institute in Knoxville, Tennessee, VR is on the verge of revolutionizing pain management, including on the chronic pain front and may offer a new way to combat the opioid crisis [15]. Virtual Reality

technology has been shown to provide meaningful improvements in managing the opioid crisis in five key areas. Prevention (promoting wellness, stress management and addiction behavior), improved pain management (distraction experiences as alternatives to pain killers), improved learning and education (including clinical skills training and administration of different life-saving drugs) and improved adherence (the experience and game-like features of VR training, helping to motivate patients, engaging them more fully in the treatment process) [7].

Virtual Reality is now finding wide applications in the clinical setting, as mode of learning for healthcare providers. The entire VR process consists of the following steps: 1) Proper planning of the VR 2) Creation of VR 3) Delivery of VR.

Therefore, this Midwestern University has created a VR naloxone simulation (naloxone Cine-VR simulation). This Cine-VR simulation is an educational intervention that was created in a manor to be valuable by healthcare professionals as well as those not associated with the medical field. The 7-minute 360-degree VR simulation shows an overdosed individual in a dormitory room and demonstrates how to identify an opioid overdose and how to administer the life-saving drug naloxone. The simulation features two college students entering their dormitory room, when they find their peer who has overdosed, calling 9-1-1 and ultimately administering naloxone to counteract the overdose. The Cine-VR simulation was created and utilized to meet the objective of, exploring interprofessional students' attitudes and perceptions related to learning how to administer naloxone through a virtual reality lens.

Methods

Design

This qualitative descriptive exploratory approach focus group research study was chosen as a probing method to gain an in-depth understanding of the interprofessional students' attitudes and perceptions. The focus group was intended to generate ideas that focused on an approach to using Cine-VR simulation to learn how to respond during an opioid overdose situation for interprofessional students, as very little is known about this phenomenon. The focus group allowed for participants to express their own thoughts and perceptions and was continued until saturation of the phenomenon was reached.

Cine-VR development

This study involved development of a Cine-VR simulation for naloxone administration training and had two primary goals: 1) to educate people on possible opioid overdose recognition and naloxone nasal spray administration and 2) to evaluate Cine-VR simulation as a teaching strategy administration of naloxone nasal spray by laypersons. The naloxone Cine-VR simulation enabled users to auditory and visually adapt to what was happening around them thus making them feel like they were in a real situation. There were three main actors (hired students) in the scenario. One who overdosed on an opioid and two friends who find the one who overdosed. The students were not trained actors.

No previous study has been conducted with a focus on interprofessional college students' attitudes and perceptions regarding Cine-VR simulation or VR 360 video as a learning strategy. Exploring interprofessional students' attitudes and perceptions related to administration of naloxone and learning through a VR lens is important as this helps to educate someone to potentially save the life of another human being.

Setting and sample

This research study was conducted at large Midwestern University. With an approval from the University's Institutional Review Board (IRB), participants were recruited through fliers and through email and screened for eligibility. There were 18,797 residential students

enrolled at this large Midwestern University in the Spring Semester 2018 in different disciplines who were invited to participate in the study (Office of the Institutional Research, 2019).

A convenience sample of n = 32 university students who were over the age of 18 and who had not had a personal traumatic experience with an opioid overdose were included in the study. The participants included adult undergraduate and graduate students of the University (Table 1). The convenience sample was asked to sign a consent form and were invited then to participate in one of the focus groups. One individual declined the invitation to participate due to conflicts with class schedule and arranging time to participate.

Degree of study	Total	Total %	Undergraduates (U%)	Graduates (G%)
Athletic Training	2	6.25	0	6.25
Audiology	1	3.12	0	3.12
Biological Studies	3	9.37	9.37	0
Business Studies	5	15.62	9.37	6.25
Child and Family Studies	1	3.12	3.12	0
Communication and Media Studies	2	6.25	3.12	3.12
Engineering	3	9.37	0	9.37
Exercise physiology	2	6.25	3.12	3.12
Fine Arts	1	3.12	0	3.12
International Studies	3	9.37	0	9.37
Medicine	1	3.12	0	3.12
Nursing	4	12.5	12.5	0
Physical Therapy	3	9.37	0	9.37
Social Work	1	3.12	3.12	0
Total	32	99.95	43.72	56.21

Table 1*: Characteristics of participants in the focus group.*

Data collection

Prior to the focus group interviews, the participants experienced a seven-minute 15 seconds-long Cine-VR simulation, which immersed them in a room with a person who had overdosed on an opioid. The simulation represented a person who had overdosed being administered NARCAN and emergency services, 911 being called.

A semi-structured interview guide was used with guiding questions that was followed up with probing questions. Each focus group began with the participants stating their program of study, if they were in an undergraduate or graduate program and if they had any previous experience with VR. Afterwards, open ended questions assessed the interprofessional students' knowledge about opioids and the use of naloxone and their perceptions of the significance of the Cine-VR simulation on their learning. The follow up, probing questions were guided by the participant responses to the semi-structured questions until a full grasp was obtained.

