

Quick Reference Guide: Anthrax

Agent Characteristics	Agent Classification: Biological		Type: Bacteria (<i>Bacillus anthracis</i>), many strains
	Description: Naturally-occurring, rod-shaped Gram-positive, sporulating microorganism. Most commonly occurs in wild and domestic animals (e.g., cattle and antelopes). Can occur in humans when exposed to infected animals or infected animal tissue (cutaneous anthrax), or when exposed to aerosolized anthrax spores (inhalation anthrax).		
Release Scenarios	Incubation Period: 1-7 days, up to 60+days		Infectivity/Lethality: Moderate/High
	Duration of Illness: 3-5 Days		Infective Dose: LD50: 8000-50,000 spores (estimated)
Person-to-Person Transmission: No		Persistence/Stability: Spores Highly Persistent/Stable; >40 years in soil.	
Health Effects	Air/Aerosolization: In a bioterror event, anthrax will most likely be aerosolized in the form of a white powder. Powders of <i>B. anthracis</i> with characteristics such as high spore concentration, uniform particle size, low electrostatic charge, etc. are considered “weapons-grade.” In an aerosol release of anthrax, re-aerosolization is a consideration depending upon the size, purity, and chemical and physical properties of the manufactured anthrax. An aerosol release of anthrax will most likely occur indoors, though an outdoor release of anthrax is possible. An anthrax aerosol release would have the potential to travel many km before dissipating. Most recently, anthrax has been used to contaminate postal facilities by mailing letters containing anthrax powder.		
	Soil/Surfaces: Spores are resistant to adverse environmental conditions and may remain viable for years in soil or in dried or processed hides of animals. Anthrax spores may remain viable in soil for 40+ years, which is a threat to the animal population. Anthrax spore viability on certain surfaces is not well-known, but it does grow readily on laboratory media.		
	Water: Anthrax is a probable water threat.		
	Other: Anthrax is naturally occurring and can cause disease in humans through contact with contaminated animals or products; this includes eating contaminated meat products.		
Effect Levels	Onset	Symptoms may occur within 1-7 days and up to 60 days after an inhalation exposure.	
	Signs/Symptoms	Inhalation anthrax: Fever, malaise, fatigue, cough, chest discomfort, stridor (noisy breathing), respiratory distress, dyspnea (shortness of breath), and cyanosis (bluish discoloration of the skin). Cutaneous anthrax: Raised itchy bump to vesicle which progresses to painless ulcer (1-3cm) with black area in the center. Swollen lymph nodes and flu-like symptoms. Ingested anthrax: Flu-like symptoms, nausea, loss of appetite, vomiting, fever, abdominal pain, and severe diarrhea.	
	Exposure Routes	Inhalation anthrax: Inhalation anthrax occurs when bacterial spores are inhaled, and may be fatal without treatment. No naturally-occurring cases in US since 1976. Cutaneous anthrax: Most common manifestation of naturally occurring anthrax; 95% of skin infections occur when bacteria enters a cut on the skin upon handling contaminated objects; 20% of untreated cases are fatal. Ingestion: Least common manifestation of naturally occurring anthrax; caused by consumption of poorly cooked contaminated meat. Intestinal anthrax has two forms: upper and lower gastrointestinal tract infections, and a high rate of mortality.	
