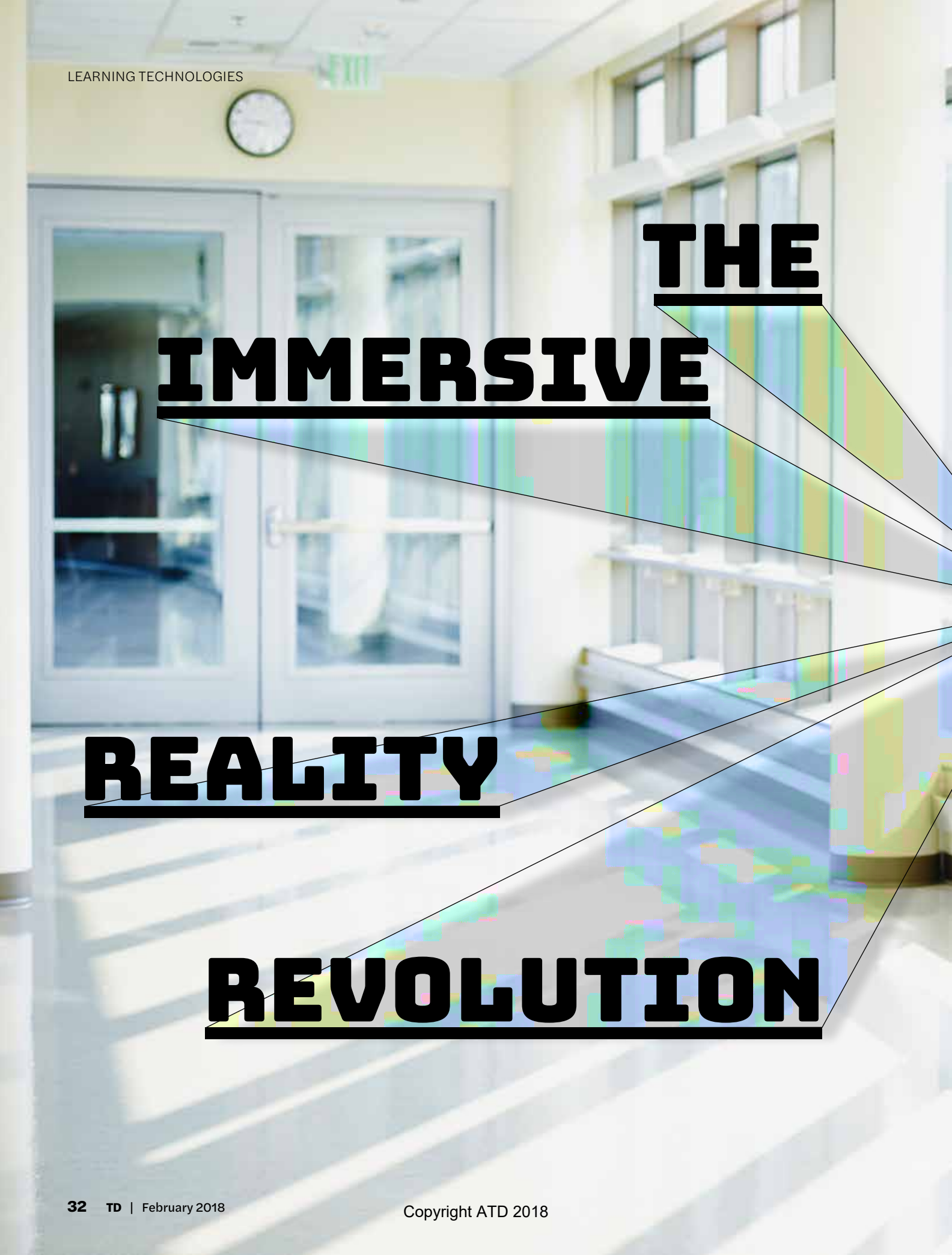

# THE IMMERSIVE REALITY REVOLUTION

Virtual and augmented reality are transforming how healthcare workers learn and practice.

