NRT Quick Reference Guide:
Bacillus anthracis (Causes the disease Anthrax)

For reference, please see "Key References Cited/Used in National Response Team (NRT) Quick Reference Guides (QRGs) for Bacterial 2011 Revision." QRGs are intended for Federal On-Scene Coordinators (OSCs) and Remedial Program Managers (RPMs).

<table>
<tr><td>Agent Characteristics</td><td colspan="2">Agent Classification: Biological Type: Bacteria (Bacillus anthracis), many strains
Description: B. anthracis is a naturally-occurring, rod-shaped Gram-positive, sporulating bacterium causing the disease anthrax, and is capable of being weaponized for all exposure routes. Powders of B. anthracis are considered "weapons-grade" with characteristics such as high spore concentration, uniform particle size, low electrostatic charge, etc. B. anthracis re-aerosolization is a consideration, particularly if weaponized. Even if B. anthracis is not weaponized, it is a concern for all exposure routes. B. anthracis spores are endemic in U.S. soils & sporadically cause anthrax outbreaks in wild & domestic animals (primarily herbivores). There are three forms of anthrax disease, Pneumonic, Gastrointestinal, and Cutaneous. These presentations can occur in humans through intentional (bioterrorism) release scenarios or natural sources of exposure (infected animals/tissues).</td></tr>
<tr><td></td><td>Bio-safety Level: 3
CDC Class: A
HHS/USDA Select Agent: Yes
Incubation Period: 1-7 days, pneumonic cases have occurred 60 days post-exposure.
Person-to-Person Transmission: No</td><td>Other Forms of Transmission: Contact with animal fur, wool, blood, or bodily fluids, ingestion, or inhalation of small pieces of tissue of infected animals.
Treatment: Supportive accompanied with antibiotics (Ciprofloxacin &/or Doxycycline).
Infectivity/Lethality: Moderate/High for inhalation exposure route if not quickly diagnosed
Persistence/Stability: Spores highly persistent/stable in soil & water</td></tr>
<tr><td>Release Scenarios</td><td colspan="2">CAUTION: REAEROSOLIZATION IS A CONCERN FOR ALL RELEASE SCENARIOS.
Air: In a bioterror event, B. anthracis may be released in an easily aerosolized form. Re-aerosolization will depend upon the size, purity, & physical properties of the manufactured spores. Release of B. anthracis can occur indoors and/or outdoors. Easily aerosolizable B. anthracis spores can quickly lead to contamination spreading throughout a building & outside surrounding areas. An outdoor release of B. anthracis spores has the potential to travel from the immediate area.
Soil: Spores are resistant to adverse environmental conditions & may remain viable for decades.
Surfaces: Spores are resistant to adverse environmental conditions & may remain viable on surfaces for months to years.
Water: B. anthracis is a possible water threat & is resistant to chlorine levels in drinking water. Reaerosolization can occur when using water for fire fighting.
Other: B. anthracis is naturally occurring & endemic in the United States, & can cause all forms of anthrax disease in humans. Naturally occurring exposure includes contact with infected animals or contaminated animal products; this includes eating contaminated meat products.</td></tr>
<tr><td rowspan="2">Health Effects</td><td>Onset</td><td>Symptoms may occur within 1-7 days or up to 60 days after an inhalation exposure.</td></tr>
<tr><td>Signs/Symptoms per Exposure Route</td><td>Pneumonic anthrax: Fever, malaise, fatigue, cough, chest discomfort, stridor (noisy breathing), respiratory distress, dyspnea (shortness of breath), & cyanosis (bluish discoloration of the skin).
Gastrointestinal anthrax: Flu-like symptoms, nausea, loss of appetite, vomiting, fever, abdominal pain, & severe diarrhea.
Cutaneous anthrax: Raised itchy bump to vesicle which progresses to painless ulcer (0.5 to >1 inch; 1 to 3 cm) with black area in the center, swollen lymph nodes, & flu-like symptoms.</td></tr>
<tr><td>Effect Levels</td><td colspan="2">Infectivity: Highly infectious if aerosolized.
Infective Dose: Although the infective dose is unknown for the different routes of exposure, for manufactured spores the infective dose is thought to be very low.