A total of 32 participants were randomly divided into seven focus groups of 4 - 6 participants. The focus group times were arranged around the participants class schedules. Participants had the opportunity to talk and express their thoughts at liberty during the focus group. All seven of the focus groups took place in a private conference room to decrease interruptions. Each focus group lasted between one hour to one and a half hours and were cofacilitated by two of the doctorly prepared authors [14]. All focus groups were guided by the same semi-structured interview questions.

Field notes were taken while the participants completed the seven-minute Cine-VR simulation experience as well as during the focus groups. The field notes reflect the observations and highlight the nonverbal communication that occurred and helped to understand the participants attitudes [5].

Data analysis

The responses of the focus groups were audio and video recorded and sent for verbatim transcription. Each participant was assigned an identification number for coding. The transcriptions were compared with the audio recordings and the field notes to assure accuracy. The transcriptions were analyzed manually for common themes separately by two of the authors (research mentor and graduate assistant). Saldina describes this research mentoring process as holistic coding [26]. A line by line approach of reading and coding with key words or phrases that portrayed the participants views and happenings were used.

Throughout the coding process, alike words and phrases were grouped together to create common basic codes that were developed into themes that accurately represented the participants attitudes and experiences [25]. Similarly, the field notes were reviewed and compared along with the two authors codes. The two authors then compared and agreed upon the common themes to safeguard that the participants viewpoints and endeavors were authentically embodied. Investigator triangulation and rigor was reached by having the same interview guide for each focus group, including two researchers to complete concurrent analysis and agreeing on common themes, reviewing and bringing in the observation field notes and adding direct verbatim participants quotes as they were stated to accurately represent their voices and lived experiences.

Results

32 participants (14 undergraduate students and 18 graduate students) across 14 disciplines met the inclusion criteria and participated in one of the seven focus groups. Table 1 provides a breakdown of participants. Participants were screened to meet inclusion criteria and then were seated in a chair that would swivel to allow them to view the Cine-VR in a 360-degree fashion. An individual headset was provided to each participant. Participants were provided instruction on how to utilize the headset. During the Cine-VR experience, participants witnessed two friends coming into a dorm room and finding a third friend who had overdosed. They reacted and called for emergency services and administered the life saving drug naloxone. Researchers were observing the participants throughout the viewing experience taking field notes. Upon completion of the Cine-VR viewing experience, participants were divided into focus groups.

Rich interaction occurred within each of the focus groups. The participants clearly stated their viewpoints, even when they differed from another participants. The thematic analysis produced four themes that reflect around the use of Cine-VR simulation as a means of educating learners on how to administer naloxone. The participants were aware of the opioid crisis as the university is geographically located in the heart of the crisis. The participants reported: 1) improved knowledge about opioid and use of naloxone, 2) changed perceptions regarding ability to act during a crisis, 3) realism of learning from Cine-VR simulation and 4) improved learning with the help of Cine-VR simulation (Figure 1).

Focus group results

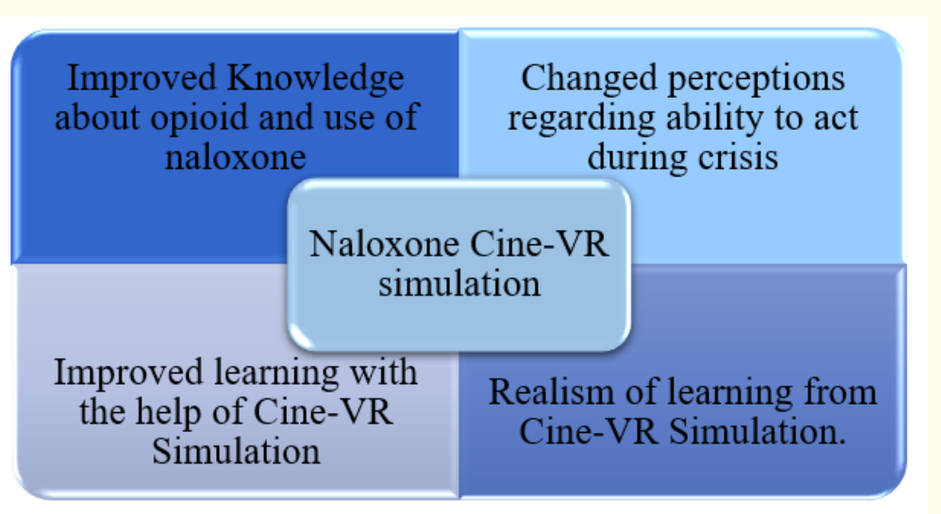

Figure 1: *Thematic analysis.*

Improved knowledge

Naloxone saves lives [12]. It takes a person suffering from opioid use disorder on average four years to seek medical treatment from the start of opioid use [11]. Our data supports that through the use of a naloxone Cine-VR simulation, understanding regarding acute treatment can improve knowledge for identifying signs and symptoms of an opioid overdose and how to respond. All 32 participants voiced that they had some degree of improved knowledge about opioid and use of naloxone through participating in the Cine-VR simulation. An International Studies graduate student acknowledged that they had a lack of knowledge prior to the Cine-VR simulation. "Seeing how the drug, Narcan, seeing how that worked, the best part was knowing that there was something that can be that effective. It's weird not really having known about that before this experience. I feel it's something we should know about more on campus, but it was nice to see that anyone can put it together and to have a good effect".

