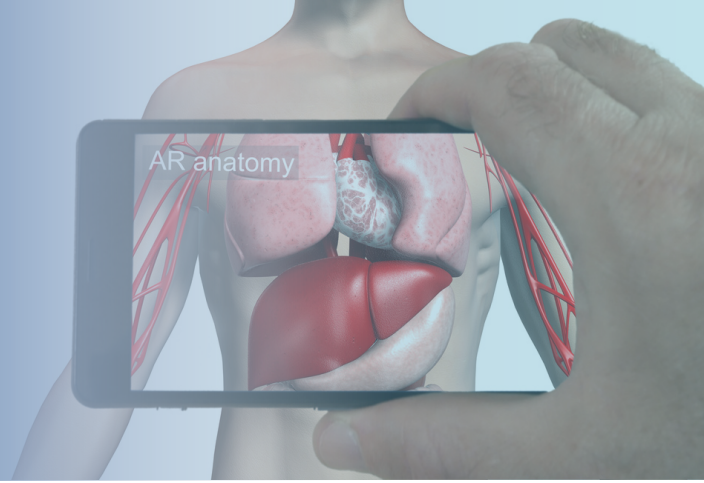


# XR TECHNOLOGY AND HEALTHCARE



## WHAT IS THE XR ASSOCIATION?

The [XR Association](#) promotes the dynamic growth of the XR industry. We convene and educate policymakers, thought leaders, researchers, developers, civil society, and the public on XR's infinite potential and serve as the premiere resource for anyone interested in learning about the applications of immersive technologies. Our member companies are united in our mission to champion the responsible development and thoughtful advancement of XR solutions that foster positive societal outcomes. Let us help you explore the endless potential of XR.

## WHAT IS XR TECHNOLOGY?

XR is an umbrella term encompassing virtual, augmented, and mixed reality technology as well as other forms of alternate, expanded, or immersive technology applications.



### Virtual Reality (VR)

VR replaces or occludes a user's reality with a new virtual environment like a factory floor or replication of the solar system.



### Augmented Reality (AR)

AR layers digital content onto a user's view of the real world, thus providing a composite view.



### Mixed Reality (MR)

MR allows users to experience simulated content within their physical worlds and to manipulate and interact with virtual elements in real time.

XR is changing the way we learn, do business, and provide essential human services. By delivering efficiencies in manufacturing, enhancing workplace safety, accelerating learning and job training, providing risk-free first responder training, improving healthcare and medical services, and providing rich experiences to individuals living with disabilities, XR is poised to become a part of daily life for users across the globe. XR is the technology of the future—today.

## XR IS IMPROVING MEDICAL TRAINING AND PATIENT CARE

XR's use in healthcare is on the rise, from the operating room to medical classrooms, from pain management to mental health. [Experts estimate the market for XR in healthcare could reach \\$19B by 2030.](#) The next page provides just a few examples of how XR is revolutionizing the medical field and improving people's lives. Learn more about XR's impact on healthcare in [XRA's letter to the U.S. Food and Drug Administration](#).

## MEDICAL EDUCATION AND TRAINING

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### Medical Education

Students can find new ways to explore and learn human anatomy using XR technology. Case Western Reserve University developed HoloAnatomy®, which allows students to learn anatomical content 3D using AR. Learning time was shortened and retention improved by using the program. Meanwhile, students at the UC San Francisco School of Nursing can use VR to better understand the impact medical complications have on physiology and practice providing care to a patient experiencing postpartum hemorrhage, preparing future nurses on how to reduce one of the leading causes of maternal mortality. By leveraging XR, schools no longer have to rely on human cadavers and can give students anywhere the opportunity to learn remotely.



### Medical Training

XR allows medical students to repeatedly practice techniques in life-like virtual environments. Massachusetts General Hospital's Department of Orthopedic Surgery uses virtual reality to train students in the motor skills required for surgery. Students can practice everything from taking an X-ray at the right angle to capture the injury to performing a reduction of a fractured bone.



### Surgical Support

XR helps surgeons visualize organs, tumors, X-rays, and ultrasounds in real time and from multiple angles without diverting attention away from patients. Today, Hoag Hospital in Newport Beach, CA, uses 3D modeling and VR tools to "rehearse" complex procedures, which reduces the time and risk associated with surgery. These virtual and augmented reality visualization and navigation tools give surgeons the ability to practice and make more informed clinical decisions. Neurosurgeons at Johns Hopkins have completed AR-guided spinal surgery by projecting images of the patient's internal anatomy based on CT scans.

## PATIENT CARE

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### Stroke Rehabilitation

VR systems have been designed to incorporate critical aspects of neuroscience and motor learning to assist stroke survivors with motor recovery. Research indicates that VR systems trigger cortical activation, which promotes neuroplastic changes and thus functional improvement following a stroke.



### Pain Management

Clinicians are also using immersive technologies for pain management and distraction for patients of all ages. In some circumstances, XR can be used as a safe alternative to opioids. VR has been used to successfully treat individuals that underwent amputation surgery that are experiencing phantom limb pain. VR can also be used as a pain distraction tool for patients undergoing intravenous insertion and other medical care.



### Mental Health

VR can be used to reduce anxiety and depression, combat eating disorders, and treat cognitive decline. The Department of Veteran Affairs has been successful in using VR to help military veterans suffering from chronic pain and post-traumatic stress disorder (PTSD), particularly those who have not responded well to conventional treatment. A study conducted by the Office of Naval Research, the Virtual Reality Medical Center and Naval Medical Center San Diego found that VR "significantly reduced" symptoms for veterans diagnosed with PTSD post-combat deployments.



### Physical & Occupational Therapy

The use of XR for physical and occupational therapy has grown in recent years and became a critical part of treatment during the Covid-19 pandemic because care could be delivered remotely. VR treatment can range from playing games to virtually practicing real life skills and activities (e.g., dishwashing, making coffee, brushing teeth, or opening a door). Studies have found that patients are more motivated to complete VR physical therapy treatment programs than traditional programs.