Lethality: For pneumonic anthrax, death is universal in untreated cases and may occur in as many as 95% of treated cases if therapy is begun more than 48 hours after the onset of symptoms.</td></tr>
<tr><td rowspan="4">Personnel Safety</td><td>Concerns</td><td>Check with the Health & Safety Officer regarding PPE, Medical Surveillance, & Health & Safety Plan (HASP). Level of PPE may vary depending upon the incident & site specific circumstances. The PPE Levels listed are general suggestions only & are appropriate only for B. anthracis; they may not provide protection for some decon & other chemicals that workers may be exposed to during response/recovery operations. For decon of workers, use warm soapy water, taking care to avoid abrading the skin.</td></tr>
<tr><td>Medical</td><td>Baseline: Annual physical & respiratory function exams. A VACCINE AGAINST ANTHRAX IS AVAILABLE.
Treatments Available: Treatment is supportive & is accompanied with Ciprofloxacin &/or Doxycycline antibiotics. Effectiveness of antibiotics may be limited if taken after 48 hours of initial pneumonic symptoms.</td></tr>
<tr><td>First Aid</td><td>During Incident: Conduct medical monitoring; use PPE as designated by the HASP; record the PPE Levels used; monitor for fever & other signs/symptoms as listed under Health Effects &, if necessary, ensure medical attention is obtained as soon as possible.
Post Incident: Monitor for signs/symptoms &, if necessary, ensure medical attention is provided as soon as possible.</td></tr>
<tr><td>PPE</td><td>Emergency Response to a Suspected Biological Incident: Possible PPE Levels for emergency responders based on scenario risks from highest level of protection to least: 1) Pressure-demand Self Contained Breathing Apparatus (SCBA) with Level A protective suit, when: a) Event is uncontrolled, b) The type(s) of airborne agent(s) is unknown, c) The dissemination method is unknown, d) Dissemination via an aerosol-generating device is still occurring, e) Dissemination via an aerosol-generating device has stopped, but there is no information on the duration of dissemination, or what the exposure concentration may be. 2) Pressure-demand SCBA with Level B protective suit, when: a) The suspected biological aerosol is no longer being released, b) Other conditions may present a splash hazard. 3) Full-facepiece respirator with P100 filter or PAPR with HEPA filters, when: An aerosol-generating device was not used to create high airborne concentration. 4) Disposable hooded coveralls, gloves, & foot coverings, when: Dissemination was by a letter, package, or other material that can be bagged, contained, etc.
Other Workers: PPE recommendations for workers other than emergency responders must be developed in the HASP for the specific scenario. PPE recommendations will vary by job type (e.g., cleanup, decon, etc.), type of exposure (e.g., airborne or surface/liquid/soil hazard), & any other site hazards (e.g., chemical, physical, etc.)</td></tr>
<tr><td rowspan="2">Field Detection</td><td colspan="2">Fixed Aerosol Monitoring: An aerosol release of B. anthracis may be detected using air samples & PCR. Results may be delayed as much as 4 hours from time of release. Consult EPA/HQ-EOC at 202-564-3850 for more information.</td></tr>
<tr><td colspan="2">Portable Aerosol Monitoring: Portable aerosol monitoring may use dry or wet sampling methods. Dry sampling methods (used for spores) can include gelatin filters, mixed cellulose ester filters, & Teflon® filters. Wet sampling methods (used for spores or vegetative cells) can include impingers (low flow) & impactors (single or six stage). Refer to the manufacturer's aseptic sampling methods, flow rates, & sampling times. Ensure that the appropriate pump is used for the selected sampling method. Field PCR: PCR systems for field applications are available, but their use is limited because of low sensitivity.</td></tr>
<tr><td>Sampling</td><td colspan="2">Concerns: BEFORE OBTAINING SAMPLES: Identify sample transportation requirements; Contact EPA/HQ-EOC (202-564-3850) for ERLN contract laboratories able to analyze these types of samples; Clearly identify & coordinate with the laboratory to be used since most labs cannot analyze all types of media (e.g., wipes, swabs, and HEPA vacuum samples); Coordinate with the sample disposal facility for acceptance criteria (i.e., sample decon requirements); Coordinate with investigative units (EPA-CID & FBI) to ensure sample chain-of-custody is maintained between the groups. Note: Detection/analytical equipment & sampling techniques will be highly site-specific & depend on: 1) the characteristics of the agent; 2) the type of contaminated surfaces (e.g., porous v. nonporous); 3) the phases/purposes of sampling (initial ID v. post-decon sampling); 4) the way in which samples are handled so as not to adversely affect viability; 5) transportation regulations 6) the acceptance criteria of the analytical laboratory & 7) the sample decon requirements for the waste disposal facilities to be used. See LABORATORY ANALYSIS, below.</td></tr>
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	CAUTION: ONLY MANUFACTURER CERTIFIED HEPA VACCUUM EQUIPMENT SHOULD BE USED. A site-specific sampling plan should be reviewed & approved by appropriate Subject Matter Experts &/or through ICS channels. **Sampling Location Plans:** If release was limited to a letter or container, start with an area thought to be free of contamination & work in concentric circles towards 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). Based on site characteristics & laboratory capacity, sampling plan may be judgmental, probabilistic, or a combination thereof.
