

Algorithm and Guidelines for Responding to an Incident Involving a Suspicious Non-Clinical Sample

Version 4.0



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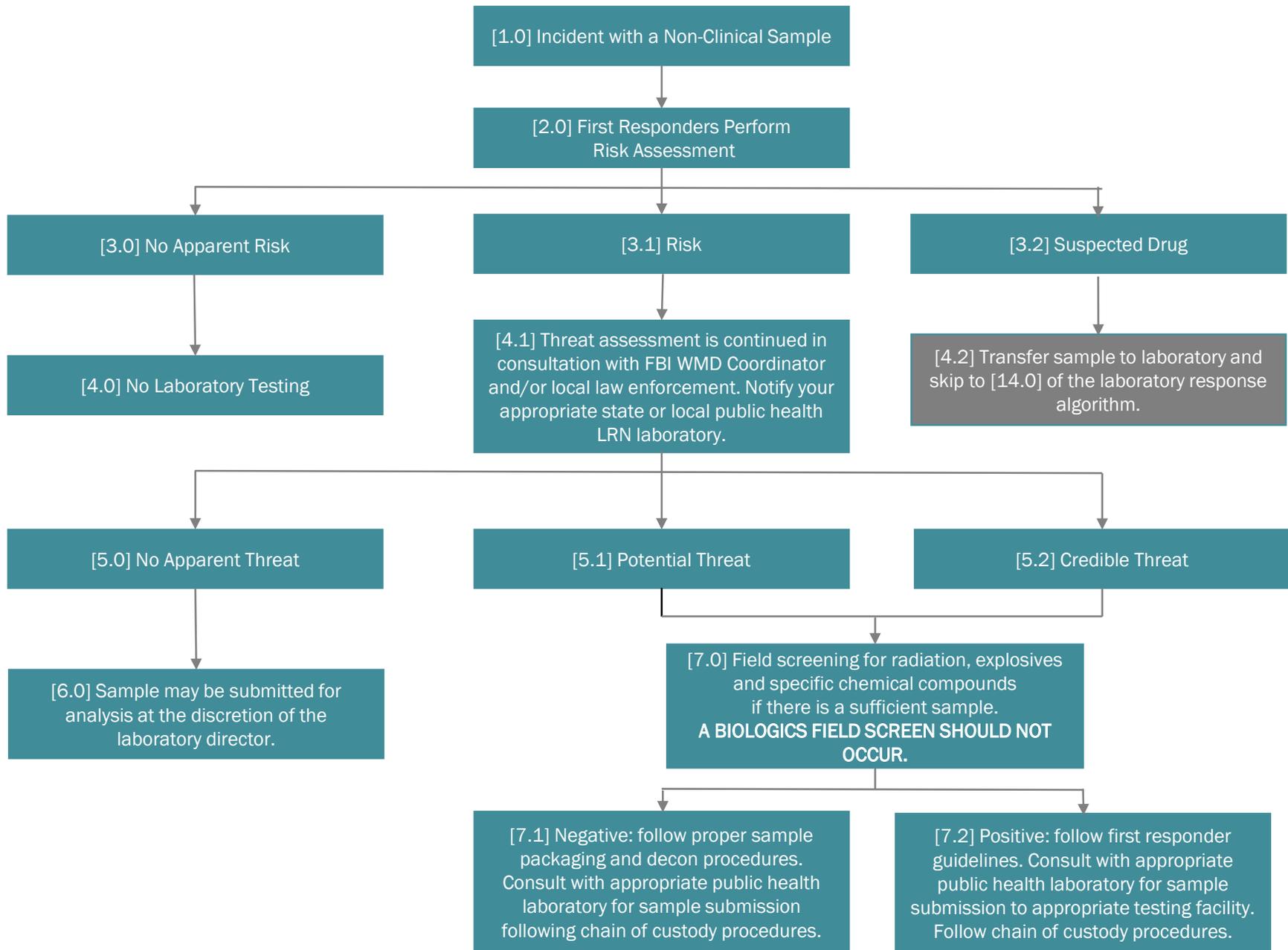
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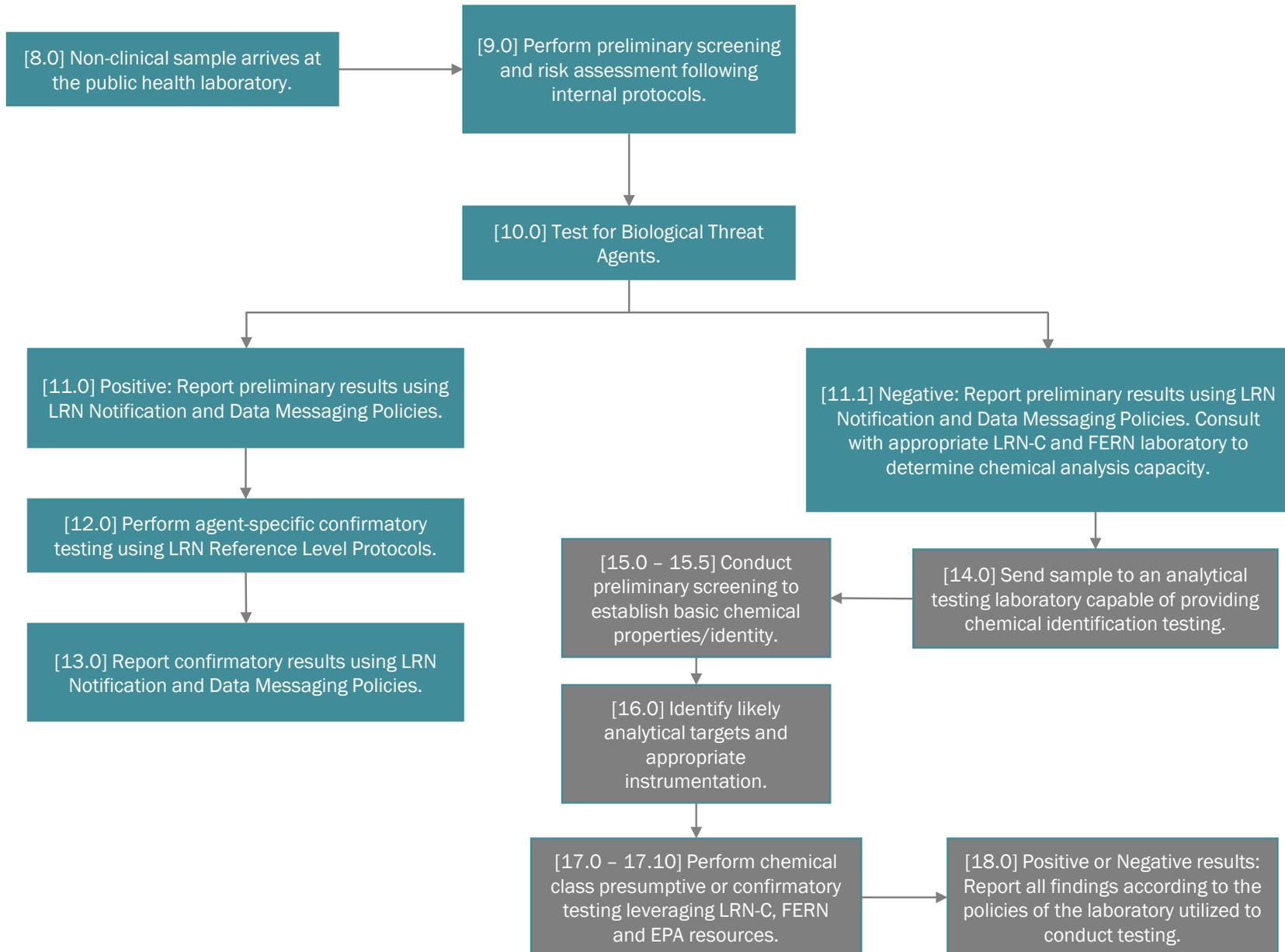
The purpose of the response and testing algorithms is to provide guidance to state and local public health Laboratory Response Network (LRN) member laboratories working with multiple organizations and agencies to respond to an incident involving a suspicious non-clinical sample. This guidance should be a starting point for communication between the laboratory and response communities and should supplement other guidance documents currently available in the field. It is critically important for laboratories to understand the roles of all partners involved in a suspicious incident event to ensure a timely and effective response. The algorithms should be followed step by step until a resolution point has been reached. The accompanying guidelines in this document should be used for further clarification on how to follow the algorithm.