BY ANDERS GRONSTEDT

Imagine downloading an app to your phone on the first day of work at a new hospital that will help you find your way around. Large arrows appear on the floor through the camera lens of your phone, leading you to your department. The same app can help do your job. Aim the phone at an EKG machine and get real-time holographic guidance on how to operate it.

The magic of augmented reality (AR) layers computer-generated images like these on top of the real world. And it's estimated that this powerful emerging technology will be on 2 billion phones this year. Essentially, AR turns the phone into a magic lens that can, figuratively speaking, arm healthcare workers and patients with superpowers.

IMAGE | GETTY IMAGES/THOMAS BARWICK

AR occupies one end of the immersive computing spectrum. At the other end is virtual reality (VR). Strap on the headset, grab the hand controllers, and walk around in a computer-generated simulation of a three-dimensional environment. Doctors can practice surgeries over and over. Teams of caregivers can practice medical emergencies. VR and AR are ushering in a new era of experiential and visceral learning.

Healthcare VR and AR are already a billion-dollar industry, according to Kalorama Research. Estimates by Grand View Research suggest that it will reach $5 billion by 2025, thanks in large part to the growth of medical simulations and training applications.

## Virtual reality

The new generation of VR offers a "flight simulator" for any healthcare task that's too dangerous, expensive, or inconvenient to practice in real life. "Room-scale VR" enables the user to physically walk around an empty room with the movements reflected in the virtual world. The sound is 3-D as well; as you move your head, the location of the sound shifts. Hand controllers or instruments with haptic feedback make the illusion complete. Feel the vibration of a tool or the resistance of pushing in a needle.

The VR experience provides enough sensory information of touch, vision, and sound to make the brain suspend disbelief and feel a complete sense of presence. You feel you're going to another place. Experience a surgery from the perspective of an operating theater or even inside the brain or the heart. Biology can be taught inside a cell.

It is learning in the context where the skill will be applied. Students can practice, explore, and fail in a safe yet highly realistic environment for a fraction of the cost of high-fidelity simulations with mannequins and cadavers. The upshot: increased patient safety, fewer complications, and a faster learning curve for new caregivers, new procedures, and new devices.

The feeling of immersion into another world and another body with VR is so powerful that it can reduce pain. Burn victims who experience a virtual snowball fight with snowmen and penguins in VR while they get their bandage changed report that the pain reduction is twice as effective as morphine, according to the Next Web. A research study published in the *Lancet* shows that amputees can reduce phantom pain by experiencing movement in missing limbs in VR. After arm amputees drove a virtual car around a racetrack with a virtual arm and various other VR activities, their pain decreased by 50 percent for as long as six months later.

**HEALTHCARE VR AND AR ARE ALREADY A BILLION-DOLLAR INDUSTRY.**

Just as VR can alleviate the pain of patients, it can make caregivers experience their pain. VR has been hailed as "the ultimate empathy machine." Step into the body of a 70-year-old dialysis patient, with vision blurred and hands swollen. Study upon study have validated the Proteus effect, in which the behavior of an individual within online virtual worlds is changed by the visual characteristics of his avatar in VR. There's a huge opportunity for healthcare organizations to improve the patient experience with VR empathy training of their staff.

## Augmented reality

While high-end VR requires the purchase of gaming computers and headsets, AR is predicted to come to half a billion phones this year. Apple has turned almost all its existing iPhones and iPads into AR lenses, and Google responded with its own version of AR for Android phones.

It's no exaggeration to say we'll never use our phones the same way again. And the rule book for mobile learning just went out the window.

Imagine a new-hire orientation scavenger hunt using a Pokémon GO model with this technology. Learn about the hospital through a virtual tour guide walking with you. Capture treasures along the way as you're learning about the departments you're visiting. The accessibility of AR on phones also can make it a killer app for microlearning, providing ongoing review and reinforcement.