	Consult EPA/HQ-EOC at 202-564-3850 for Environmental Response Laboratory Network (a.k.a. ERLN laboratory) contact information for personnel who can explain/describe the sampling procedure most compatible with their current analytical procedure. **Types of Samples:** Air, water, soil, & surfaces. **Note:** While *B. anthracis* DNA can be detected long after the bacteria themselves have perished & might be of forensic interest, the presence of the DNA says little about the potential human risk in the days following a release. **Air:** Collect air samples with gel filter or impinger. Refer to the manufacturer's aseptic sampling methods, flow rates, & sampling times. Ensure that the appropriate pump is used for the selected sampling method. **Water**: Since *B. anthracis* can persist in water; any potable water source should be sampled. If the potable water is chlorinated, the chlorine needs to be neutralized immediately with a sodium thiosulfate or other neutralizer at the concentration specified by the analytical laboratory prior to shipment. As chlorine levels can vary substantially throughout a drinking water system, it is not always appropriate to assume that a sample is chlorinated based solely on a description of the water treatment processes in use. **Soil:** For the localized areas where soil deposition of the agent is suspected to have occurred (i.e., aerosol or liquid droplets), a surface soil sample from a depth of less than 1 inch (2.54 cm) should be obtained from non-vegetated area. **Surfaces: 1)** Wipe & Swab Sampling (for non-porous surfaces): Sterile macrofoam swabs moistened with 1X phosphate-buffered saline supplemented with 0.01% Tween-20 (PBST). If this solution is not available, use sterile de-ionized water (DI). Do NOT use dry wipes or swabs. **2)** HEPA Vacuum Sampling (for both porous & non-porous surfaces): collect samples in a HEPA sock designed to fit into an inlet nozzle of a HEPA vacuum cleaner. Good for screening & determining the extent & location of contamination in large areas. **Agriculture & Wildlife:** Upon confirmation of an outbreak, ensure these agencies are notified immediately since anthrax is a zoonotic vector borne disease; USDA at 202-720-5711 & National Center for Emerging and Zoonotic Infectious Diseases at 800-232-4636 (after hours call the Directors Emergency Operations Center at 770-488-7100).
	Samples that test for Re-aerosolization: 1) Wipe sampling of the air duct system (filters, areas of particulate deposition) if exposure occurred indoors. **2)** Air Samplers & Single Stage Impactors with settle plates for capturing airborne particulates of respirable size (1-5 microns) on a series of agar plates. Agar plates are then sent to laboratory for culture analysis. **Refer to Portable Aerosol Monitoring Section for more information. 3)** High Volume Air Samplers, such as dry filter units (DFUs), are used to primarily capture high volumes of air for evaluating whether spores are being re-aerosolized.
	Sample Packaging & Shipping: The packaging & shipping of samples are subject to strict regulations established by DOT, CDC, USPS, OSHA, & IATA. Contact the sample-receiving laboratory to determine if they have additional packaging, shipping or labeling requirements. Samples should be packaged in an air-tight container & kept at temperatures of 40-50°F (4-10°C). Ensure samples are not placed directly on the ice used for cooling the shipping container.
Laboratory Analysis	**CAUTION: Many labs may not be able to perform analysis on all matrices (e.g., wipes & soil).** The goal of laboratory analysis for environmental sampling purposes is to determine if viable *B. anthracis* is present in the sample. **Note**: The selected laboratory may use a tiered approach. If a tiered approach is used, the initial analysis may only determine if select/particular components of the bacterium are present in the sample (e.g., presence or absence). It may take additional time (up to weeks depending on the laboratory) to determine if the bacterium are viable & still able to cause adverse effects.
	Laboratory Information: Contact EPA/HQ-EOC (202-564-3850) for contract laboratories able to analyze these types of samples.
