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Suggested Practice for Remediation of Highly Infectious Biological Agent Contamination in Indoor Environments

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Introduction

This chapter describes the basic procedures to follow and precautions to observe when performing the remediation and restoration of nonlaboratory indoor environments known or suspected of harboring contamination from potentially infectious biological agents, especially those recognized as being easily aerosolized and thus presenting an inhalation risk. This includes contamination from potential biowarfare agents—that is, weapons of mass destruction, such as the spores of *Bacillus anthracis*, the causative agent of anthrax.

Scope of Effort

The source of the contamination is often identified as a dust, powder, or similar substance capable of being aerosolized. In some cases, environmental sampling and analysis identify one or more specific areas of contamination, without identification of an initial source material. In either situation, the remediation and restoration practices are the same. In all cases, the scope of effort focuses on prevention of further contaminant dissemination, the physical removal of the offending agent(s), and the subsequent reduction of exposure risks to the workers, building occupants, and the public at large. The goal is restoration of the environment as it was prior to the biological incident. Attention to detail and the use of common sense should always prevail.

Recommendations contained in this report are based on information contained in various relevant guidance materials from a number of organizations including the Occupational Safety and Health Administration (OSHA, 1994), National Institute of Occupational Safety and Health (NIOSH/NCID, 1997), Centers for Disease Control and Prevention (CDC, 2001a, 2001b), Department of Justice (USDOJ, 2001), Environmental Protection Agency (USEPA, 2001), American Conference of Governmental Industrial Hygienists (Shaughnessy & Morey, 1999), and the Institute of Inspection, Cleaning, and Restoration Certification (IICRC, 1997, 1999, 2001).

Response Teams and Situations

Response teams must be properly trained and equipped HAZMAT responders, as defined by the HAZWOPER standard, to participate in a medical surveillance program. Such teams shall utilize a HAZMAT equipment vehicle that carries all personal protective equipment (PPE) and control equipment that allow the teams to enter an "immediately dangerous to life and health" environment.

Calls for the remediation and restoration of indoor environments with suspected or confirmed contamination by biological agents occur following the evacuation and closure of the facility, in conjunction with the shutdown of all ventilation systems.

Worker Protection

Consistent with current CDC recommendations, each worker must at a minimum utilize a powered air-purifying respirator (PAPR) with full facepiece and high-efficiency particulate air (HEPA) filters, disposable protective clothing with integral hood and booties, and disposable gloves. If an aerosol-generating device was used to disseminate the airborne agent, or similar conditions exist, then a NIOSH-approved, pressure-demand, self-contained breathing apparatus, in conjunction with a Level A protective suit, is recommended. Respirators should be used in accordance with a respiratory-protection program that complies with the OSHA respiratory-protection standard (29 CFR 1910.134). Wearing disposable rubber shoe coverings with ridged soles made of slip-resistant material over the booties of the disposable suit will reduce the likelihood of slipping on wet or dusty surfaces. Protective clothing should be removed and discarded before removing the respirator. Disposable gloves should be made of lightweight nitrile or vinyl. All PPE should be decontaminated immediately after leaving a potentially contaminated area.

Environmental Remediation

Identification of a localized source of contamination may require full-scale containment commensurate with current mold remediation and asbestos abatement practices. Full-scale containment requires the use of a sealed critical barrier of polyethylene in conjunction with a negative pressure air machine that exhausts air out of containment through a HEPA filter unit and then to the outdoor air.

Both within and without a full-scale containment area, the remediation effort focuses on the physical removal of the spores or other agent(s) and their related dusts and other particles. A key to effective remediation involves controlling the secondary aerosolization of airborne spores and related particles that can be expected to occur during the cleaning process. Thus the use of portable, high-volume, HEPA-filtered air scrubbers, or controlled and HEPA-filtered airflow for a particular zone or the entire facility, is required.

All surfaces and materials should be thoroughly vacuumed using HEPA-filtered vacuums. Hard surfaces should be wet-wiped using a suitable detergent. Visible amounts of loose suspect powders and dusts can be contained in wet cloths and secured in airtight plastic bags. Care should be taken when bagging such items to minimize creating puffs of air that might spread the contamination. The use of biocides, particularly in regard to anthrax contamination, should be precluded. Aqueous and gas-phase biocides are impractical, since an attempt to inactivate bacterial spores would require an extremely efficient and currently unavailable delivery system necessary to penetrate all areas, and the use of high chemical concentrations and extended contact times. Potential worker exposure, as well as harm to valuable materials from direct biocide contact or from its damaging residuals, is an additional deterrent to their use.

Following thorough vacuum cleaning, carpet and upholstered furniture can be cleaned using an extraction process as described in the IICRC carpet and upholstery cleaning standards. HEPA air scrubbing should then continue for an additional 72 hours minimum.

Clearance Testing

Designed on a case-by-case basis, a clearance testing protocol should be implemented to include sampling of representative areas and materials using composite wipe samples for detecting the biological agent, followed by acceptable analytical techniques, such as rapid PCR or other recommended methods. Absence of the biological agent (e.g., anthrax spores) from all collected samples would provide presumptive evidence of remediation effectiveness and permit reoccupation of the building.

Mechanical Hygiene

Building ventilation systems should be assumed to be contaminated and therefore must be contained, inspected, thoroughly cleaned, and cleared through sampling and analysis, as previously described. Again, the remediation emphasis should be on physical removal of contamination rather than the use of biocidal agents.

Decontamination and Waste Disposal

Decontamination of PPE and equipment is essential. Therefore, an area for washing protective clothing to remove potential biological agents and associated particles prior to removal of the gear must be available. Likewise, all cleaning equipment must be decontaminated by thorough washing, rinsing, and drying.

All disposable materials used in the remediation are to be disposed of according to applicable local, state, and/or federal requirements. At the present time, a number of states consider all potentially contaminated materials from an anthrax remediation site to be potentially infectious medical wastes that must be treated and disposed of according to current medical waste regulations. An initial, yet unofficial recommendation of the USEPA is to treat such materials only by incineration or steam autoclaving.

Medical Surveillance

Biological remediation workers should be thoroughly trained and knowledgeable about the clinical symptoms of the disease agents to which they may be potentially exposed and directed to notify immediately a predesignated physician or medical center if any symptoms or suspected symptoms occur. Consensus statements on biological warfare agents have been published by the American Medical Association and are excellent training resources (Inglesby, 1999).

Only those workers who have previously undergone medical screening and are designated as healthy should serve as biological agent remediation workers. Requirements include completion of a thorough physical examination, as well as acceptance of appropriate, recommended, and available immunizations.

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