Health and Safety	Concerns		
	Medical Surveillance		
	First Aid/Decon		
	PPE		
Field Detection	<p>Lethality reflects the relative ease with which an agent causes death in a susceptible population and can be represented quantitatively by the exposed population mortality rates. Anthrax is highly lethal. Infectivity refers to how easily an agent can cause disease in a host. An agent is highly infective when few organisms can cause disease. An infective dose is the number of organisms required to cause disease in an exposed person. Given the uncertainties regarding published infective doses for bioagents, it is important to examine what the infectivity numbers represent, including the routes of exposure and the animal species used for the lab studies. Responders should not assume that an infective dose estimate represents a safe level. For instance, for inhalation anthrax and other severe or lethal diseases, the infective dose is the LD50 (a.k.a. “Lethal Dose 50%”). The LD50 stands for the dose administered which kills half the exposed population, if untreated. For anthrax, between 8,000 and 50,000 spores can kill half of an untreated, exposed population.</p>		
	<p><i>Under ICS, check with your appointed Health and Safety Officer regarding PPE, Medical Surveillance, and Safety Plans. Level of PPE may vary depending upon the circumstances of the site and the incident.</i></p> <p>The PPE Levels listed are general suggestions only.</p> <p>For more info on PPE and health and safety decision-making, please see http://www.ert.org/products/Anthrax.pdf the OSHA/NIOSH interim CBRN guidance document, the NRT Anthrax TAD: www.nrt.org, the EPA’s Respiratory Protection Program Draft January 2005 or the EPA’s Medical Surveillance Program Implementation Plan Draft January 2005. EPA documents are available at www.epaossc.org/grg</p>		
Sampling	<p>Pre-exposure Annual exams to ensure proper respiratory function; ideally, responders are vaccinated against anthrax.</p> <p>During exposure Wear PPE as designated by the Health and Safety plan. Treat any accidental exposures with the antibiotics Ciprofloxacin and/or Doxycycline. Set up a medical monitoring plan, documenting PPE levels used, exposure incidents and outcome, antibiotics used, etc.</p> <p>Post exposure Monitor responders for signs/symptoms and treat accordingly.</p>		
	<p>Decon outer PPE with very dilute 0.05% bleach solution. Decon skin with warm soapy water (0.05% bleach solution may irritate skin) for 10-15 minutes. Antibiotic available and effective (Ciprofloxacin, Doxycycline). Vaccine is effective.</p> <p><i>With respect to specifics (e.g., value of mechanical scrubbing, contact time of decon solution, and need to rinse completely) OSCs should check with the EPA National Decon Team Subject Matter Experts at 513-487-2420 (after hours call 24-hour pager at 1-800-329-1841).</i></p>		
<p>The BioWatch Program helps detect aerosol releases of bioagents. Certain buildings, such as postal facilities may have autonomous detection systems (ADS) that continually test for anthrax using air samples and PCR.</p> <p>Immunoassay Tests (smart tickets): These assays are intended for rapid detection of anthrax and for screening environmental samples. Each ticket employs patented immuno-chemistry tests for specific biological agents. Features rapid identification, minimum operator training and sample preparation, response time in 5-15 minutes. Note: Immunoassay tests should not be used alone, but should be confirmed with samples analyzed by culturing at LRN lab.</p>			
<p>Sampling Location Plans: If release was limited to a letter or container, start with an area thought to be free of contamination and work in concentric circles towards or away from the initial point of contamination. Be concerned about other contaminated areas due to foot traffic/ventilation systems (elevator buttons, mail, corners of hallways, baseboards, light switches, door knobs, etc). If point of release or aerosolization is unconfirmed, then use a statistically-based sampling method. Note: These are general guidelines and do not replace need for a site-specific sampling plan that should be reviewed and approved by appropriate SMEs and/or through ICS channels. More specific EPA/NRT sampling procedures/guidance for biowarfare agents can be found in EPA and Tetra Tech “Biological Sampling Procedures Booklet for Regional Counterterrorism Response Plans” TDD: S05-0302-004. See also NRT Anthrax TAD for method comparisons at: http://www.nrt.org/Production/NRT/NRTWeb.nsf/AllAttachmentsByTitle/A47AnthraxTAD/\$File/Anthrax%20TAD%20citable%20904.pdf?OpenElement04.pdf?OpenElement</p>			

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	<p>Concerns: Different detection/analytical equipment and sampling techniques will be highly site-specific and depend on: 1) the characteristics of the terrorist agents; 2) the type of contaminated surfaces (e.g., porous v. nonporous); 3) the phases/purposes of sampling (initial identification v. post-decon surface sampling); and 4) the sampling procedures of the analytical laboratory. Note: Before obtaining samples clearly identify and coordinate with laboratory to be used, as not all laboratories can handle all types of media. Basic Ordering Agreements (BOAs) for laboratory sampling analysis have been established with contract labs. Contact ERT for details; coordinate with investigative units (CID/FBI); ensure plan for appropriate chain-of-custody.</p>		