These are minimal guidelines, and APHL anticipates that state and local public health LRN member laboratories will adapt these algorithms to best fit their needs and protocols. These practices are not meant as a standalone protocol, and it is strongly recommended that laboratorians work closely with their first responder communities to provide additional guidance.

ALGORITHM FOR RESPONDING TO AN INCIDENT INVOLVING A SUSPICIOUS NON-CLINICAL SAMPLE



STATE AND LOCAL PUBLIC HEALTH LABORATORY TESTING ALGORITHM FOR PROCESSING A SUSPICIOUS, UNKNOWN NON-CLINICAL SAMPLE



GUIDE FOR RESPONDING TO AN INCIDENT INVOLVING A SUSPICIOUS NON-CLINICAL SAMPLE

1.0 INCIDENT INVOLVING A SUSPICIOUS NON-CLINICAL SAMPLE OCCURS

An incident here is defined as an event that initiates a call to public safety (e.g., 911) and activates first responders. This can include fire department/hazardous materials (HAZMAT) personnel, local law enforcement, Civil Support Teams (CST), or engagement from any emergency response stakeholder. Such incidents involve environmental samples, defined here as non-clinical samples (e.g., powders, liquids, mixtures, pastes and solids). For more information, see [Guidance on Initial Responses to a Suspicious Letter/Container with a Biological Threat](#).

2.0 FIRST RESPONDERS PERFORM A RISK ASSESSMENT

Risk is defined as the probability of suffering a harm, trauma or peril. The risk assessment is defined here as an assessment that indicates the potential for suffering harm or peril. Factors that influence the level of risk include the nature of the hazardous material, amount of material, type of containment device, the level of available resources, and the likelihood of exposure. The risk assessment is a fluid process that should be performed in coordination with local or federal law enforcement. For more detailed references, see *ISO 35001, Biorisk management for laboratories and other related organisations*: “Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated “likelihood” (as defined in ISO Guide 73) of occurrence;” the American Society for Testing and Materials (ASTM) E2770-17, [Standard Guide for Operational Guidelines for Initial Response to a Suspected Biological Agents and Toxins](#). Information for performing a risk assessment can be found in the National Fire Protection Agency (NFPA) Guidance 1600, [Standard on Disaster/Emergency Management and Business Continuity Programs](#).

3.0 NO APPARENT RISK (CONTINUE TO BOX 4.0)

If the sample/situation is deemed to have no apparent risk, no testing is necessary and the algorithm ends. An example of a sample/situation with no apparent risk is an unknown powder found next to a box of powdered donuts in a kitchen area or a mailing from a company with a free sample of their new and improved detergent. Essentially, the potential sample (e.g., liquid, particulate matter, solid) is expected to be there and there is no articulated threat. Should additional testing be requested, consultation with the laboratory director will be warranted.

3.1 Risk Low or High (Continue to Box 4.1)

First responders conduct a preliminary risk assessment and determine there is the possibility that the sample possesses an inherent risk to the public. This may require the assistance of a public health agencies. A sample/situation that has risk may be the presence of powder, particulate matter, or liquid with no obvious explanation, with or without an explicit threat or prior intelligence. Examples of risk may include a suspicious liquid found in a hallway of an office building or a powder found with a threatening letter. Risk can be broken down into categories such as low or high, but for the purposes of this model and to simplify the equation, any risk (low or high) proceeds through the algorithm. An example of a risk assessment plan can be found in the [ASTM Standard E2770-17](#). It is important to note that a negative field test does not necessarily negate the assessment that a threat may be present. Oftentimes, field equipment does not possess the level of sensitivity required to analyze complex mixtures; leading to a higher likelihood of false negatives.

3.2 Suspected Drug (Continue to Box 14.0)

Recently, natural and synthetic narcotics have emerged as a major potential threat to the health and well-being of first responders. The spectrum of toxicity amongst a new class of opioids, specifically fentanyl and derivatives thereof, pose a significant risk to the handler in the field. As many of these opioid analogs may contribute to false negatives with traditional colorimetric and strip testing methodologies, it is recommended that first responders refrain from performing these tests if there is no immediate impact on public health. Moreover, the testing methods commonly utilized in the field have also demonstrated their ineffectiveness to accurately identify target agents when present in simple mixtures. Suspected drugs should be packaged and transported to your local public health laboratory for analysis in a controlled environment.

4.0 NO TESTING NECESSARY

In consultation with the appropriate laboratory representative, if a sample/situation is deemed to have no apparent risk, no laboratory testing is recommended. Individual states and public health agencies have their own policies in place to resolve an incident where laboratory testing is not required, and these should be followed based on your jurisdiction.

4.1 Threat Assessment

A critical aspect of characterizing the unknown non-clinical sample includes an evaluation of the threat, which provides an indication of potential violence, harm or danger, and may include an indication of intent and capability. As stated previously, a negative field test does not necessarily negate the possibility of a threat. The credibility of a threat is determined by evaluating all available information, including that derived from law enforcement interviews, intelligence information, hazard assessment results and communication with public health, including the state and local public health LRN member laboratory.