Some of the participants described certain aspects of the Cine-VR simulation that they felt impacted their knowledge: an undergraduate exercise physiology student said "I was like, Call 911! Call 911! That's just the logical thing to do", and a graduate student from the college of Fine Arts stated, "I learned that this is what you find in the kit (naloxone), this is how you put them (naloxone) together". A graduate audiology student said, "it might have just been the situation that we were put in, but I wasn't really focused on anything more than the NARCAN. That was the main focus for me". Other participants found increased overall knowledge. One graduate student from the Communicational and Media department expressed, "the lesson we saw was how to assemble and administer NARCAN", and an undergraduate communications and media participant said, "I thought it (Cine-VR) was educational about NARCAN".

An undergraduate exercise physiology student stated, "I've never seen NARCAN before, so I didn't know what it looked like, or where it went, or anything. So, the VR (Cine-VR) that was useful to just see it". An undergraduate biology major said, "I thought it was very informative. I definitely learned what to look for". A communication graduate student added, "I was thinking before today that I would walk in the door and call 911 immediately, and then after today (Cine-VR) I would do the same thing, but I would be a lot less panicked". An undergraduate business major participant stated: "I liked learning about how to use Narcan. I mean, I've always wanted to know how to, really. Just In any situation, be able to carry it for festivals. I guess in general, just know how to use it, and it seems fairly simply".

The participants take away from the Cine-VR had an influence on how they would respond in the event of an overdose. A graduate student in communication and media studies stated regarding the Cine- VR, "I knew they were searching for the NARCAN, but it was more of a vibe for me of understanding what to do in the medical scenario. I learned this is how you administer and put the NARCAN together, because I was watching it, I was forced to listen and try to watch and learn" this student later went on to say "I would say prior to this (Cine-VR simulation), I have some experience with being certified in First Aid and CPR and I have worked in medical emergencies. So, I feel like I would have some type of grasp, but this defiantly helped me understand more of the logistical ways to actually interact with people who have experienced an overdose".

The understanding that naloxone saves lives was impactful. An undergraduate student from the college of business said learning "that even if they haven't overdosed, administering NARCAN won't hurt them is the biggest thing I'm taking away from this. I didn't know that". This sentiment was also mentioned by a graduate physical therapy student who said "that you went through all the symptoms and you know, don't be afraid if someone does an OD on opioid. They're still okay to receive this (naloxone)". An undergraduate nursing student reported learning that the "dispensing of Naloxone to those who, not just like, health professionals but also users or friends of users because they can be the ones who utilize it the most when someone they know passes out or overdoses".

Knowledge gives power. The participants repeatedly mentioned the increase in knowledge in identifying an overdose as well as how to respond and administer naloxone. An International Studies graduate student stated: "I've heard of Narcan before but never seen a demonstration of it, don't even know where to get it to use it. It's definitely not something that's covered in first aid and that kind of stuff which I think it should be".

This sentiment was similarly expressed by a nursing undergraduate student as detailed: "I didn't even know that Narcan was commercially available. I thought you had to call 911and then they would come with it. So, I guess I would have called 911 and not even known that I could find something to assemble (naloxone)".

This was followed by another similar comment from an undergraduate global health student: "I learned that people might have NARCAN already that I can look for and help them if that situation ever comes. Also, I learned what an overdose is, a lot of the times in the news and stuff is like but it is different to actual see it happening".

A notable increase in the perception of ability to administer naloxone occurred because of the Cine-VR. One undergraduate social worker student participant voiced: "I've heard of Narcan but had no idea how it was administered. In response, I would have called 911 but not really known anything to do from there. After this (Cine-VR simulation) I would have at least known that it was a nasal spray which I didn't know. I definitely thought it was like a shot before. Now, my focus was more on the Narcan and the overdose and what those signs and symptoms look like".

While an undergraduate communications and media student participant said: "We always hear about NARCAN but I didn't know what it looked like and I didn't know that you put it in the nose, so I thought it was informative. I have never administered Narcan, though I feel way more comfortable knowing where it goes. I would defiantly deal with Narcan, if I had too".

The increase in knowledge led to a reported increase in level of comfort with naloxone and identifying signs and symptoms of an overdose. An undergraduate chemical engineering student said "I did try to pay attention to how they assembled it (naloxone), so I think I would be better at administering now. But before, I wouldn't have been as comfortable". A graduate audiology student stated that "on a scale of one to ten, ten being the most comfortable, I would say I am an eight. If the situation (administering naloxone) arose I would feel comfortable taking the lead in what was going on". Another physical therapy graduate student stated "I think it's good to be exposed to situation's like that so that way if it does happen in real life you're not completely blind to it. Like, you've seen it before you'd know how to handle it then".

The opportunity for repetition of content review with Cine-VR was noted by one graduate medical student who commented: "I like that it (Cine-VR) was aimed towards this population. And, so, the putting together of the Narcan itself, I've watched twice because I wanted to make sure I got it. I'm sure the instructions provided with kits (naloxone) can explain that, too. I mean it seems pretty easy to administer it but I feel like when I'm in the situation, there's so many variables that could go wrong or something that might not happen or might not happen the right way that I might feel like, Am I doing something right? I'm not sure. It's actually, you know, gone as planned".