Sampling	<p>Samples that test for re-aerosolization 1) Wipe sampling of the air duct system (filters, areas of particulate deposition) if exposure occurred indoors. 2) Sheep blood agar plates determine the presence of bacterial growth. 3) Andersen Air Sampler & Single Stage Impactors with settle plates capture airborne particulates on a series of agar plates based on their aerodynamic properties. 4) Dry filter units (DFUs) are the most direct indicator of airborne anthrax spores. Check for the presence/install DFUs.</p> <p>Samples that can test Decon efficacy 1) Wipe Samples: Synthetic, non-cotton (Dacron/rayon) wipes pre-moistened with a nutrient solution, buffer solution, or sterile water. Good for small sample areas of nonporous surfaces. Coordinate methods and buffer solutions with designated Laboratory Response Network (LRN) laboratory. 2) Swab Samples: Synthetic, moistened, cotton sterile or macrofoam swab moistened with buffer solution (PBST) or sterile water. Most useful for hard to reach nonporous surfaces. CDC study shows that rayon & polyester swabs are not as efficient as cotton/macrofoam swabs in spore recovery. Do not use dry swabs. 3) HEPA Vacuum Sampling: collect samples in a HEPA sock designed to fit into an inlet nozzle of a vacuum cleaner. Good for screening and determining the extent and location of contamination in large areas. Used on both porous and nonporous surfaces. For sampling method please see: http://www.bt.cdc.gov/agent/anthrax/environmental-sampling-apr2002.asp</p>		
	<p>Sample packaging and shipping: Packaging and transporting anthrax samples are subject to various regulations established by DOT, CDC, USPS, OSHA, and IATA. Consult and coordinate with analytical laboratory receiving the samples to determine packaging or shipping requirements. Details can be found at www.cdc.gov/od/ohs/biosfty/shipregs.htm or http://www.cdc.gov/od/sap/ or http://www.asm.org/ASM/files/LEFTMARGINHEADERLIST/downloadfilename/0000001202/ProtocolPackShip.pdf</p>		
Laboratory Analysis	<p>Polymerase Chain Reaction (PCR): Amplifies DNA sequences and compares them to standard gene sequences for anthrax. PCR is a screening method that should not be used alone. It is useful for analyzing initial samples at sites with suspected contamination. Positive results should be confirmed with bacterial culturing. Field PCR systems are very selective, but do not work well with heterogeneous environmental samples (e.g., dust, soil). PCR has been shown to work best as a final confirmation of positive samples taken from plated colonies.</p> <p>Culturing: The sample is prepared for elution and plating, and inoculated onto sheep blood agar plates at LRN labs. The plates are incubated at 37°C for up to three days and examined for growth of possible anthrax colonies. Positive results with other assays such as PCR need to be confirmed with bacterial culturing.</p> <table border="1" data-bbox="94 835 1576 968"> <tr> <td data-bbox="94 835 927 968"> <p>Laboratory Information: Biological and Chemical Agent Analyses Contract Vehicles for EPA emergency lab support contact Battelle Security 24-hour control center at: 614-424-5909. US EPA has IAGs with Aberdeen and Dugway for Analytical Lab Support During a WMD response; for access, please contact the ERT 24-hour number: 732-321-6660</p> </td> <td data-bbox="927 835 1576 968"> <p>CDC Laboratory Response Network Labs CDC Bioterrorism Preparedness and Response Program: 404-639-0385 http://www.bt.cdc.gov/agent/anthrax/lab-testing/approvedlrntests.asp</p> </td> </tr> </table>	<p>Laboratory Information: Biological and Chemical Agent Analyses Contract Vehicles for EPA emergency lab support contact Battelle Security 24-hour control center at: 614-424-5909. US EPA has IAGs with Aberdeen and Dugway for Analytical Lab Support During a WMD response; for access, please contact the ERT 24-hour number: 732-321-6660</p>	<p>CDC Laboratory Response Network Labs CDC Bioterrorism Preparedness and Response Program: 404-639-0385 http://www.bt.cdc.gov/agent/anthrax/lab-testing/approvedlrntests.asp</p>