At the incident scene, the threat assessment is coordinated by the incident commander and varies by the need of law enforcement. The state and local public health LRN member laboratory may be asked to participate by phone during the Federal Bureau of Investigation (FBI)-led threat assessment so they are aware that public health testing and referral support may be needed. On-scene responders, public health representatives, local law enforcement and FBI representatives should work together to determine the threat level.

Following the initial risk assessment, factors such as technical feasibility, operational practicability and behavioral resolve combined with examination of pertinent intelligence will inform the credibility level of the threat. If the initial risk assessment determines that there is a potential threat, the FBI will perform their credibility threat procedure, which is conducted by the local FBI Weapons of Mass Destruction (WMD) Coordinator with guidance from the FBI Headquarters. Based on the risk and threat assessments, it may be necessary for first responders to restrict access to the area for public safety pending confirmation from the state or local public health LRN member laboratory.

5.0-5.2 NO APPARENT THREAT, POTENTIAL OR CREDIBLE THREAT

After performing the threat assessment, the incident is categorized as follows:

5.0 No Apparent Threat

The assessment determines that no threat exists and as such no testing is recommended. Note: In some situations, further analysis may be requested due to ongoing public safety concerns and samples could continue through the algorithm. First responders on scene will proceed as directed by supervising officials.

5.1 Potential Threat (low risk)

The assessment determines that a threat exists and there is no readily available information that explains the presence of the unidentified substance. In these situations, communication between the first responders on-scene and the jurisdictional state or local public health laboratory determines if the sample should be sent to the laboratory for further analysis.

5.2 Credible Threat (high risk)

The assessment determines that a threat exists and that it is credible. On-scene information leads law enforcement officials to have a reasonable belief that an event has occurred. All credible threats should immediately be sent to the jurisdictional state or local public health LRN laboratory for confirmatory testing.

6.0 SAMPLE SUBMISSION

Even when there is no apparent threat associated with an incident, the laboratory may still be asked to assist in identifying the unknown material in question. These requests may be submitted to the laboratory at the discretion of the laboratory director and should be processed in a manner consistent with your state's policies. Samples not properly screened are accepted at the laboratory director's discretion and may be rejected for submission to the laboratory. It is up to the individual state or local laboratory director to determine if they will accept incomplete screens.

7.0 FIELD SCREENING (EXPLOSIVES AND RADIATION AT A MINIMUM)

Field screening is defined as testing performed by first responders prior to the sample being taken to the appropriate state or local public health LRN laboratory. Such testing should include, at a minimum, radiation and explosives screening. Other basic analyses, such as volatiles, may also be performed provided they do not contaminate or fully consume the sample. Field screening is NOT to be considered a confirmatory test.

Guidance on performing field screening can be found in the FBI, Department of Homeland Security (DHS), Health and Human Services (HHS)/Centers for Disease Control and Prevention (CDC) Coordinated Document, [Guidance on Initial Response to a Suspicious Letter/Container with a Potential Biological Threat](#).

The field screen should be performed by trained hazardous materials (HAZMAT) personnel and other trained first responder teams. Responder training guidance can be found in [National Fire Protection Agency \(NFPA\) Guidance 472: Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents](#). The purpose of the field screen is to rule out explosive materials and incendiary devices, limited chemical agents, radiological substances and materials that may pose significant risks to transport personnel and state and local public health LRN laboratorians.

In some instances, and at the Governor's discretion, the National Guard Bureau of WMD CSTs will be deployed to an incident. During these events, the CSTs may be called upon to provide onsite safety screening characterization of potentially hazardous environmental samples. The CSTs are equipped with mobile laboratories, referred to as an analytical laboratory system (ALS), which is a standardized mobile laboratory system accessible in every state and territory of the US. The ALS is designed to apply standardized analysis to screen potentially hazardous samples and prepare them for safe transport, by the appropriate law enforcement entity, to the appropriate LRN reference laboratory for confirmatory testing and definitive analysis. State and local public health LRN laboratories are encouraged to develop relationships with their CSTs prior to an incident. More information on the capabilities of the CSTs is available in the document, *The Role of Civil Support Teams in Support of the Laboratory Response Network*.

7.1 Field Screening is Negative

If the field screen is negative, complete proper decontamination, appropriately package and transport sample, along with the proper Sample Submission and Chain-of-Custody Form, to the appropriate state or local public health LRN member laboratory. See Appendix A for Chain-of-Custody Form or use forms which are consistent with law enforcement requirements. All samples transported to the laboratory suspected to have a biological component should reference the FBI document for transport. Samples should be triple sealed in leak-proof containers. When transporting the sample, US Department of Transportation (DOT) requirements are recommended and may be required for commercial transport of sample. The outermost container should be appropriately decontaminated either by laboratory personnel or hazardous material responder (i.e., with 10% freshly made bleach solution to decontaminate it with a minimum of 20 minutes contact time). Further sample transport requirements and instructions can be found in Appendix D. Note: Ensure you consult with your state or local public health LRN member laboratory. See Appendix B for acceptable sample requirements. It is at the state or local public health LRN member laboratory director's discretion to accept a sample that arrives without proper documentation or packaging according to national sampling standards found in Appendix C.

7.2 Field Screening is Positive

If the field screening is positive for radiation or explosives, immediately consult with the state or local emergency response or public health LRN member laboratory to send the sample without delay to an appropriate testing agency capable of handling such a sample. It is expected that both laboratory and first responders be familiar with DOT Hazardous Materials Transportation Act and Hazardous Materials Safety Act as mentioned in the [All Hazards Receipt Facility \(AHRF\) Screening Protocol](#).

STATE AND LOCAL PUBLIC HEALTH LABORATORY TESTING GUIDE FOR PROCESSING A SUSPICIOUS, UNKNOWN NON-CLINICAL SAMPLE

8.0 SAMPLE ARRIVES AT THE STATE OR LOCAL PUBLIC HEALTH LABORATORY

8.0.1 Prior to accepting the sample, the receiving laboratory must check the incoming sample to ensure that proper packaging occurred, that all accompanying documentation is included and correct, and that it comprises any field screening results to ensure that at a minimum, explosive, radiological and volatile organic compound (VOC) field screening was performed. In a true unknown event, the laboratory will determine the appropriate testing scheme based on available information and intelligence. Some laboratories choose to rule out the threat of biologics prior to commencing any chemical testing whereas some laboratories choose to do the opposite or perform concurrent biological and chemical testing. There are a variety of factors that will influence this decision such as field screening results, the threat assessment, and laboratory capacity. Regardless of pathway, LRN for Biological Threats Preparedness (LRN-B) laboratories along with LRN for Chemical Threats Preparedness (LRN-C) laboratories and the Food Emergency Response Network (FERN) infrastructure will typically be leveraged to see to it that work is completed in the safest, most efficient manner possible.

