Medical Activity Alert

Earthquakes threaten 1 in 4 Americans. Earthquakes currently cannot be predicted, but people can act beforehand to reduce the harm when earthquakes occur. One way to do that is to implement earthquake early warning, which refers to a system that rapidly detects earthquakes just after they begin, quickly calculates how strongly the ground will shake, and notifies people or systems just a few kilometers or tens of kilometers from the epicenter before the shaking arrives. With a few seconds' warning, people and systems can take useful protective actions. The next few pages answer key questions for people deciding whether and how to adopt earthquake early warning for people engaged in medical activities. This material was written by leading earthquake engineers, seismologists, emergency managers, and other pioneers of earthquake early warning, including people who developed, implemented, and use earthquake early warning in real life.

Essence of the Practice

A public address system sounds an audible alert in a medical setting (Figure 1). Medical professionals hear the alert, secure sharp instruments, and take action to protect themselves, patients, or both. These actions can vary widely by setting: in a phlebotomy lab, withdraw needles and activate the safety feature; in a surgery, protect a patient from dust and prepare the patient for a delay in the continuance of the operation; secure dangerous equipment such as cauterizers; in a nuclear medical laboratory, shut down hazardous equipment; in other settings, warn patients to take a safe seat or lock wheelchair brakes.

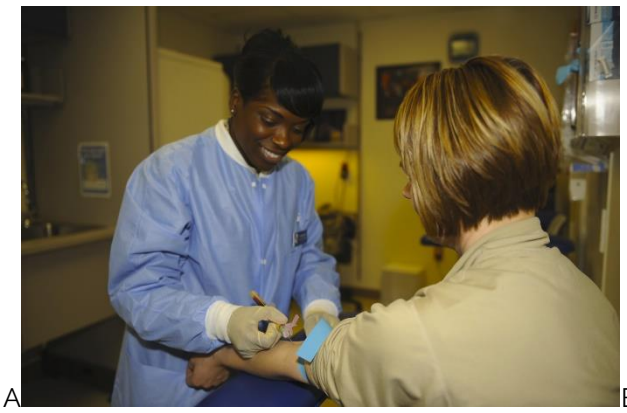
A  B 

Figure 1. Earthquake early warning could help to avoid injuries in medical settings such as (A) phlebotomy labs. (B) Cedars-Sinai Medical Center in Los Angeles has implemented such a system (images: A: U.S. Air Force Senior Airman Ciara Wymbs, public domain; B: Jorobeq, 2006, Creative Commons Attribution 2.5 Generic)

Context in Which the Use Case Would Work

The use case works in a medical setting in which medical professionals are using potentially dangerous equipment on patients and it is practical to secure the equipment and the patient quickly to prevent harm before strong shaking arrives.

Realistic Expectations

Some fraction of users will be so close to the rupture that strong shaking arrives before the alert can reach them. With regular training, one can expect a reduction in staff and patient injuries and infection resulting from shaken or falling objects and hazardous materials. Do not expect complete success. Securing machinery and initiating protective actions can accelerate the resumption of patient care after the earthquake.

Clear Behavior

Varies by setting. Different behaviors apply to clinical, non-clinical, and surgical settings.

Potential Vulnerabilities

High turn-over rates for medical staff may make it difficult to maintain awareness for all staff. The human tendency to "just complete this one thing" (e.g., finish filling tubes) prior to taking immediate action could allow avoidable harm. Challenges with directing patients to take defensive action due to language barriers and disabilities, although this is addressed in employee training.

Implementation Costs

Cost to implement an audible alarm through a radio system can cost in the low $10,000s. For an IP phone system, $1,000s. Drilling can involve 1 hour of staff preparation per drill, perhaps once or twice annually. Can exceed $100,000 for a large medical complex because of the number of facilities in the complex and because of significantly greater regulation in medical facilities as opposed to others. System testing and certification and staff training and drills can take a few days. In some settings, staff might review emergency actions for a few minutes just prior to each operation.

Implementation costs vary by the products selected. The Cedars-Sinai Medical Center found that their early warning system hardware cost on the order of $20,000 per unit, with one unit required per fire panel. They found that fire panels can be interconnected for audio announcements, in which case only one unit is required for each such group of interconnected panels. A large hospital campus can require several units.

A hospital complex can provide hand-held radios to security personnel, plant operators, and others as a backup to announcements over the fire alarm system. In such a case, the hospital complex can connect the early warning system hardware to a two-way radio transmitter. Cedars-Sinai found that the equipment required to connect the early warning hardware to the two-way radio system cost on the order of $800.

Permits and engineering can cost $10,000 for a hospital building regulated by the California Office of Statewide Health Planning and Development (OSHPD). For a building not under OSHPD jurisdiction, local permitting can cost about $1,500 for mechanical and electrical diagrams of the fire-panel solution.

Hardware and Software Requirements

For a two-way radio system, the user must have such a system, and new hardware is added. For address through an IP phone system, only new software is required. Fire marshal and manufacturer certified interfaces are required. Installation requires approval and inspections by the fire department and possibly by state hospital regulators.

Training Materials, Requirements, and Frequency

State and federally compliant standard operating procedures must be prepared. Handouts and presentations must be prepared. The Center for Medicare and Medicaid Services accreditation requires end users to perform training and drills at least twice a year. Providence Health and Services posts signs in common spaces to inform visitors how to react in case of an alert. It also distributes an instructional video as part of ongoing education.

Maintenance Requirements

Typically, a vendor will perform the maintenance and test equipment annually and whenever attached equipment such as fire panels are changed or added. Code requirements and testing may vary by region: local fire departments and state regulators may each have their own requirements. This work may already be part of existing maintenance activities.

Example of Past Use

Cedars-Sinai Medical Center implemented such a system. Hospital staff were trained on how to react to the alerts and staff have gone through drills (Lin 2020). For information, contact Early Warning Labs, 1-424-238-0060, Info@EarlyWarningLabs.com or the Cedars-Sinai Emergency Management Department, 1-310-423-4336, disaster@cshs.org.

Providence Health and Services in the Oregon region (eight acute-care hospitals) will begin using such a system by the end of 2020. For more information, contact the Providence Health and Services Oregon Region Emergency Management, 1-503-893-7543.

References

Lin, RG II (2020) California's new early warning earthquake app features a shaking countdown. Los Angeles Times, February 12, 2020. https://www.latimes.com/california/story/2020-02-12/californias-new-early-warning-earthquake-app-features-a-shaking-countdown [accessed April 28, 2020]