Participants voiced an overall increase in their level of knowledge related to identifying an opioid overdose, calling for assistance and administering naloxone through the use of Cine-VR simulation.

Changed perceptions

Participants across professions reported various levels of changes in perceptions after participating in the naloxone Cine-VR simulation. Some participants identified thought provoking and differing responses related to their perceptions. While each participant expressed their perceptions of the Cine-VR simulation experience in a unique way, there were many commonalities. An undergraduate student from the college of business said: "Prior to this (Cine-VR) I wouldn't have known. I wouldn't have picked it (naloxone) up. It looks like my grandma's insulin diabetes things. I had one other thing that I was - oh - just the one other comment that I want to play Devil's Advocate a little bit, young people in a dorm room, I'm trying to think back to my situation when my friends were like, blacked out in their dorms doing things they shouldn't have been doing... My first thought, and I feel guilty saying this, wouldn't be, "Call the cops", either. The

syringe in the arm's the big red flag, which I'm assuming- actually I don't know- but if the syringe is how that's normally presented, then I would've been like, "Yeah, 911". But if I hadn't seen the syringe, then I would be like, "I don't know what's wrong, I don't know if this is a big deal..". Eventually I would've definitely called 911, but I don't know if everyone would've thought that".

An undergraduate nursing student questioned the actions of the actors from the Cine-VR simulation by stating: "I thought it was really interesting how, I mean those like subtle nuances when, especially when they were about to call 911 and they said they don't want to get in trouble. So, I think that opens up a whole door for like the cause of calling 911 immediately and when they are not. Those who call 911 should get immunity and receive immunity from police. And even if they have prior convictions or they're on parole, I think it's important to explore that as well. So, I think, like, in that situation it's always difficult because if you're taking part of it or if you're just a bystander, you'll always wonder, "Am I going to get in trouble as well?" So, I think I'll always have that at the back of my mind regardless of what was going on".

Another undergraduate student from nursing, also focused on the skills related to the overdose response: "I like how the one girl noticed that he didn't put the Fentanyl patch on (Cine-VR). Which I think is a really good thing to look for. It's something that I wouldn't have thought to look for, because I feel like I would've gone straight for the needle on the arm. So, it was really observant to look past just what you immediately see and look at the whole picture".

While an undergraduate participant from global studies related the Cine-VR to their personal life by stating: "I am from a town that has kind of been ground zero for the opioid epidemic so there is a really, really big problem there. And there is stigma that goes along with it, with Narcan, people say "Well, they made a choice". They (community members) say "Why is Narcan free but my insulin costs x amount of money?" So, I think it would be helpful for people in my hometown to be put in the position (of overdose). He is just a young guy".

Changed perceptions specific to the Cine-VR experience also occurred. An undergraduate nursing student who reported no prior experience with Cine-VR stated: "From a nursing school aspect, we only have ten minutes at a sim yesterday, and we complain all the time that by the time we figure out what's going on and what we should be doing there, really, we don't get much done. So, we had two minutes less and in the video and I learned and saw so much more than I would have, I feel like, trying to act it out ourselves. So, I thought that was really great".

Other participants formed an emotional connection that helped them to identify their perceptions. A graduate student from the communications and media department commented: "I think flipping the script is a really powerful tool, so you can see how the people you are interacting with- you can kind of see what they are seeing, even if you're not generating the same feelings. You can at least form some understanding of what they're going through".

Another participant (undergraduate communications) had a similar experience, and went on to describe how they would share with their peers their experience with Cine-VR and how after undergoing this Cine-VR, they will remember what they learned: "I wanted to help them look for it (naloxone). I will tell them (friends), "I did this VR, it's really awesome, it's really informative", I think they'd be excited. I thought it was realistic, and another factor is the people always consider they could possibly get in trouble and they address that, because that can also really sway someone's decision to doing something. And the calling the mom, the phone being locked, the panic of it, initially, that was super realistic. People don't know what to do and that scares me, because I think you should get it done fast. But you're searching around for a long time. So, definitely realistic". I'll remember it!".

One graduate student participant from International Studies reported having zero prior experience with any kind of VR for learning or any other purpose, the Cine-VR helped to relate the process: "I'd describe it as interesting. I'd say very informational in understanding how we could help students better learn. As I was leaving, one of my classmates was walking out and said it was awesome, you'll really enjoy it so I'm like okay. Also, I think it was more about the process of addressing the situation. You kind of had to follow the girls around

the room as they were trying to figure out what to do. I think it was a good experience. I got some good information. You kind of feel for the character since you're in the middle of it. The one thing I really want to know is how I can learn how to use Narcan and then how I can get one to carry in my med kit? Or just to have in our office and those kinds of things".

Getting to the business of saving lives, an undergraduate student from the college of business said, "I will go look at this (purchasing a dose on naloxone) immediately after this Cine-VR simulation today. "An undergraduate social worker stated: "I think if it was like this afternoon or like tomorrow or sometime close by, I could do it from memory from the video. But if it was a couple weeks from now I'd want to at least have seen a kit and put it together myself first. So, I'm more confident than I was going into it but at the same time I would like to be a little bit higher before I'd have to face that situation".