Laboratories need to take into consideration the potential for a sample to contain a mixed hazard (e.g., biological hazards, chemical hazards including illicit drugs, etc.) before sample handling and testing. Although it may be unlikely a sample would contain a mixed hazard, or that the sample matrices would be able to support mixed hazards, it is not impossible and laboratories do need to take an all-hazards approach to the concern in order to direct testing appropriately within the lab and to ensure laboratory staff will be able to handle and work with the sample safely. Receiving laboratories will need to make facility specific risk assessments and considerations based on available resources and capabilities to safely handle potential mixed hazard samples. Considerations should also be based on any field screening testing that occurred before arrival and/or upon receipt at the laboratory and based on any threat credibility assessments from law enforcement.

8.0.2 Sample Preservation

Photos of the materials should be taken; minimize handling of evidence (i.e., envelopes) and store some of the original sample. The recommendation is to remove materials from the outside packaging, such as an envelope, and store the contents in the appropriate conditions according to your laboratory protocol. The outside packaging should be minimally handled and stored in the best possible conditions to preserve traditional forensic evidence. Secondary evidence such as growth plates can be destroyed after final testing conclusions have been made and adhering to the LRN-B Reference level protocols. The important material to save is the primary evidence, which is the original sample, so that further testing can occur if requested. *The general rule of thumb is to preserve the original sample until all legal matters have been resolved.*

9.0 PERFORM RECOMMENDED PRELIMINARY SCREENING AND SPLIT SAMPLE FOR BIOLOGICAL, RADIOLOGICAL AND CHEMICAL TESTING GROUPS FOR FUTURE TESTING

Note: Per FBI policy, no chemical testing should be performed on evidence submitted by the FBI unless requested by the local WMD Coordinator. Biological testing is the only analysis required. For non-FBI samples, testing proceeds at the discretion of the laboratory director.

9.0.1 Preliminary Laboratory Screening

If upon reviewing field results, the laboratory determines minimum safety expectations have been met, the sample may be aliquoted for biological and chemical testing. However, if enough sample is available, it is highly recommended, for the safety of the laboratorians, that state and local public health LRN laboratories perform additional laboratory screening procedures to confirm these field tests prior to further manipulation of the sample. In situations where a biological threat could not be ruled out, two trained laboratorians should perform a joint initial assessment of the sample in at least a Biosafety Level 3 (BSL-3) suite in a Class II biological safety cabinet or a BSL-2 suite with a Class III Biological Safety Cabinet (glove box) in a facility capable of filtering and protecting against chemical, radiological and biological agents. If LRN-B and LRN-C member laboratories are co-located and staff are cross trained in basic practices,

both a biologist and a chemist should work together to perform this screening process. If the laboratory has radiological capability, then a radiochemist should also be engaged in this preliminary screening process. If the laboratory has an AHRF, then the AHRF and [AHRF Screening Protocol](#) may be used for this preliminary screen.

The following are testing options that could be performed if appropriate instrumentation and supplies are available. *Note: Before preliminary testing is performed, laboratories must have protocols in place to triage potential positive samples.*

The following list is not comprehensive, and any appropriate instrumentation should be used to test the sample.

EQUIPMENT/TEST	HAZARD CLASS/COMPOUNDS
Geiger Counter with a Geiger Mueller Probe (β/γ) and Pancake Probe (α) <ul style="list-style-type: none"> Gamma radiation screening should be conducted on the exterior of the package. Alpha/beta radiation screening should be conducted on the sample before it is split. 	Radiation
Explosives Kit	Explosives and Oxidizers
E.L.I.T.E. Tickets	Explosives
DropEx Plus Explosive Detection System	Explosives
M8, M9 Paper	Chemical Warfare Agents
Gas Meter	Volatile Organic Compounds/ Lower Explosive Limit
Oxidizer Test Kit/Strip	Oxidizers
Litmus Paper	pH, Corrosives, Water Reactivity
FTIR/Raman	Additional Chemical Classifications via Spectroscopy
Water Reactivity Test	Water reactive chemicals

If preliminary positive results are obtained from these screening assays, the state or local public health LRN member laboratory should follow existing protocols for subsequent testing or referral. If all screening assays performed are negative for both radiation and explosives, accession the sample into the LRN-B Reference laboratory for further testing. Take into consideration results for all tests to ensure proper personal protective equipment (PPE), fume hoods, biological safety cabinets or other protection equipment is used.

9.0.2 Prior to performing any laboratory analyses, the sample should be split to allow for biological, chemical and other testing. For laboratories who wish to perform concurrent chem/bio testing the sample designated for the chemistry lab should be passed through a 0.2 μm filter to reduce the threat of spores.

To maintain chain-of-custody for a split sample, a laboratory should create a new chain-of-custody form and document on the new form the creation of an additional sample identification number on the original form. For example, if a powder comes into the laboratory (sample 1) and is immediately split for biological and chemical testing, then the new samples would be 1.0 and 1.1. Each additional split must also be noted and given a unique identification. If the sample 1.1 is split again, the resulting samples would be identified as 1.1 and 1.2. This type of splitting identifies each sample individually and avoids the issue of disappearing identifiers such as splitting 1 into 1.1 and 1.2, where item 1 seems to disappear. If records are kept and a logical identification is used, chain-of-custody is maintained. Each time any portion of the sample changes hands or is transferred, chain-of-custody must be completed and maintained.

For derivative or secondary evidence such as plates, slants and cultures, a similar system can be employed. The general rule of thumb still holds that if records are kept in a logical system and documented at each step, then chain-of-custody is maintained. Guidance from the FBI (see Appendix A for an example form) laboratory suggests that a separate chain-of-custody form should be started for derivative samples. An example of documentation is to note that 10 plates, such as five chocolate agar and five sheep blood agar, were created from sample 1 and were delivered by Person A and received by Person B at X time. Derivative or secondary evidence can often be properly decontaminated and destroyed after testing is complete (see 8.0.2 *Sample Preservation*).

