# Virtual reality alleviates pain, anxiety for pediatric patients

September 8 2017, by Kate Detrempe

Blaine Baxter, who suffered an injury to his arm while racing a go-kart, has benefited from virtual reality to distract from the pain of dressing changes. Courtesy of the Baxter family. Credit: Stanford University Medical Center

As patients at Lucile Packard Children's Hospital Stanford undergo routine medical procedures, they are being whisked away to swim under the sea, zap flying cheeseburgers in outer space, catch basketballs using their heads and fly on paper airplanes through the sky, thanks to virtual-reality technology, which is being implemented throughout the hospital to help ease patients' feelings of pain and anxiety.

Packard Children's is one of the first hospitals in the country to begin implementing distraction-based VR therapy within every patient unit.

"Many kids associate the hospital with things they deem stressful and scary," said pediatric anesthesiologist Sam Rodriguez, MD, co-founder of Packard Children's Childhood Anxiety Reduction through Innovation and Technology, or CHARIOT, program, which is leading the VR rollout. "We are finding that the ability to distract these patients with fully immersive, fun and relaxing sensory environments can have a significant impact on the anxiety and pain that they experience during minor procedures, dressing changes and other medical treatments."

In February, 9-year-old Blaine Baxter suffered a severe injury to his arm while racing a go-kart and had to undergo daily, painful dressing changes. "He would immediately start crying and scream out of fear, and had to be sedated before doctors could approach his arm," explained Blaine's mother, Tamara Baxter. "He was so riddled with anxiety after everything he had been and was going through. VR was a game changer for Blaine. As soon as he put the goggles on, sedation was no longer needed, and during his dressing changes we went from hearing pain-

stricken screams to 'Wow, I'm under the sea looking at sea snakes. This is so cool. You have to see this!'"

The use of VR is a novel experience for many of the patients at Packard Children's, said Veronica Tuss, a child life specialist with the hospital's Child Life and Creative Arts Department. The department's members engage patients in age-appropriate activities to help normalize their time in the hospital. Through providing education and procedural support, they play a key role in helping to decrease patients' stress levels prior to procedures. "VR is often so unfamiliar that it is instantly engaging and incredibly distracting," Tuss says. "If I'm preparing a child for their very first IV, and they share with me that they don't want to see what's happening procedurally, I know I need a distraction that is visually engaging. With VR, an often-intimidating setting suddenly becomes this really cool thing or place that they get to explore. It can minimize the experience of getting the IV to the point that we may actually turn a negative experience into a positive one."

## Evolution of CHARIOT

The hospitalwide VR rollout is the latest evolution in distraction-therapy techniques pioneered by Rodriguez and fellow anesthesiologist Thomas Caruso, MD, who co-founded CHARIOT with Rodriguez. In 2015, the duo introduced the Bedside Entertainment and Relaxation Theater, which uses video projection to allow patients undergoing surgery to watch movies, music videos and other entertainment on a large screen attached directly to their gurney up to the moment they enter the operating room.

Earlier this year, CHARIOT launched Sevo the Dragon, an interactive video game projected on the BERT screen that takes a necessary part of anesthesia—breathing anesthesia medicine through a mask—and transforms it into a game. While BERT is great for younger children, the

VR experience is becoming a useful tool, especially for older children, said Rodriguez and Caruso, both of whom are clinical assistant professors of anesthesiology, perioperative and pain medicine at the School of Medicine. The VR goggles escalate the immersive entertainment experience to a 360-degree view of relaxing scenery and engaging games.

For patients as young as 6, VR distraction therapy is being used in Packard Children's Bass Center for Childhood Cancer and Blood Diseases, short stay unit and emergency department; the vascular access, imaging, ambulatory orthopedics and general surgery clinics; and the perioperative unit. It will be rolled out by the end of the year to the hospital's acute care floor units, Stanford Children's Health's ambulatory surgery clinics and even the labor and delivery unit. The goal is for all of the hospital's 29 child life specialists to be trained on the use of VR goggles by that time. In addition, pediatricians at the Stanford Children's Health Bayside Medical Group-Berkeley clinic will be implementing VR technology during immunizations for patients who are fearful of needles.

"Children shouldn't grow up being afraid to go to the doctor to have a shot, but certain experiences can cause phobias that last into adulthood. Needle phobia is a common example of that, and it's the primary reason adults avoid important immunizations like flu shots," Caruso said. "Now, when patients get a shot while they are wearing VR goggles, they are reporting only limited levels of pain, if any."