Decontamination/Cleanup	**CAUTION: ONLY MANUFACTURER CERTIFIED HEPA VACUUM EQUIPMENT SHOULD BE USED.** **Decon Planning:** Site-specific decon/cleanup plan should be developed & approved by all necessary organizations/SMEs via ICS channels. Responders should develop a plan that takes into account: **1)** Nature of contamination including purity, physical properties, how it entered the facility, etc.; **2)** Extent of contamination, including the amount & possible pathways that have spread the agent. It is advisable to isolate the contaminated area; & **3)** Objectives of decon, including decon of critical items for re-use & the treatment, removal, or packaging of other items for disposal. **Note:** Crisis exemptions from EPA's Office of Pesticide Programs might be necessary depending on decontaminating agents used. **CAUTION: DECON SOLUTIONS SHOULD NOT BE DEPLOYED AS A SPRAY WHENEVER POSSIBLE**. **Decon Methods:** Decon decisions will be site & situation specific but due to re-aerosolization concerns, ***under NO circumstances should a non-HEPA vacuum cleaner or a broom be used.*** EPA's National Decon Team (800-329-1841) can provide specific decontamination parameters & requirements for using readily available commercial items such as household bleach. **Methods used on surfaces: 1)** Source reduction steps, including HEPA vacuuming; **2)** Liquid antimicrobial products such as pH-amended bleach (mixture of 1 part household bleach (5.25% to 6.0%) to 1 part white vinegar to 8 parts water, is recommended). This product affects surfaces differently in terms of corrosiveness, staining, & residue. The product will be most efficient **a)** at higher temperatures (i.e., >70°F or 21°C) **b)** when plain bleach (e.g., no added fragrance) is used to make the pH-amended bleach solution, **c)** when pH is ≤ 7, **d)** when presence of other surface contaminants is minimal, & **e)** when surfaces remain wet with amended bleach solution for 60 minutes. pH-amended bleach can be deployed as a liquid. **Note:** Store-bought bleach does degrade with time – check the expiration date. Alternate antimicrobial products include: chlorine dioxide, hydrogen peroxide, & peroxyacetic acid. **Fumigation:** Uses gas or vapor to decontaminate facilities in which there is evidence of high levels of contamination, re-aerosolization of spores, or if decontamination of limited access areas is required (e.g. HVAC systems). **Fumigants:** chlorine dioxide, vaporized hydrogen peroxide, & paraformaldehyde. 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, & toxicological properties should be taken into account. Each chemical has a specified range for process variables (e.g., temperature, relative humidity, conc. & contact time) that must be followed. **Other Decon: 1)** Ethylene oxide sterilization is used to decontaminate items in an off-site sterilization chamber. **2)** Irradiation uses cobalt-60 & electron beam technologies to destroy *B. anthracis* in mail, & other paper goods at off-site locations. This procedure may destroy magnetic media. Irradiation & chemical sterilization may be useful in decontaminating items that are intended to be returned to owners. The Brentwood, Trenton, & Capitol Hill remediation teams used chloride dioxide liquid & fumigation to decontaminate the site (ClO_2 at 750 ppmv for 12 hours at a minimum of 75°F (24°C) & 75% relative humidity. **Verification of Decon:** Site and situation specific. Please contact ERT (732-321-6660) and/or NDT (800-329-1841) for further assistance.
Waste Disposal	**CAUTION:** Hazardous waste transportation & disposal are regulated federally; however more stringent regulations may exist under state authority. These regulations differ from state-to-state. Detailed state regulations can be found at www.envcap.org.
	Waste Disposal Planning: Waste generated from assessment & cleanup activities should be autoclaved, chemically disinfected, or fumigated & then tested to be sure the agent(s) were inactivated. Waste disposal for agent-contaminated wastes generated from the decontamination & disposal activities will be problematic. Landfills willing to take these wastes may be limited & incineration may be prohibitively expensive or impractical. All waste disposal options should be investigated as early into the response process as possible. Transportation of the agent contaminated wastes from the site to the landfill or incinerator may be problematic as well. First, agreements must be reached between the waste sender & acceptor BEFORE transport, followed by timely public notification of the transport & disposal phases. Transportation of hazardous waste may cross several states and localities, which may exceed federal regulations. Requirements for transporting hazardous materials, & procedure for exemption, are specified in http://www.fmcsa.dot.gov/safety-security/hazmat/complyhmregs.htm#hmp. The U.S. EPA has developed a web-based Incident Waste Management Planning & Response Tool which contains guidance related to waste transportation, contact information for potential treatment, disposal facilities, & state regulatory offices, packaging guidance to minimize risk to workers, & guidance to minimize the potential for contaminating the treatment or disposal facility. Access to the EPA's web based disposal tool requires pre-registration (http://www2.ergweb.com/bdrtool/login.asp).