Overcoming a stigma became a point of discussion around perceptions. Several participants voiced their disdain over the realization that stigma is a part of deciding to call for help when someone overdoses. This was brought out strongly in the Cine-VR. An international study graduate student said: "I have heard about the opioid abuse around the area and sadly there is a stigma surrounding it. But VR (Cine-VR) is increasing awareness and will help us to get over it and to get support for the people who are using".

A graduate student in international studies affirmed: "For me, it (Cine-VR) was a teaching tool. And I also felt the mental health was highlighted in the video. And there is also stigma surrounding mental health. Using these things can help to destigmatize these fields. And I believe we can use the technology not only in life, gaming and in some of these fields. For example, one of the things I have been hearing is how they have been developing applications to support, for example, mental health. Different, say, for example, sexual harassment, or drug abuse. We can also use these learnings to get support and using the virtual reality is also another tool that we can benefit from. Not only using it for gaming".

An overall finding regarding perceptions was the impact highlighted by many of the participants. A physical therapy graduate student stated: "I feel like everyone at this point should be pretty good at like, working out, other stimuli in the environment. When you have an emergency situation, you're like, nervous system kind of focuses on that emergency anyway. So, I think, because this was like a simulation, having us focused in made more sense because that's what you do if that was your friend. You'd be really focused and hyper vigilant in the situation. So, that was a good".

A business graduate student participant reported: "Seeing how students can be affected by certain scenarios and how you can interact with students and how it is realistic for that. So definitely I think in an education field you could definitely use that". Because the visual (Cine-VR), I can picture putting it (naloxone) together and where it goes".

Improved learning with VR

Cine-VR was reported to be an engaging form of learning. An undergraduate biology major reported "I think just as a general, being in a headset and with goggles and having like, nothing else to look at or hear, helps you really engage". An international graduate student said: "I think the nice thing about the VR (Cine-VR) scenario is it was like living it. You are like listening to it and watching it. There is less distraction from around". An undergraduate business major expressed "I think the way that we had to view it being immersed in the experience was also beneficial". A chemical engineering undergraduate student reported "it puts you in the situation, so it is better than watching a video". A graduate medical student said, "you can describe how everywhere you look, your part of the simulation. You're part of the program. It makes it different than just watching a movie". A graduate Physical therapy major who cried after the Cine-VR stated: "It felt like you were looking for (Narcan), like looking with them. That you kind of choose like where you're looking around and you're not just like stuck in one screen, it's different then in just like a classroom setting and this (Cine-VR) is more interactive".

An undergraduate biology student articulated: "I'll take away just how different it is to sit down, read a book, just digest all that information and then actually sit down and experience it, and just how better I feel like I'm going to remember that stuff since I actually watched it, instead of just reading a really dry material about it".

The researcher's observational notes found that the body language exhibited by a physical therapy graduate student was very tense and facial expressions were very thoughtful throughout the seven plus minute Cine-VR. The same participant revealed that: "It (Cine-VR simulation) catches your attention a little bit more. If that would've been just watching a screen I probably wouldn't have been as attentive cause I could hear things around me, so I was turned around, I was really aware of my surroundings in that case".

Another physical therapy graduate student added: "Yeah I would agree with that. That was pretty neat to see how that all- cause you could hear people from behind you and I- at one point didn't even realize there was anything going on behind me so that was kind of interesting".

The body language of an undergraduate business student was hard to sit still. The participate was bouncing their legs throughout the entire scenario. The participant expressed: "Yeah I felt like I was a part of it, to an extent, because I was sitting there in a 360 room... but at the same time I kind of like wanted to do something in a way and just sitting there was kind of hard but I mean yeah I felt like I was in the room, like I was a part of it watching".

An undergraduate communication and media student was seen shaking her head "no" as she was watching the Cine-VR. She went on to state: "I was like, "Why would you touch that? Don't touch it!" Further stating "So to have, learning through and seeing everyone look like they did in this room, so... I really liked it. I learn hands-on and it was a way to learn hands-on but not jeopardize anything", Furthermore, But I really like, because if you're watching a video in a classroom versus VR you can just look away from that video look on your phone, do this, do that. But when you're in VR, you can't look anywhere but the situation you're in". I saw kids were walking by and they stopped and then I was like, "Oh my gosh!" I was checking both ways but all of a sudden I saw three people and two of them were recording and I was like, "Wow! That is terrible". But yeah, there's nothing I could do about it".

Cine-VR was reported as being a value-added learning experience. A request for further Cine-VR simulations was echoed by many of the participants with some providing details as to where within their own programs Cine-VR could highlight their learning. One graduate international studies student participant exclaimed: "I would be receptive to more VR because VR is still so new almost and something that's interesting so when you have the opportunity to learn that way it will stand out. I think once we kind of oversaturated with VR all the time it might not be as exciting because it will lose that fun factor but like I said, it's really good to get that baseline understanding and really see a scenario and be like, okay, this is the issue we're trying to address".