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Decon	<p>Decon Planning: Site specific decon/cleanup plan should be developed and approved by all necessary organizations/SMEs via ICS channels. Responders should develop a plan that takes into account: 1) The nature of contamination including purity, spore size, chemical/physical properties, how it entered the facility, etc.; 2) The extent of contamination including the amount and possible pathways that have or could have spread anthrax spores. It is advisable to isolate the contaminated area; and 3) The objectives of decon, including decon of critical items for re-use and the treatment, removal, or packaging of other items for disposal. Note: Crisis exemptions from EPA Office of Pesticides might be necessary depending on decontaminating agents used.</p> <p>Decon Methods: OSCs should check with the EPA National Decon Team Subject Matter Experts regarding specific decontamination parameters, as well as specifics on the use of readily available commercial items such as standard bleach, at 513-487-2420 (after hours call 24-hour pager at 1-800-329-1841).</p> <p>Methods used on surfaces: 1) Source reduction steps, including HEPA vacuuming; 2) Liquid Antimicrobial products such as bleach (sodium hypochlorite) to inactivate spores on hard non-porous surfaces. These products affect surfaces differently in terms of corrosiveness, staining, and residue. Mixing direction, application methods, and contact time should be followed precisely. Available Methods: sodium hypochlorite, aqueous chlorine dioxide, hydrogen peroxide/peroxyacetic acid. Note: See bleach/vinegar procedure in Ricin TAD at www.ert.org</p> <p>Fumigation: Uses gas or vapor to decontaminate facilities in which there is evidence of aerosolization of spores (e.g., cases of inhalational anthrax). The history of usage of the agents as fumigants, materials compatibility, penetration capacity, method of removal at the end of fumigation, as well as their physical, chemical, and toxicological properties should be taken into account. Available Methods: chlorine dioxide, hydrogen peroxide, and paraformaldehyde. Each chemical has a specified range for the process variables; namely, temperature, relative humidity, concentration, and contact time, that must be followed.</p> <p>Other Decon: 1) Ethylene oxide sterilization is used to decontaminate items in an off-site sterilization chamber. 2) Irradiation uses cobalt-60 and electron beam technologies to destroy anthrax in mail, and other paper goods at off-site locations. This procedure may destroy magnetic media. Irradiation and chemical sterilization may be useful in decontaminating items that are intended to be returned to owners. See NRT Anthrax Appendix C for facts comparisons. http://www.nrt.org/Production/NRT/NRTWeb.nsf/AllAttachmentsByTitle/A47AnthraxTAD/\$File/Anthrax%20TAD%20citable%2009_17_04.pdf?OpenElement <i>The Brentwood, Trenton, and Capitol Hill remediation teams used Chloride Dioxide liquid and fumigation to decontaminate the site (CI02 at 750ppmv for 12hours at a minimum of 75 F and 75% relative humidity).</i> Note: for more info, please see http://www.ert.org/products/Anthrax.pdf</p> <p>Decon Effectiveness: Multi-agency, multi-disciplinary experts should be consulted for advice in developing a post-decon sampling strategy and establishing criteria for verifying decon effectiveness. Expert input is especially important if contamination is extensive. Rigorous environmental sampling should be done after decontamination and samples should be cultured in the lab. Targeted sampling should be done in areas known to be contaminated prior to decon as well as statistically relevant sampling in the decontaminated area. Vigorous air sampling after decon may also be appropriate if spores are likely to re-aerosolize. If fumigation is to be done, use of biological indicators in hard-to-reach areas may provide assurance that the fumigant adequately penetrated all of the contaminated areas.</p> <p>Clean-up Adequacy Verification: There is currently no scientifically sound basis for determining a "safe" number of residual viable spores in a decontaminated area. For areas to be re-occupied or used by the general public EPA recommends that decontamination be continued until there is no growth of B. anthracis found on post-decon samples. Viable spores may remain, but that the risk of contracting anthrax in that area would be extremely low. In workplace situations, OSHA offers alternative criteria to the "no growth" decon goal, especially where PPE, special work practices, and engineering controls can be used to minimize the risk of disease. OSHA provides guidance on use of these alternative controls at: http://www.osha.gov/SLTC/etools/anthrax/transition_program.html</p>		
Waste/ Disposal	<p>Anthrax is not regulated under Subtitle C of the RCRA, but should be handled with caution. In some states and localities, waste management will vary; for instance, anthrax waste may be considered municipal waste, medical waste or infectious substances with special requirements for handling and disposal depending on the state. Contact the state or local regulatory agency to determine appropriate waste management practices. Anthrax spores are subject to DOT regulations and the CDC's Select Agent program requirements. See http://hazmat.dot.gov/training/rmgmt/guide_anthrax.htm or http://www.asm.org/ASM/files/LEFTMARGINHEADERLIST/downloadfilename/0000001202/ProtocolPackShip.pdf Wastewaters from contaminated sites should be pre-treated prior to disposal, using a chemical like 5.25 – 6.0 %sodium hypochlorite or another sterilization process.</p>		