It is critical to maintain chain-of-custody on each sample. If chain-of-custody is not maintained, this may severely jeopardize law enforcement prosecution of suspected perpetrators. *Note: If chemical, biological, and radiological laboratory facilities are not co-located and biological testing is negative and the need exists for chemical testing or it is requested, the sample should be appropriately packaged and transported to a laboratory capable of such testing.*

- Minimum Sample Size Requirements for Biological Analysis (non-FBI cases): If there is bulk liquid or solid, save 1 milliliter of liquid or a swab of solid material. Acceptable sample types for biological testing include swab, wipe, liquid, powder, and HEPA filters. First responders should consult with their LRN-B Reference level laboratory to determine additional acceptable sample types.
- Minimum Sample Size Requirements for Chemical Analysis: Save 1-2 milliliters or 1-2 grams of remaining, unprocessed sample in a sealable glass container. First responders and state or local public health LRN-B Reference level laboratories should consult with the state or local public health (LRN-C or FERN) or state radiological laboratory to verify testing capability and sample size requirements policies. Consult with your laboratory's chemistry laboratory to determine capability for chemical threat agent analysis. Contact your local PHL for sample volumes of less than 10 mL.

10.0 SAMPLE IS SENT TO THE LRN-B REFERENCE LABORATORY AND TESTED FOR BIOLOGICAL THREAT AGENTS

Perform the LRN-B Reference level protocol for Environmental Sample Processing for Bioterrorism Agents Panel, PCR Screening and Ricin Toxin TRF Testing and begin culturing for microorganisms.

11.0 PRELIMINARY POSITIVE LABORATORY RESULT

11.0.1 Report preliminary positive results following LRN-B Reference level notification and data messaging policies, including the CDC Select Agent reporting requirements, as well as your laboratory-specific communication policies.

11.0.2 Consult with your laboratory director and biological, chemical and/or radiological threat coordinators to determine if there is a need for chemical or radiological threat agent analysis. If testing is determined necessary, the sample should be prepared for chemical testing using appropriate PPE and biological safety hoods/rooms.

11.1 Preliminary Negative Laboratory Result

11.1.1 Report preliminary negative results using LRN-B Reference level notification and data messaging policies as well as your laboratory specific communication.

12.0 AGENT SPECIFIC CONFIRMATORY TESTING

LRN-B Reference level laboratories will perform agent specific confirmatory testing per existing protocols.

13.0 REPORT CONFIRMATORY TESTING RESULTS

Report positive and negative results using LRN-B Reference level notification and data messaging policies as well as your laboratory specific communication policies.

Sample Disposal

Upon completion of all tests and depending on the needs of the requestor, sample may be returned to submitter, referred to another laboratory or destroyed using an autoclave. All sample disposal procedures should comply with federal guidance and the select agent regulation. Consult with sample submitter regarding final disposition.

14.0 SAMPLE SENT FOR CHEMISTRY ANALYSIS

In certain situations, biological testing may be unnecessary when the threat assessment points to the high likelihood of a chemical agent or drug being implicated in the event. APHL developed this algorithm to assist laboratories with analyzing these suspicious non-clinical samples for chemical threat agents. Sample submitters should consult with the LRN-C Coordinator to determine testing capabilities. Upon receiving a request, the laboratory should ensure the Laboratory Director, LRN-B Coordinator and FBI WMD Coordinator (if necessary), are contacted and consulted. LRN laboratories have different capabilities for chemical testing and may not be able to perform certain methods. In these situations, other laboratories may be leveraged, such as FERN, the Environmental Response Laboratory Network

(ERLN) and drug analysis laboratories. While the LRN-C is structured to process and analyze clinical specimens, its infrastructure includes knowledgeable chemists and highly sophisticated analytical instrumentation, with easily modifiable methodologies that can be utilized for screening purposes and to aid in sample triage and identification.

It is important to recognize that a laboratory may not accept any sample that is beyond their analytical capability or ability to accept, store and analyze the sample safely. If this situation occurs, they should contact another analytical testing laboratory that has the ability to perform the requested testing method, the CDC LRN-C through the LRN Help Desk or the CDC Emergency Operations Center (EOC). Highly knowledgeable staff and a wide range of instrumentation are readily available through the LRN-C and FERN programs. Many existing methodologies can be easily adapted to accurately analyze non-clinical samples and provide presumptive compound identifications. For confirmatory purposes, the laboratory must have trained personnel available to perform the requested testing and these laboratorians should have competency assessments for the methods in place before any samples are tested. In a true unknown event, the sample initially is classified according to general chemical class. However, field testing data may negate the need for the laboratory to perform this screen. If additional analysis is needed to either confirm the identity of the material or classification, it is completed after the initial classification. All results are reported using the appropriate laboratory and network reporting mechanisms. Note: the US Environmental Protection Agency (EPA) has a program with the National Homeland Security Research Center called [Standardized Analytical Methods \(SAM\) for Environmental Restoration Following Homeland Security Events](#). These analytical methods may be used to determine the chemical involved in the event or to confirm field screening results.

15.0 GENERAL CHEMICAL COMPOUND CLASSIFICATION

This first level of testing provides a general chemical classification and may yield a presumptive identity to the target analyte. Analytical groups operating within LRN-C, FERN, ERLN and forensic drug laboratories may be able to offer insight into the nature of the chemical compound in order to facilitate confirmatory testing. At this phase of testing, key chemical properties are established such as pH and solubility. Additional screening methodologies such as volatile organic compound (VOC) readings, Fourier-Transform Infrared (FTIR) scans, and strip testing (e.g., Cyantismo, M-8) also provides valuable information and help the chemist determine which piece of analytical instrument is best suited for compound identification. If a presumptive positive is established during the screening process, the results should be appropriately qualified and confirmed when possible. Results may be reported “as is” with approval from the laboratory director, or transferred to the laboratory.

15.1 Microscope/IR/Raman

FTIR techniques, either FTIR-Microscopy or FTIR coupled with Raman spectroscopy, will allow library screening, which may provide compound specific or mixture specific classification. This technique is a reasonably effective means of identifying inorganic compounds such as salts, and simple organic compounds. FTIR is a useful screening tool, but due to its shortcomings in analyzing dilute and complex mixtures, testing should always be coupled with a more robust piece of analytical equipment such as gas chromatography-mass spectrometry (GC-MS), liquid chromatography-mass spectrometry (LC-MS), or inductively coupled plasma mass spectrometry (ICP-MS).

15.2 Solubility Tests

Wet chemistry techniques will provide general classification of materials (liquid or solid). Coupled with FTIR results, potential structure elucidation is possible. Some LRN-C laboratories have this capability.

15.3 Colorimetric Tests

Wet chemistry colorimetric techniques, such as a hazard classification test, can be used to determine chemical class and/or provide hazard recommendation. Most LRN-C laboratories have this capability but may not have a standard written protocol or reagents available. Colorimetric testing, such as the Marquis test, may be especially useful for drug screening.

15.4 XRF (solids only)

X-ray fluorescence (XRF) is widely used for elemental analysis, particularly in the investigation of metals, glass, ceramics and building materials. Detector types vary, and can include gas flow proportional counters, sealed gas detectors, scintillation counters and semi-conductor detectors.