One participant expressed concern over the cost of Cine-VR but focused on the benefits of the Cine-VR and how it could benefit her nursing program. She stated: "It would be good for teaching, for showing nursing students different kinds of patients. We get the good clinical experience, but we don't get to see everything in our clinicals. It would be good to get a broader experience. I think the power of VR as well as a learning tool. And then I think the first thing that I think about VR is just the cost behind it because I know it can be expensive. Especially, if you're going to administer to a whole class. But I think the utility and the power of it can be really beneficial".

Several participants were seen smiling throughout many parts of the Cine-VR. One such participant, a graduate audiology student said: "I think for my field, we do a lot of, before you can actually put your hands on a patient, you have to get observation hours, and everyone hates the observation hours because it's a YouTube video and you don't get anything out of it. So, I think for those hours, I think that would be super helpful, and I think you would feel more like you were in with a patient and Absolutely. One hundred percent. I wish I could learn everything that way". And when your teacher always says, "Read this chapter before you come to class", and no one really does it, if you did this beforehand and then at class you went over how to do it and you saw the pieces, that could be really helpful".

The Cine-VR boosted confidence in the participants on their knowledge, skills and attitudes related to administering naloxone because of this experience. A graduate audiology student voiced: "I feel like it was... I feel I could do that now, watching the assembly kit. Whereas, if you just showed me a video of it, I don't know that I would have understand as much as I did watch it in virtual reality" furthermore, stating "stating "we're all so used to learning through words, not just by seeing". It kind of forces you to focus, as opposed to... like you were talking about checking your phone or that person sneezes behind you or starts whispering so you turn around to see what they're talking about. This would take away any of that side conversation because if you're both wearing goggles you're not going to be like, "Hey, what part are you at?" Or "What time are you at?" So, that would help with that".

A graduate international studies student reported: "I think, just confidence, and seeing it (Cine-VR) play out in a real-life situation is really cool. Cause I have never personally experienced it before, so getting to watch it makes me feel like oh, if I was in that situation I would know what would be going on".

Realism of learning from VR simulation

The realism in education and simulation learning is needed to give students the experiences needed for them to be able to gain the ultimate learning experience. Utilizing Cine-VR as a modality to provide a real experience, the participants reported feeling a part of the Cine-VR simulation. Graduate Athletic training major reported that "It (Cine-VR simulation) was immersive". A graduate international studies student said, "I just was so engaged and there was nothing else, couldn't hear anything else, and it really helped me only focus on what was going on". Another international graduate studies student said, "I felt that I was living it, not watching it, the whole thing!" A graduate physical therapy student said", so you had the feel like, you were like a part of the situation. You're not just watching it, like, you feel like you're in it". And a graduate physical therapy student reported, "I did like that it was immersive. I felt my heart rate and I was like oh my, I really thought they were going to die, but then I was like oh this is a legit thing that happens". This was further exclaimed by an undergraduate nursing student who added: "Be a part of a situation rather than just like watching it like a movie or TV or something like that. I think of the instructiveness whether you can look around in three hundred sixty degrees. You know if you're facing one direction, you know something might be gone or overheard and you actually have to turn around to actually figure out yourself where that part of the scene has been taking place. So, it's like, you're more subconsciously engaged that way as well. Because you're engrossed in the situation. I mean, you kind of feel like you're in there, as if like if you're in a movie something's always a distraction going on. So, I think this way, the fact that you are completely interested makes it less distracting".

Numerous participants commented on the feel of being in the Cine-VR and having been a part of the scenario. This was expressed clearly by a business graduate major as: "I kind of felt like an omnipresent thing. Just watching the scenario but also immersed in it, which was cool, because it was enough you could see people's facial expressions it wasn't like looking down, which was cool. It felt like you were there, but you didn't really have a purpose, but you almost felt panicked when the people were panicking. And you were almost like, "Where's the NARCAN?" I was analyzing the scenarios. "Why did they drop that syringe on the ground?" It's the best experience I've had with virtual reality. I think another pro was, in that one specifically, the situation was realistic. Their reactions to finding their friend, and their panic, and then "Okay, well now we need to do something". I thought that was realistic and could be a really good experience for people to really understand what a scenario looks like. Especially in a dorm setting, that was a good response. I'd say realistic. Your friends finding you, I felt like is realistic, and if your friend has overdosed, then people finding you that way. I also think their reactions were good, because in most emergency scenarios people initially are kind of in a panic and then they click and realize, oh! This is what they're doing. This is what the next step needs to be. I think the video recording was realistic, too, because I think that happens a lot. Especially with the opiate epidemic currently. So, I think it was realistic" I felt like I got so much emotion from how they were reacting".

In addition to feeling immersed or a part of the Cine-VR simulation, participants commented on the realism of the experience. One undergraduate nursing student participant mentioned, "I thought it was realistic when they were deciding who they should call and what

they should do, and then him waking up and being angry about it. I think that was very realistic". A graduate engineering student added, "How the person calmed that girl down". A graduate audiology student said, "and his response was very realistic as well. I don't want to get in trouble, I don't want to call the police". An undergraduate engineer student said, "I think it's a lot more powerful than just videos because you are actually there experiencing it. It might evoke a lot more emotions because you think about it for longer. "An undergraduate business student participant expressed: "I thought it was a very lifelike situation, because the chances of- and I'm being extremely stereotypical, so please excuse me but, the chances of three, or two very educated, calm, relaxed people walking in on a situation like that, at least in my experiences of friends that I've had that have overdosed, it's... not usually like that. They're either on another medication, or they're not in also a right frame of mind. So, the chaotic-ness, I think was much more life-like".