## Customizing VR for the hospital setting

The CHARIOT team has medically customized the VR headsets to better fit kid-sized heads with an easy-to-clean strap and a disposable screen liner for immunocompromised patients. Sound capabilities allow the volume to be adjusted so the care team can communicate with patients during procedures, and each headset is accompanied by a

smartphone preloaded with customized content specific to children in the hospital.

The CHARIOT team works carefully to select games that require limited head and arm movement so kids seated in bed can play without turning their bodies or getting tangled in IV lines and other wires, and so patients with arm bandages or casts can still participate. CHARIOT also works with companies to adapt commercially available games for the health care setting, removing themes of injury or death and eliminating "game over" termination so that the distraction of the game doesn't go away at the moment patients need it the most.

Working with Silicon Valley-based software engineers, Rodriguez and Caruso are also developing original VR content specifically created for the pediatric patient population. Their first game, Spaceburgers, was developed with Juno VR and is specifically designed for children in a hospital setting. It transports patients to outer space and immerses them in relaxing music as they zap space objects—including "spaceburgers"—that fly toward them. It allows health care providers to adjust the cognitive load according to the patient's needs, meaning they can use a controller to increase the level of distraction during the most stressful parts of a procedure, like right before a needle poke.

Research is underway to further quantify the impact VR has on the levels of pain and anxiety that patients experience during vascular access procedures, including blood draws and port access, by comparing the experiences of patients who have used VR with those who have not. "Preliminary results have shown that kids tend to be more cooperative when they are engaged in VR, with less movement, less fear and sometimes even lower pain scores, which can make the experience more positive for the provider and the child," Rodriguez said.

The impact of VR can last beyond the immediacy of a procedure,

Caruso added. "Having a less terrifying experience when you go to the hospital can change your behavior for weeks after a procedure," he said. "Things like sleep regression or acting out during the recovery period are associated with distressing perioperative experiences, but by using VR and reducing the fear and anxiety that kids experience before a procedure, we hope to positively impact their behaviors after the procedure."

Now, the CHARIOT team is researching the impact of passive VR experiences, such as watching fish float by, compared with the impact of active games, such as zapping spaceburgers, to understand whether the content itself impacts patients' reported pain and anxiety levels in the clinical setting. Packard Children's is one of the first hospitals to integrate the use of VR as a potential method of anxiety reduction into patients' electronic medical records, which is helping care teams determine which content is most effective for certain populations, according to patient age, procedure and content type.

"Among our patients, there is a subgroup who do well during a procedure with or without VR, a subgroup with minor anxiety where VR helps slightly and they enjoy it, and a subgroup where it makes a profound difference," Rodriguez said. "These patients sometimes come in for a procedure with a 10-out-of-10 level of anxiety and fear, but when we implement VR during a procedure, they report stress levels of 2-, 1- and in some cases 0-out-of-10. Those are the patients we are really targeting with these VR interventions."

## What's next

CHARIOT's hospitalwide VR rollout is on track to be fully realized in the new Lucile Packard Children's Hospital Stanford, which is set to open in December, and will continue to expand with additional technologies.

"Our ultimate goal is to take a personalized approach to care by adapting and developing technological interventions for each child's needs," Rodriguez said. New content and more VR headsets will be available in the new hospital, including additional headsets specifically for patients with chronic conditions who are using VR as a relaxation technique to escape the hospital environment. For patients who are interested in watching their IV placements and minor procedures as they happen, CHARIOT has recently introduced augmented reality headsets—a technology that layers visual enhancements atop existing reality. Their first AR experience shows two avatars demonstrating the process of peripheral IV placement. The goal is to expand the availability of AR programming in the new hospital. A new volunteer program intended to support child life specialists with patient distraction and VR headset setup is being implemented within perioperative services and will expand in the new building to support the broader deployment of distraction-based technologies.

In addition, Rodriguez and Caruso are in discussions with local technology companies about how to share these technologies beyond Packard Children's. "Our overarching mission is to help as many children as we can and make our discoveries available to other people and other hospitals," Caruso said. "Having the hardware and software tools at the ready would make this a reality."

Rodriguez hopes that the program will continue to improve patients' experiences as it evolves. "If you can take someone and alleviate their fear, it makes everything we're doing worthwhile," he said.

Provided by Stanford University Medical Center