15.5 Mass Spectrometry

The goal of screening should be to establish which mass spectrometry tool is best suited to analyze the sample in question.

GC-MS

Gas chromatography mass spectrometry (GC-MS) is an essential technique for any analytical laboratory. GC-MS can analyze small to moderate sized organic compounds (approximately 50amu - 400amu in size) and library match the results across a National Institute of Standards and Technology (NIST) database. GC-MS can be extremely versatile and is able to analyze diverse classes of organic compounds ranging from volatile and semi-volatile organics to complex biologically active molecules. Presumptive positives/library matched results should always be confirmed with the use of certified reference material and an isotopically labeled internal standard whenever possible.

LC-MS

Liquid chromatography mass spectrometry (LC-MS) allows the analyst to chemically identify organic compounds across a greater molecular weight range. In general, high resolution mass spectrometry can analyze compounds up to 4000amu. Quadropole time-of-flight mass spectrometry (QToF) has been utilized in recent years for non-targeted screening but comes with a significant time investment in building your own library. Unlike GC-MS, LC-MS technology does not often possess library matching capacity unless a laboratory has established one themselves. Liquid chromatography with tandem mass spectrometry (LC-MS-MS) is the ultimate tool in confirmatory analysis. Presumptive positives identified on an LC-MS system should also be confirmed using external standards, or isotopically labeled internal standards, and certified reference material whenever possible.

ICP-MS

Inductively coupled plasma mass spectrometry (ICP-MS) is the ideal way of analyzing metallic or metalloid concentrations. If toxic elemental exposure is suspected, then an ICP-MS can confirm the presence of metal and metalloids in a variety of matrices. In advanced settings, a laboratory may be able to speciate certain classes of organic vs. inorganic metallic complexes such as arsenic and mercury, should that level of specificity be required.

16.0 DETERMINE IF FURTHER CLASSIFICATION OF THE MATERIAL IS NEEDED.

16.1 No Further Classification is Needed

Follow internal laboratory reporting protocols to determine how to report results. Note: A centralized mechanism, laboratory information management system (LIMS) or other electronic data reporting capability is still needed to report non-clinical chemical test results to external partners. Report results using LRN Notification and Data Messaging Policies if clinical specimens are tested.

16.2 Additional Classification is Needed

Identify likely analytical targets based upon preliminary and first responder results.

Select the appropriate methods available to the laboratory. Consult with your laboratory director and FBI WMD Coordinator (if applicable) to determine how to report results. Note: A centralized mechanism, LIMS or other electronic data reporting capability, is still needed to report non-clinical chemical test results. Report results using LRN Notification and Data Messaging Policies if clinical specimens are tested. Determine if analysis can be completed within the selected laboratory or requires referral to another laboratory.

17.0 PERFORM CHEMICAL CLASS OR AGENT SPECIFIC CONFIRMATORY TESTING USING STANDARDIZED ANALYTICAL METHODS OR OTHER METHODS.

This is broken down into 10 general high priority categories of materials. See also Appendix C.

17.1 Explosives (corresponds to US DOT Class 1–Explosives).

This includes materials, such as diazonium salts, nitro compounds, perchlorates, peroxides, RDX, etc. Recommended instrumentation for this category is FTIR spectroscopy, ion mobility spectroscopy (IMS) and calorimetry. At present, most laboratories do not accept potentially explosive material, and very few have the capability to screen unknown material for an explosive threat.

17.2 Non-Volatile Organic Compounds (this does NOT correspond to US DOT Class 2–Gases)

This category includes materials such as pharmaceutical and environmental contaminants or toxins. Recommended instrumentation for this category includes LC-MS-MS, ultraviolet-visible spectroscopy (UV/Vis) or fluorescence spectroscopy. At present, some LRN-C laboratories have LC-MS-MS; most laboratories do not have fluorescence or UV/Vis spectroscopy.

17.3 VOCs/SVOCs (corresponds to US DOT Class 3–Flammable Liquids and Combustible Liquids).

This category includes volatile and semi-volatile materials. Recommended instrumentation for this category includes GC-MS, solid phase micro extraction (SPME)-GC-MS, and purge and trap GC-MS. At present, all Level 1 and Level 2 LRN-C laboratories have GC-MS instrumentation; however, not all laboratories have purge and trap GC-MS capability. Most FERN laboratories are also well equipped for VOC and SVOC testing.

17.4 Metals and Element Compounds (corresponds to US DOT Class 4–Flammable Solids).

This category includes heavy metals and other toxic elements (such as arsenic, lead, cadmium, mercury, uranium, etc.) and elemental compounds (such as various species of organic and inorganic arsenic and mercury.). Recommended instrumentation for this category includes ICP-MS, liquid chromatography inductively coupled plasma mass spectrometry (LC-ICP-MS), as well as older techniques such as graphite furnace atomic absorption spectroscopy (GFAAS). At present, Level 1 and Level 2 LRN-C laboratories have ICP-MS instrumentation, but not all laboratories have LC-ICP-MS or GFAAS capability. Laboratories specializing in drinking water testing may also be a valued resource for elemental analysis.

17.5 Inorganic Compounds (generally corresponds to US DOT Class 5–Oxidizers and US DOT Class 9–Miscellaneous).

This category includes ionic compounds (e.g., cyanides, sulfides, phosphates, etc.). The recommended instrumentation for this category includes ion chromatography (IC), ion chromatography mass spectrometry (IC-MS), FTIR and other techniques, such as XRF or Raman. At present, most LRN-C laboratories do not have this instrumentation; however, Level 1 and Level 2 LRN-C laboratories may be able to adapt GC-MS methodology if these ionic compounds can be readily converted into a gas.

17.6 Toxic Gases (corresponds to US DOT Class 6–Toxic Substances, specifically Division 6.1 Toxic or Poisons).

This category includes toxic asphyxiant, explosive, acute or chronic effects, or gases (e.g., ammonia, chlorine, carbon monoxide, cyanogen chloride, diazomethane, fluorine, hydrogen cyanide, hydrogen sulfide, methane, ozone, phosphine, phosgene, radon, etc.). Recommended instrumentation varies for this category, but in general is calorimetric, GC-MS, gas chromatography–flame ionization detector (GC-FID) or gas chromatography-nitrogen phosphorous detector (GC-NPD). LRN-C laboratories have GC-MS capabilities; however, most do not have the appropriate autosampler, such as a SUMA canister or Tedlar bag introduction system. If toxic gas exposure is suspected, the Chemical Threat (CT) Coordinator should be immediately notified along with CDC's EOC. It is unlikely a typical public health laboratory will have the ability to accept these reagents.