A business graduate student participant expressed that the: "The situation was very like, something you might actually come upon. It wasn't some random situation and they were stressed just like you would expect someone to be but they handled it correctly. I appreciate that there's realistic concerns of "Are we going to get him in trouble?" "Is he going to lose his scholarship?" Like, that's all things we consider when we're helping someone even if it's like drinking and they're of age".

A graduate business student stated: "I think it was really realistic with how the people were reacting, how the actors were acting about the overdose situation. How at first they were reacting kind of in a panic way and then they thought about it and the procedure with it was cool".

An international graduate studies student participant discussed the opportunity to make the Cine-VR more hands on by saying: "We were definitely in the center of it but also it's kind of bad that you can't do anything. You're in the center of the situation happening and even if you don't know what to do had a loss for them or feel like oh we should do this. You can't really help. So, it was good to be in the center and see it all go down and learn from their experience but then again you're like oh I want to do something".

Some participants commented on the full 360-degree view of the Cine-VR simulation. An undergraduate communication major stated "I like that you could move around. I love the 360 of it. There was always action happening regardless. It wasn't lagged or anything. It made it pretty real". A graduate student from audiology reported, "I would agree with that. I liked that I could look behind me even if there was nothing going on. It wasn't like the screen was cut off, which made it, again, feel more realistic".

The emotions were aroused by the realism of the Cine-VR simulation. Some participants expressed disdain related to a scene in the Cine-VR that had bystanders walking by, gawking and filming the situation as it unfolded. An undergraduate biology major commented, "I think the bystanders that came were another cool dynamic to add because I think that's plausible". An undergraduate communications student who cried immediately following the Cine-VR said: "the actual scene I was very upset when people started recording. I literally started tearing up and I kicked because I was like, "Get out of here!" It really upset me". I think a pro is just being immersed in that situation. I think that's awesome. I started to tear up a little bit, and kick and, kind of like kick the people away because I was really actually mad. I was so mad. And I get heated talking about it now. So, yeah, I started to cry a little bit".

A graduate student in Communication and Media who was using hand gestures during the Cine-VR experience, verbalized: "I also did not understand what the people in the hallway were doing as taking photos, that was very distracting to me, whereas I feel like I should've been watching the event go down, but for some reason I couldn't stop watching these people watch what was going on".

An international graduate studies student participant stated: "I thought it was well done in terms of representing what could actually happen. I just don't like that when people are observing a situation go down, so I was getting annoyed that those kids sitting there filming and just playing with the ball. So, I kept looking over thinking they would help and I'm like what the heck guys. It's true to form though is the worst part but, I guess I was just personally getting annoyed".

A graduate student from the communications and media department expressed, "I thought it was troublesome that it took the two people who found the subject- they went through all of his stuff, and looked all over the room, before they noticed the needle and tourniquet". An undergraduate exercise physiology student reported "the actor that had overdosed being angry when he woke to 911 calls- I was not expecting that, and I think that is a very realistic reaction. I thought that was really good".

Discussion

The results revealed rich descriptions from a group of interprofessional undergraduate and graduate students at a large Midwestern University regarding use of Cine-VR as a successful modality for learning. This aligned with the purpose of this study to explore interprofessional students' attitudes and perceptions related to learning how to administer naloxone through a VR activity. This discovery is value added to educators across a vast array of professions who have the need to educate students on opioid overdose management or other practice-based concepts. Our study supports that Cine-VR can transition current learning modalities to a format that provides the identical learning experience to student one that it does to student 5000 or infinity through the immersive real to life experience. We utilized a naloxone administration scenario but through the focus groups conversations it became evident that this style of learning can apply to many other subjects with inferred similar findings. Our participants voiced improved knowledge about opioids and use of naloxone, expressed changed perceptions regarding ability to act during a crisis, and indicated satisfaction with realism of learning from Cine-VR simulation and improved learning with the help of Cine-VR simulation. As no prior research has explored the perceptions and attitudes of interprofessional students using Cine-VR for learning of any topic, this brings a unique perspective to educational research.

Educators and students alike have goals for learning modalities. Content is a key factor in the type of modality chosen to deliver a specific concept of learning. Cine-VR was the chosen modality to deliver lifesaving training on how to identify signs and symptoms of an opioid overdose and how to administer naloxone. Nonmedical opioids are the second most sought after drug of choice on college campuses, second only to marijuana [21]. Fifty-five percent of full-time college students reported illicit drug use in their lifetime [28]. This makes the importance of accessible and meaningful training related to opioid overdose and treatment as a part of college life imperative. The qualitative responses on the participants' knowledge about opioid overdose and use of naloxone indicate that Cine-VR was a successful learning modality to improve critical knowledge of this content.

