

Earthquake Guidelines

Overview

Earthquakes, especially major ones, are dangerous, inevitable, and a fact of life. It is not possible to prevent earthquakes or change the likelihood of an earthquake occurring. However, we can greatly increase our chances of safety and survival, by being aware and prepared. Since knowledge and preparation are keys to your survival during and after an earthquake,

Sooner or later another “big one” will occur. There are no warnings for earthquakes, a person is more likely to be injured trying to move during an earthquake rather than immediately seeking a safe space by furniture, or near an interior wall, not doorways, as they are often not structural. however, for the United States, "Drop, Cover, and Hold On" is recommended.

What are we trying to accomplish?

To maintain hyperbaric and wound care operations following a major earthquake that may impact the structural integrity of the facility, and to ensure the continuum of care for patients, visitors, and casualties of the event.

Earthquakes

- Occur without warning
- Can be deadly and extremely destructive
- Can occur at any time
- **After shocks often cause the most damage**

DANGERS ASSOCIATED WITH EARTHQUAKES

The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Most casualties result from falling objects and debris or collapsing structures.

Injuries are commonly caused by:

- Partial building collapse, such as falling masonry, collapsing walls, falling ceiling plaster.
- Flying glass from broken windows.
- Overturned bookcases, filing cabinets, fixtures, furniture, office machines and appliances
- Fires, broken gas lines, etc. These dangers may be aggravated by lack of water due to broken water mains
- Fallen power lines (both inside and outside of the building)



Hospital Clinic
Northridge, CA.



Apartment Building
San Francisco, CA



Dentist Office
Northridge, CA

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How vulnerable is your hyperbaric facility and hospital buildings?

Every hospital clinic should be assessed to identify its unique vulnerabilities, although studies of past earthquakes reveal some common issues. Much depends on a building's age, as this indicates which codes were used to guide its design and construction. In a clinical hyperbaric facility, many questions need to be addressed to ensure the safest possible environment for our staff and patients.

Earthquake Safety

WHAT TO DO DURING AN EARTHQUAKE

In an earthquake, the area immediately outside a building is the most dangerous place to be. We call this "the danger zone" because bricks, windows, facades and architectural details are often the first parts of the building to fall off. The taller the building, the wider the danger zone. A basic rule of thumb is if you are inside, stay inside and if you are outside, stay outside.

But what if you are in the danger zone when the earthquake starts?

Rule: If you have to look way over your head to see the top of the building, get back into the building and find a safe place. You simply won't have enough time or mobility to get far enough away from tall buildings when the ground is moving. A general rule of thumb: If you don't have to look up very much to see the top of the building, you are probably far enough away from it.

When the Ground Shakes



Myths vs. Fact




One of the great myths of an earthquake is that all the buildings collapse. Actually, in the United States, we don't see a lot of building collapse, especially when you compare it to the number of buildings that are impacted by the earthquake. The most vulnerable elements that can affect the functions of the hospital have been identified from past earthquakes. They are the emergency generator, the bulk oxygen storage tank, the internal and external emergency communication systems, and the patient elevators. These elements, other than the elevators, normally can be anchored and braced against seismic damage rather inexpensively.

What rescuers and experts DO NOT recommend you do during an earthquake, based on years of research about how people are injured or killed during earthquakes.

- DO NOT run outside or to other rooms during shaking
- DO NOT stand in a doorway

COLOR TAGGING SYSTEM

A color-tagged structure is a structure in the United States which has been classified by a color to represent the severity of damage or the overall condition of the building. The exact definition for each color may be different at local levels.

-  **A red tag indicates UNSAFE:** Extreme hazard, may collapse. Imminent danger of collapse from an aftershock. Unsafe for occupancy or entry, except by authorities.
-  **A yellow tag indicates LIMITED ENTRY:** Dangerous condition believed to be present. Entry by owner permitted only for emergency purposes and only at own risk. No usage on a continuous basis. Entry by public not permitted. Possible major aftershock hazard.
-  **A green tag indicates INSPECTED:** No apparent hazard found, although repairs may be required. Original lateral load capacity not significantly decreased. No restriction on use or occupancy.

EARTHQUAKE DAMAGE RATING SCALE

Modified Mercalli Intensity Scale (MMI)

Is used by all insurance provider to assess the damage to a building or structure. The linear scale for the Mercalli ranges from I, meaning not felt, to XII, which is total destruction of the area affected by the quake. The consistency of the scale varies and depends on the distance from the epicenter. On the other hand, the scale on the Richter ranges from 2.0 to 10.0, or higher but has never been recorded. Because MMI measures the actual effects of an earthquake, it is much more useful to insurers in determining the level of damage to structures.

| INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |
|-----------|----------|----------|----------|-------------|---------|-------------|-----------------|---------|------------|
| Shaking | Not felt | Weak | Light | Moderate | Strong | Very Strong | Severe | Violent | Extreme |
| Damage | None | None | None | Very slight | Light | Moderate | Moderate/ heavy | Heavy | Very heavy |
| Peak Acc | <0.17 | 0.17-1.4 | 1.4-3.9 | 3.9-9.2 | 9.2-18 | 18-34 | 34-65 | 65-124 | >124 |
| Peak Vel | <0.1 | 0.1- 1.1 | 1.1- 3.4 | 3.4- 8.1 | 8.1- 16 | 16 - 31 | 31- 60 | 60-116 | >116 |

Peak Acc = Peak ground acceleration (g), Peak Vel = Peak ground velocity (cm/s)



The Hyperbaric Facility

WHAT THE HYPERBARIC FACILITY NEEDS TO DO DURING AND POST-EARTHQUAKES

Planning for this type of natural disaster is generally covered in your company policies and producers, these policies generally only address staff and patient safety during an earthquake and the possible egress of your staff and patients to safety. What we will address in the Safety/ chamber bulletin is the operational assessment of equipment and steps that are needed to get our facilities operational as fast as possible to aid in the treatment of the injured population.