17.7 Radiochemicals (corresponds to US DOT Class 7–Radioactive Materials).

This category includes a variety of radiochemicals, such as polonium-210, radon, uranium, etc. Recommended instrumentation includes gamma spectroscopy, alpha spectroscopy and liquid scintillation counting techniques. Public health laboratories working in collaboration with the state Conference for Radiation Control Program Directors (CRCPD) group may have the capability to test for some or all radionuclides in an environmental sample. If ingestion or human contamination is suspected, LRN-C laboratories may be able to assist with some elements or facilitate testing at CDC via the EOC.

17.8 Acid/Bases (corresponds to US DOT Class 8–Corrosives).

This category includes corrosive materials, such as acids (either single or mixed) and bases (either single or mixed) and can be either organic or inorganic corrosive materials. Recommended instrumentation includes FTIR and wet chemical techniques (e.g., pH, indicators, titrations, etc.). At present, some LRN-C laboratories have FTIR capabilities or instrumentation, however, the capacity may exist in-house and other methods of pH analysis might be readily available.

17.9 Pesticides (does NOT correspond to US DOT Class 9–Miscellaneous).

This category includes pesticides, herbicides, fungicides, insecticides, etc. (e.g., carbamates, organo-phosphates, haloacetic acids, etc.). Recommended instrumentation varies, but primarily includes GC, GC-MS and LC-MS-MS. At present, all Level 1 and Level 2 LRN-C laboratories have GC-MS capabilities. FERN laboratories could be leveraged in a suspected pesticide event.

17.10 Chemical Warfare Agents (this is a separate category and does not directly correspond to any US DOT Hazard Class).

This category is broad and includes known and suspected chemical warfare agents (e.g, vesicants, mustards, blister agents, organophosphate nerve agents, cholinesterase inhibitors, choking agents, etc.). Recommended instrumentation includes GC-MS and LC-MS-MS. All Level 1 and Level 2 LRN-C laboratories have LC-MS-MS methodologies capable of detecting exposure to warfare agents in clinical samples, but most do not have the capability to test live warfare agents. If a suspected warfare agent is released the CT coordinator should be immediately notified, along with CDC's EOC and FBI's WMD coordinator (if not already involved), and the triaging of clinical specimens to the laboratory should be immediately executed.

18.0 REPORT RESULTS

All results (positive or negative) should be reported to the submitter, appropriate network (i.e., LRN-B) and/or organizations utilizing your laboratory specific reporting policies.

Sample Disposal

Follow laboratory protocols for disposal of hazardous chemical, biological and radiological wastes.

Training Requirements and Recommendations

To ensure consistent implementation of this guidance, it is strongly recommended that the following training courses be conducted on an annual basis or more frequently as needed by the local jurisdiction:

1. First Responder Outreach and Cross-Training in Laboratory and Field Environments

It is important to develop and implement national training and competency assessment programs (e.g., proficiency testing, certification) for first responders involved in responding to all-hazard threats. Cross-training should include ASTM Standards E2770-17 and ASTM E2458-17.

2. Preliminary Laboratory Screening

It is recommended that joint training for biologists and chemists take place to ensure employee safety and adherence to laboratory protocols. Laboratories are encouraged to cross-train on the AHR Facility Protocol. Currently, training is offered through the [Wadsworth Center](#) in Albany, New York.

3. Class II and Class III Biological Safety Cabinet Training

Annual training on the Class II and Class III BSC is vital to ensure proper use of this equipment.

4. Radiation Detection Equipment Training

Many laboratorians may not be trained on the proper equipment and procedures for testing samples for radiation. Annual training and refresher courses should be conducted for this function.

5. Site-Specific Risk Assessment and Biosafety Training

Each facility should perform its own site-specific risk assessment and biosafety trainings based on their facility needs to determine whether enhanced safety precautions are warranted or additional trainings are needed.

Biosafety training on safe practices and procedures ensures laboratorians are protected while handling infectious or dangerous materials.

[APHL Risk Assessment Best Practices](#)

REFERENCES

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- xiii Integrated Consortium of Laboratory Networks. Laboratory Logistics Limiting Issues. Available at: <https://www.icln.org/resources/subgroups/laboratory-logistics/lab-limiting-issues/Lab%20Limiting%20Issues%202011%2010%2026%20Version%201.0.pdf>

APPENDIX A: CHAIN-OF-CUSTODY GUIDANCE

General: Guidance for Proper Use of Chain-of-Custody Form

- A. The custodian is responsible to maintain and collect additional chain-of-custody documentation generated at the laboratory.
- B. The laboratory will maintain originals (copies if necessary) of all chain-of-custody documentation and provide originals to law enforcement officials upon transfer of evidence. Copies should be maintained by the laboratory for its records.
- C. In the event that custodianship of the evidence is split, due to sampling of a specimen or the transfer of one or more items, the chain-of-custody forms must be initiated, maintained and transferred with that portion of evidence; the custodians receiving and releasing the sample or item will keep a copy of the Receipt of Property form.
- D. The chain-of-custody documentation should be considered confidential/classified information; it should be maintained in a secure location.

Receipt of Property Form

- A. This form must be completed, signed, providing date and time, upon the receipt of evidence. Both the laboratory and the law enforcement official will retain a copy of the completed form.
- B. This form must be completed, signed and dated upon the release of evidence to a law enforcement official. Both the laboratory and the law enforcement official will retain a copy of the completed form.
- C. Description information should include the following information for each and every item:
 - 1. Unique identifier for each item
 - 2. Number/quantity
 - 3. Type/description
- D. If multiple items are received, all items must be listed on the form or attached. Each item should be assigned a unique identifier (e.g., number). The original identifier should be maintained on the chain-of-custody records for any sample/portion of that item.
- E. The name of the carrier/courier and the shipping/reference number should be recorded if item(s) are delivered by a carrier/courier.
- F. Additional information may be attached as appropriate (e.g., original source/submitter, collected by, emergency contacts, situational information).

Chain-of-Custody Form

This form must be signed and dated when transferring custody within the laboratory, from the initial receipt of the evidence, through the processing, storage, and release of the evidence to a law enforcement official.

RECEIPT FOR PROPERTY RECEIVED/RETURNED

Case ID: _____

Collection/Sampling Date: _____ Time: _____

Collected/Sample Taken By: _____

Organization: _____

Address: _____

City, State: _____ Phone: _____

Description of Sample/Evidence: _____

Chain-of-Custody Form (cont'd)

This Chain-of-custody form remains with the sample/evidence at all times. By signing this form, all parties verify the sample/evidence is attended at all times.