Tracking virtual objects to the real world can be used for a range of performance support as well. Virtual arrows on the floor can guide you to the imaging department or to the attending doctor. Pharma sales reps can pull up their phones or iPads during client meetings to visualize the mechanism of their medication. They can walk around a giant cell floating across the doctor's office and observe it from different angles. Technical staff can hold up their cameras to medical equipment for support. The phone recognizes different components of the equipment and overlays holographic step-by-step instructions on each equipment part, visually guiding the worker through the operation, repair, or service. It also can feature "X-ray vision" to view what's inside it.



IMAGE | THINKSTOCK

These AR apps might seem limited and impractical, but they are only the beginning. The AR technology in your phone today will power the AR headsets of the future that soon will replace the phones. Microsoft's HoloLens—a self-contained, holographic computer—is an early developer version of these futuristic AR glasses.

It's already being used to teach anatomy students at Case Western Reserve to visualize the various layers of the human body. Fifteen minutes with the 3-D images could have saved them dozens of hours in their traditional anatomy labs, reports Pamela Davis, dean of the school of medicine. However, these AR headsets are still too costly and too limited for the mass market. Developing comfortable AR eyewear is a difficult challenge that probably will take about four to six years before we see mass adoption in learning. But it will happen. All the tech giants—Apple, Microsoft, Facebook, Google, and more—have staked their future on them.

## Giving caregivers superpower

VR and AR are here now. *ComputerWorld* reports that about 60 percent of physicians already use VR technology to practice surgeries. But it's still clunky. The VR headsets look like something a welder would wear, and viewing the world through a smartphone is not optimal. However, they will get better, cheaper, and more ubiquitous in the next few years. As that happens, VR and AR are poised to disrupt the learning industry.

VR can take you to any place; AR can bring anything to you. VR offers a digital rehearsal space so convincing that learners feel they are actually there. AR can make the real world the canvas of any number of learning activities. They both empower caregivers to dramatically boost performance, safety, and compassion. This is a hopeful future where technology is not replacing healthcare providers, but augmenting their abilities so they can offer superior patient care and experience.

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## FROM IDEA TO VIRTUAL OR AUGMENTED REALITY

Virtual and augmented reality are coming fast. This is not the time to wait and see, but to learn and do. How can your healthcare organization get in on the action? Here are some critical steps.

### Demo

When it comes to VR and AR, seeing is believing. Decision makers have to experience it. Get an Oculus Rift or HTC Vive VR headset and a gaming laptop to demonstrate the full power of VR. Let stakeholders play the Job Simulator game for 10 minutes, and they will be your VR evangelists. Next, load up an AR demo on your phone. The Apple App Store has more than 100 ARKit demos for the iPhone 6S and newer. The INSIGHT HEART app takes you inside a heart. The Google Play Store has good ARCore demos for newer Android phones. Atom Visualizer is my favorite.

### Pilot

When your stakeholders have experienced VR and AR, it's time to identify a healthcare problem that can be uniquely solved with the technology and will have maximum business and health impact.

### Develop

Some suppliers offer off-the-shelf VR and AR content for particular treatments or simulations. But most programs will have to be custom developed to your needs. One effective way to leverage the investment is to develop a desktop version of the same program for broad distribution at minimal extra cost. Custom developing VR and AR requires a team of experienced game designers. Most VR and AR programs are developed in the Unity game engine. The team needs a minimum of one 3-D artist and programmer, and an instructional or game designer.

### Deploy

AR can be deployed as mobile apps to learners' phones and tablets. VR requires that you purchase a gaming computer and a $500 headset and set it up in a training room, in a cafeteria, or at events. Trainers can travel with them to clinics. This is only a short-term problem because less expensive VR headsets will come to the market soon.

### Analyze

VR and AR learning programs can offer a treasure trove of analytics. Heat maps can visualize where in the environments students walked, looked, and interacted. That information can be used in debriefs with students and to improve the program.