



# The Use of Virtual Reality (VR) as an Effective Modality for Pain Management in the Care of Pediatric Burn Victims

Deepika Budhraja, Norhan Gomaa, Ariana Ochoa, Victoria White, Taylor Paradossi



## Abstract

Virtual Reality (VR) is a novel invention originally intended for gaming. Recent studies have shown VR to be effective as adjuvant pain management for pediatric burn patients. Pain relief is essential to the rehabilitation and success of burn victims, as their care is known to be excruciatingly painful. Significant in the pediatric population, pain management decreases fear and anxiety which increases treatment compliance and promotes better health outcomes. Standard care for pediatric burn patients currently depends on the use of potent opioids, anxiolytics, and other sedating medications. Use of VR could lessen dependence on opioids on both an individual and societal level.<sup>1</sup> Although VR technology has the potential to be costly upfront, it has been shown to be cost-effective by minimizing opioid exposures and complications, and decreasing lengths of hospital stays.<sup>2</sup> The use of VR is an easily implementable, cost-effective, and non-invasive modality with great potential in utility for pain management. Such should be considered further not only for its value in promoting positive health outcomes, but also for decreasing the use of opioids for pain management in an already vulnerable patient population.

## Objectives

- Identify the current methods of pain management in wound care for pediatric burn patients and how these can be detrimental long term.
- Explain the physiological effects of VR in pain management, with an emphasis on distraction blunting pain signaling in the brain.
- Discuss considerations for broad application/utility of VR in pain management of pediatric burn victims through analysis of current use(s) (cost-effectiveness, decreased use of opioid medications, accessibility).

## Current Practices in Management of Pediatric Burn Patients

In 2018, the World Health Organization (WHO) began the Global Burn Registry (GBR) in order to better understand burn injuries worldwide. With data collected from 20 countries and 8,640 patients, 42% (3,649) were children, illustrating the high prevalence of burn injuries in the pediatric population.<sup>3</sup> Since burns typically result in debilitating pain, most clinicians in the United States rely on opioids for pain management.<sup>4</sup> Of 133 burn centers surveyed in the United States, 95% reported that long-acting opioids were utilized throughout a burn patient's hospitalization, with the most widely used opiate being Morphine.<sup>3</sup>

## Risks of Opioid Use

The risk of opioid addiction is well known, as well as an accompanying rise in deaths from opioid overdose. In 2017, the US Department of Health and Human Services declared the opioid crisis a public health emergency.<sup>1</sup> Of note, opioid prescription rates have since been trending down nationally, and it is suspected that this can be attributed to evolutions in medicine in pursuit of adjunctive pain control strategies, such as the use of VR.<sup>5</sup> Despite this, regional burn centers reported 86-90% of adults and 77% of children were prescribed opioids at discharge.<sup>5</sup> Outside of the public health crisis, the harmful effects of opioids can be seen as acutely as negative physiologic effects within individuals, known as opioid-related adverse drug events (ORADEs).<sup>1</sup> ORADEs include effects such as constipation, over-sedation, delirium, and respiratory depression. ORADEs bear both clinical and economic implications.<sup>1</sup>

## Success of VR in Pain Management

VR provides analgesia by way of cognitive distraction, and has been shown to decrease opioid use and subjective pain levels. A within-subject randomized control trial demonstrated that with the use of immersive VR during dressing changes, total opioid administration was significantly less than when VR was not used, with an average decrease being 11.3 mcg/kg of Fentanyl-- a 39% decrease in opioid use.

A randomized control study conducted at a large American Burn Association-verified pediatric burn center studied the efficacy of VR as a distraction technique versus standard care (opioids and sedatives).<sup>7</sup> Patients self-reported pain using standardized measures and it was found that VR participants had significantly lower pain scores across all conditions, with as much as a 32% reduction in pain.<sup>7</sup>

In addition to immediate physiological benefits of pain relief, VR has been proven to have psychological benefits as well. Interviews of children 6 months post-burn care found a statistically significant link between adequate pain control and decreased PTSD symptoms.<sup>8</sup> Although VR specifically was not implemented in this study, the demonstrated efficacy of VR in reducing pain levels should be correlated to this same potential.

## Costs Effectiveness of VR

In the hospital inpatient setting, VR therapy was shown to be more cost-effective per patient in comparison to standard care, with savings of up to \$156.17.<sup>2</sup> Majority of research concerning cost-effectiveness of VR looks at overall hospitalization costs. With the idea that the longer the hospitalization the more opioids likely being used, decreasing pain with VR decreases length of hospital stay, which would also decrease opioid-associated costs.

One study found that implementing an inpatient VR pain relief program saved the hospital an average of \$98.49 per patient. Among patients who did not receive VR (not eligible or not willing), the hospital lost \$16.90 per patient.<sup>2</sup> Costs of the VR program in general were \$246,090 per year-- \$3.39 per patient, and included the virtualist that ran the program, and materials for the headset such as disinfectant wipes, foam liners, bouffant hats, and headphones. The VR program reduced lengths of hospital stay upwards of 14.6%.<sup>2</sup>



## Practical Considerations

Comprehensive VR systems may require multiple pieces of technology, equipment, special training, and infection control considerations that make them appear prohibitively costly and impractical in some clinical settings. Despite this, studies have shown that simple devices such as iPads and smartphones alone can be used as a considerably cheaper and comparatively effective alternative. At UNC Children's Hospital, a group of pediatric patients utilized either an iPad or a full headset system postoperatively and their pain and anxiety levels were evaluated.<sup>9</sup> The study found that although the full headset system was more potent in reducing pain scores, there was no statistically significant variance in additional pain medication required between the two groups/methods of VR.<sup>9</sup> A separate randomized controlled trial assessing the effectiveness of smartphone VR (goggles with no screen that have any phone clipped/mounted inside instead), compared to standard care in pediatric burn patients, found the smartphone VR group to report significantly reduced pain scores compared to standard care.<sup>7</sup>

## Conclusions

VR has great potential as an adjunctive treatment in pain management, especially in pediatric burn patients. This is a significant advancement in healthcare as it's non-invasive, cost-effective, and can be easily implemented. There is substantial evidence demonstrating the efficacy of VR in reducing pain levels, decreasing opioid use, and most importantly enhancing patient outcomes.

Currently, there is considerable reliance on opioids for pain management, which not only has risks associated with their use such as ORADEs and the possibility of addiction, but the underlying opioid epidemic as well.<sup>1</sup> VR can be used as a tool to address these challenges in providing adequate pain management with less risks. Furthermore, if utilization of opioids can be reduced, so would some of the economic burden related to opioid use, contributing to even greater cost savings in society and healthcare overall.<sup>2</sup>

Implementing VR for pain management will require consideration of a few practical factors, such as accessibility and cost. There are fully immersive VR experiences which would have more significant expenses, however there are more cost-effective alternatives such as iPad and smartphone-based VR that can be more easily, more widely adopted.<sup>7</sup> There is potential for considerable savings and better allocation of resources given the long-term cost-effectiveness of VR therapy with reductions in length of hospital stay and opioid use/complications.

The use of VR technology is promising in terms of transforming the care of pediatric burn patients as it provides effective pain relief, reduces opioid dependence, and improves patient outcomes. As there will likely be challenges in implementation, further research is warranted to maximize its potential benefits. As healthcare is forever evolving and new innovations and technologies are emerging, we should strive to work towards a more effective and compassionate approach to pain management in such novel ways.

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