Virtual reality 360 technology was designed for the viewers to be immersed in the virtual surroundings and experience the content, instead of passively watching. Immersive view lets each person to choose where they look within the scenario [13]. Immersive VR with head mounted displays has proven to be effective in increasing learning and motivation [8]. The qualitative responses on the participants perceptions of their own ability to act in an opioid overdose crisis and utilize naloxone support an increase in participants' comfort level to take action in future possible opioid overdose situations. While it is known that participants show remarkedly improved skill sets with other levels of simulation, the use of Cine-VR is new [3]. Our participant responses identify Cine-VR as a meaningful way to learn and retain skills surrounding learning to save a life using naloxone. The advantage offered by Cine-VR over other traditional simulation modalities include that is less expensive to develop, easier to access and requires less space and specialized equipment [37].

The literature lends itself to various forms of VR being utilized in healthcare education for many years [3,23,29]. Most of those learning modalities connected to VR are haptic, or gaming related. Haptics have been used for simulation purposes to assist educators in delivering as real to life situations as possible through the use hands on skill-based learning [4]. Games that are specific to healthcare continue to increase in number [8,16]. Cine-VR brings a new platform of VR 360-degree learning. Virtual reality 360-degree immersive videos have been used over the past years for short trainings including pediatric and physical therapy departments to help prepare patients for treatments [22].

Cine-VR simulations are new and an advancement on other degrees of more traditional mannequin based or standardized patient simulation. Live actors are utilized with Cine-VR that help to bring in the realism of the scenario. Our study identified realism as an impor-

tant finding from our participants lived experiences with the Cine-VR. Not only were their stated opinions but there were physical reactions such as smiles, expressions of anger and tears throughout this real-to-life experience. These emotional reactions align with recent findings of realism in other forms of VR. In a previous study involving VR 360 video, emotional connections were linked by participants to increased knowledge of content learned [3]. Slater and team sated in reference to VR, that "knowing it is not real but feeling it as if it were" has led to several research projects around phobias with successful patient results [30]. While our study, did not focus on a phobia, it is the same principle that through exposure to an overdose, our participants expressed the feelings of being actually in the room and learning to save a life.

Our participants repeatedly expressed their feelings and emotions stating sense of being a part of the scenario or involved in some way. According to authors, Bowman and McMahan, full immersion is not always necessary [1]. Our participants while immersed in the room were not an active part of the scenario. They were able to look up, down and all around them to see and feel what was going on around them, thus the feeling of immersion and presence.

Limitations of the Study

Cine-VR-based simulations provide experiences that would be difficult, if not impossible, to replicate using traditional methods. However, the study of Cine-VR's effectiveness as an educational tool is still maturing. As Rizzo and Shilling point out, What makes the clinical use of VR so distinctively important is that it represents more than a simple linear extension of existing computer technology for human use. By way of VRs capacity to immerse a user within an interactive computer-generated simulation, new possibilities exist that can go beyond the simple automation of previous clinical assessment and intervention approaches [24].

We recognize precise limitations in our study, specifically that further research needs to be done in the area of how Cine-VR scenarios are perceived by the human mind. Research indicates that a Cine-VR scenario that is primarily observed within a 90-degree field of view may have more of a cognitive effect (and less of an emotional effect) than a scene that requires the audience to observe the story utilizing the full 360-degree field of view [19]. Similarly, a Cine-VR scenario that fully utilizes the 360-degree field of view to understand the story may have more of an emotional impact, but less of a cognitive impact [37].

Moreover, the production quality of any Cine-VR experience may have had a conscious or subconscious effect on the audience. "Production quality" may include variables such as the talent of the actors and screenwriters; technical expertise of the crew including lighting and sound; quality of the equipment used in production (i.e. microphones and cameras). We believe that our Cine-VR simulation was of the highest quality given our limited budget. Nevertheless, it is possible that production quality may influence the audience. While is needed to understand the correlation between the audience's field of view and cognitive impact, the overall effect of "production quality" is more subjective and may never be fully understood.

Another limitation relates to the use of a convenience sample across 14 disciplines utilized for the study. It would be interesting to see equal group representation per discipline to distinguish how this may have affected the qualitative evaluation process.

Future Research

Presently, VR is relatively new and, therefore, may be seen as an exciting, cutting-edge way to learn – especially by a generation already attracted to digital technology. We are unsure whether the students' enthusiasm for the project stems from their enthusiasm for the technology or from its educational impact. Further research is needed to determine whether, as the novelty of Cine-VR and HMDs fades, Cine-VR will have less of an educational impact. Or, will higher quality equipment at lower cost provide educators with a powerful tool for the healthcare field?

Conclusion

Participants attitudes and perceptions on the use of naloxone were increased. The naloxone Cine-VR simulation can subsequently be used to support a broad range of healthcare educational institutions effort by providing a consistently repeatable educational scenario that can be widely accessible and technologically simple enough to use across a range of high-end and off the shelf, technologies. The findings of this study add new information to the existing body of literature by contribution an unobstructed view of learning through the use of Cine-VR and the effectiveness of that learning experience on an interprofessional group of participants. These findings promote the correlation between increased knowledge of naloxone use, and the ability to act during an overdose situation and the use of Cine-VR simulation. Additionally, through the realism exhibited in the Cine-VR experience, Cine-VR simulation is a proven way of improving learning. With this knowledge, we can progress forward with creating additional Cine-VR simulations for a variety of healthcare scenarios.

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