Here are some generally consideration and question that will need to be address:

1. What level (floor) is the facility located. The higher the level the chances of structural damage can increase
 - a. Egress route for staff and patients.
2. What type of oxygen system is supplying the chamber (Dewars vs. Bulk) each has its own unique set of potential problems during an earthquake?
 - a. How to check for oxygen system for operational readiness
3. What are the current codes and requirements for both inpatient and out-patient facilities?
 - a. Know what codes can be applied to your facility (State & National Safety Codes)



HYPERBARIC OPERATIONS

If your Class B chamber has lost primary and secondary oxygen supply due to a break in the oxygen supply line, the emergency vent will not work. Do the following procedure to bring the chamber back to 1 ATA;

1. **Open the chamber exhaust to it maximum setting**
2. **Increase the rate set to a rate of 5 or maximum setting. The chamber will slowly decrease in pressure over a time period of between five (5) and ten (10) minutes**

Assess facility for damage, initiate repairs as appropriate or secure unsafe areas.

- Check the power plant and insure that all vital functions are operating properly.
- Check all utilities and utility connections for damage (e.g., communication, fire alarm detection and suppression, HVAC, medical gases, sewage, water).
- Inspect gas lines (oxygen, air).
- Check for continuity of the supply lines (many facilities within the earthquake zones have an automatic-sensor valves and are designed to shut-down for earthquakes larger than 4.0 Richter scale).
- Ensure continued functioning of emergency power generators.
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- Activate alternate care sites for evacuated patients, if necessary; implement evacuation of unsafe/unstable areas of the facility, if necessary; activate search procedures as appropriate.
- Assess status of security systems, access and egress from facility, and implement security plan

Hyperbaric chamber (during the earthquake and aftershocks)

This is a recommended check list for the prevention of damage to the class B hyperbaric chamber. AFTER patient and staff safety concerns have been addresses.

These actions will possibly prevent damage to the acrylic pressure vessel during aftershocks

1. Cover the chamber acrylics with as many hospital blankets as possible (the more the better) and tape in place with any available tape. This will prevent debris from aftershocks from damaging the outside of the chamber acrylics
REMEMBER the low-pressure side of the pressure vessel is where all of the stress is and can do the most damage to the pressure vessel. If we can prevent any damage to the chamber acrylic, it will allow the facility to be operational much sooner (it can take months to get a new acrylic for the chambers).
2. Close all gas (oxygen and air) valves

Placing the hyperbaric chamber back into service post-earthquake

1. After being cleared to enter the hyperbaric facility. You will need to check the operational status of your oxygen supply system (bulk or Dewars)
 - a. Walk the gas system from supply to chamber, looking for possible breaks in the piping and isolation vales that might have been closed (DO NOT OPEN THEM if closed)



- b. Once the continuity of the piping has been confirmed we need to check for small leaks (this could cause an increased fire risk in remote location within the facility or host hospital).
 - i. Start at the main supply (Bulk or Dewars tank) Look at the pressure within the tank itself
 - Ensure that all isolation vales are in the closed position.
 - ii. Start at the supply and open the first vales in the supply line (listen for leaks) and continue this process with each valve until you reach the chamber isolation valve at the back of each chamber. If no leaks continue to the next step.
 - iii. Once you have all of the oxygen supply isolation valves in the open position, Close the main supply valve at the oxygen source (bulk tank or Dewars cylinder), then ensure that the chamber isolation valve is closed (at the back of the chamber on the wall).
 - iv. Record the line pressure at the oxygen alarm panel or hyperbaric zone isolation valve.



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- v. After a period of time (about 30 minutes) record any changes for the original pressure reading. If you see a drop-in line pressure this would indicate a leak in the hyperbaric oxygen supply line that would need to be addressed before the start of hyperbaric operations.



- vi. (keeping all of the other possible valves in the open position). This will charge the oxygen supply line with between 50 and 90 psi of pressure. By shutting the two primary isolation valves will allow the hyperbaric technician to watch the oxygen supply gauge either on the wall or chamber for a drop-in pressure over a time period. This will alert the technician to very small leaks within the piping system.
 - c. If all check out your system is operational ready
2. The next step is to inspect the chamber itself for possible damage (water, scratches broken knobs etc.)
- a. Check for grounding at all points this will also address the structural integrity of the building ground as well as the chamber.
 - b. Check the communication system for operation.

REMEMBER: Before placing your chamber back into service you will need clearance from both the host hospital and RestorixHealth to ensure the complete system is still meets all regulatory requirements as well as all supporting equipment.