

The Compounding Chronicles — September 2025



Keeping It Clean When the Weather Gets Mean

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Extreme weather events such as sandstorms, forest fires, and other natural disasters can threaten one of the most critical safeguards in healthcare—environmental air quality. For pharmacies and sterile compounding areas, which depend on precisely controlled cleanroom conditions, these events pose significant risks to both patient safety and operational continuity.

Last month's massive dust storm that swept through Arizona got me thinking about the ripple effect events like these have on healthcare systems. Sterile compounding pharmacies (which rely on clean environments to operate) could potentially still be dealing with the environmental aftermath weeks after the storm had passed.

How Extreme Weather Impacts Sterile Compounding Air Quality

In regions like Arizona, massive dust storms, known as haboobs, introduce large quantities of particulate matter into the air. These particles often contain fungi and microorganisms that can infiltrate critical environments and wreak havoc lasting weeks before they are finally remediated out of the critical spaces. During a severe 2018 Phoenix dust storm, hospitals reported HVAC filter overloads and increased indoor particle levels. If not adequately filtered, dust can infiltrate buffer and anterooms, jeopardizing ISO classification compliance, and is potentially recovered in viable environmental monitoring (EM) results.

In addition, forest fires produce high levels of fine particulate matter (PM_{2.5}) and volatile organic compounds (VOCs). During the 2020 California wildfire season, several hospitals experienced smoke infiltration despite sealed buildings, forcing pharmacy directors to temporarily limit sterile compounding activities. Smoke can compromise indoor air quality, increase total particle counts, and strain HEPA filters—sometimes leading to premature filter failure or certification challenges.

Storms that cause flooding bring unique microbial threats. In 2017, Hurricane Harvey led to widespread water damage in Texas hospitals. Some facilities reported mold contamination in air ducts within days, requiring full remediation and recertification of compounding spaces. Some pharmacies shut down their operations and found alternative means to continue patient care at other compounding sites.

Risks to Sterile Compounding Areas

Sterile compounding cleanrooms are built to maintain compliance with USP <797> and <800> standards. Their protection depends heavily on controlled airflow, pressure differentials, and filtration integrity. During extreme weather events, there are several environmental and certification elements affected.



Spatial particle counts are elevated, causing excursions with both viable and nonviable particulates for ISO-classified environments. HEPA filters, which are the foundation of creating clean environments, are severely impacted because HEPA filters will prematurely load with particulate, leading to increased differential pressures and reduced airflow. In other ways, power interruptions or excessive outdoor particulate load can cause cleanrooms to lose positive pressure segregation, which also affect the microbial state of control of cleanroom suites. Negative-pressure spaces are challenged with maintaining containment of potential hazardous drug contamination.

Without sounding over-reactive, the result of severe weather effects is serious. Events can lead to potential cleanroom and device certification failures, interruptions in sterile compounding operations, and, most important, increased risk of contaminated compounded sterile preparations (CSPs).

Considerations for Response and Remediation

Hospitals and pharmacies must take proactive steps to protect cleanroom environments during and after extreme weather events. Consider the region of the world where you work to determine the likelihood of disruption and how severe local weather can affect pharmacy operations.

Strengthening HVAC and Filtration Controls

- Use high-efficiency pre-filters upstream of the cleanroom HEPA filters to reduce dust and smoke load.
- Monitor and replace filters more frequently during wildfire season or dust storm episodes.
- Validate HVAC pressurization to ensure cleanrooms maintain required differentials despite outside conditions.
- Perform routine HEPA filter integrity testing and monitor differential pressure across filters to confirm ongoing performance and identify early clogging.

Enhance Environmental Monitoring (EM)

- Increase the frequency of viable and nonviable monitoring during and after environmental events.
- Trend results closely for spikes in particle counts or microbial growth.
- Investigate any excursions immediately with a risk-based approach regarding emergent situations for compounding activity.

Develop Contingency and Emergency Protocols

- Develop SOPS for cleanroom shutdown or limited operations specific to severe weather events that result in air quality excursions.
- Ensure back-up power systems protect HVAC and PEC performance during outages.
- Train staff on emergency gowning, cleaning, and decontamination measures following environmental disruptions.

Post-Event Remediation

- Conduct a thorough inspection of cleanroom seals, gaskets, and penetrations for leaks.
- Perform deep cleaning and disinfection of cleanrooms after significant particulate or microbial exposure.
- Require recertification of PECs and SECs if conditions indicate compromised state of control.
- Perform frequent viable air and surface sampling to determine the current microbial state of control throughout the duration of the weather event and after, until levels resume normal conditions.



Summary

While natural disasters cannot be controlled, their impact on hospital pharmacy operations can be mitigated. The key lies in proactive planning, vigilant environmental monitoring, and strong response protocols. By reinforcing HVAC systems, adopting best practices for staff training in severe weather situations, and maintaining robust contingency procedures, pharmacies can safeguard their sterile compounding environments—even when nature disrupts the world outside.

By anticipating these challenges and preparing targeted response strategies, hospitals can protect both their cleanroom integrity and the patients who rely on the sterile medications prepared within them.

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