Received from: _____
(sign/date/time)

Received by: _____
(sign/date/time)

Case ID #: _____

Date: _____ Time: _____

Transfer From (print/sign): _____

Transferred To (print/sign): _____

Security Method while held: _____

Date: _____ Time: _____

Transfer From (print/sign): _____

Transferred To (print/sign): _____

Security Method while held: _____

Date: _____ Time: _____

Transfer From (print/sign): _____

Transferred To (print/sign): _____

Security Method while held: _____

Date: _____ Time: _____

Transfer From (print/sign): _____

Transferred To (print/sign): _____

Security Method while held: _____

Date: _____ Time: _____

Transfer From (print/sign): _____

Transferred To (print/sign): _____

Security Method while held: _____

Additional Comments or Instructions: _____

APPENDIX B: THE LABORATORY RESPONSE NETWORK

Laboratory Response Network for Biological (LRN-B) and Chemical (LRN-C) Threats Preparedness

The Laboratory Response Network (LRN), the nation's premier laboratory system for identifying, testing and characterizing potential agents of biological and chemical terrorism, was founded in 1999 by the Centers for Disease Control and Prevention (CDC), the Association of Public Health Laboratories (APHL) and the Federal Bureau of Investigation (FBI). This integrated network of laboratories is a unique asset in responding to all-hazard threats, providing immediate and sustained laboratory testing and communication to respond quickly to acts of chemical or biological terrorism, emerging infectious diseases and other public health threats and emergencies.

LRN for Biological Threats Preparedness (LRN-B)

The LRN-B is comprised of National, Reference and Sentinel laboratories forming a tiered network (Figure 1). At the foundation are thousands of sentinel clinical laboratories, which perform initial screening for potential pathogens. When sentinel clinical laboratories cannot rule out the presence of a biological terrorism agent, they refer specimens and isolates to an LRN-B Reference laboratory. The Reference laboratories, made up of over 170 state and local public health, military, international, veterinary, agriculture, food and water testing laboratories, are responsible for performing complex analyses and providing support to law enforcement for threat investigations. In the years since its inception, the LRN-B has played an instrumental role in improving public health infrastructure (e.g., staffing, laboratory equipment) by helping to boost laboratory capability and capacity, and by responding to real threats in a timely and efficient manner. At the apex of the pyramid are national laboratories, such as those at the CDC and the Department of Defense. These laboratories test and characterize samples that pose challenges beyond the capabilities of Reference laboratories, and provide support for other LRN members during a serious outbreak or terrorist event.

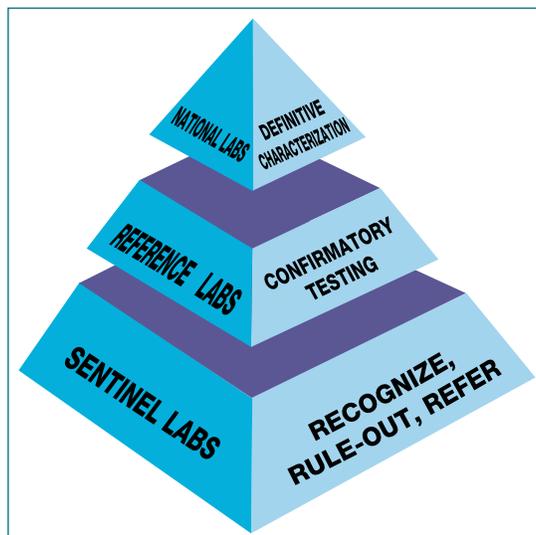


Figure 1: LRN Structure for Biological Threats Preparedness

LRN for Chemical Threats Preparedness (LRN-C)

The LRN-C was established in 1999, and comprised CDC and four public health laboratories (New York State Department of Health-Wadsworth Center; California State Public Health Laboratory; Virginia Division of Consolidated Laboratory Services and Michigan Public Health Laboratory). In 2000, New Mexico Department of Health, Scientific Laboratory Division joined the network. These laboratories use methods that are based on mass spectrometry and are quantitative, detecting the actual chemical agent, or more common, a metabolite of the agent, in urine or blood.

Today there are 55 LRN-C members (CDC and 54 public health laboratories). All labs are qualified to package and ship clinical samples. Forty-seven laboratories have the capability to test for exposure to six different threat agents. Ten laboratories have expanded capability to test for exposure to an additional six threat agents, and have expanded capacity to provide 24/7 analytical analyses in the case of a large scale event. (Figure 2).

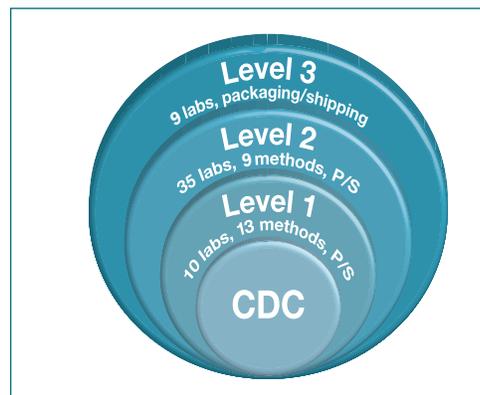


Figure 2: LRN Structure for Chemical Threats Preparedness

Level 3 Laboratories

Although every network member participates in Level 3 activities, only seven laboratories are designated as Level 3 laboratories. These seven laboratories work with hospitals and other first responders within their jurisdiction to maintain competency in clinical specimen collection, storage and shipment.

Level 2 Laboratories

Thirty-seven laboratories are designated as Level 2 laboratories within the LRN. These laboratories can detect exposure to a limited number of toxic chemicals—such as cyanide or toxic metals—in human specimens, such as blood or urine.

Level 1 Laboratories

Ten laboratories in the nation are Level 1 laboratories. These laboratories can detect an expanded number of chemical agents in human specimens, including all Level 2 laboratory analyses plus analysis for mustard agents, nerve agents and other toxicants that could be used in chemical warfare. These laboratories are intended to provide the CDC with much needed surge capacity during a large scale event.

APPENDIX C: HIGH-PRIORITY CHEMICALS FOR CHEMICAL THREAT ASSESSMENT

Chemicals as a group:

- Acids (single or mixed)
- Bases
- Metals
- Inorganic ions/anions
- Semivolatile Organic Compounds (SOCs)
- Volatile Organic Compounds (VOCs)
- Explosives
- Radiochemicals (Alpha, beta and gamma radiation)
- Gases

Chemicals by elements/compounds/types:

Chemical warfare agents

- Tabun
- Sarin
- Soman
- Vesicant agents
- Sulfur mustard
- Nitrogen mustard
- Lewisite

Radiochemical agents

- Polonium-210
- Cesium
- Radon
- Uranium
- Other radiochemicals

Chemicals by elements/compounds/types:

Metals

- Arsenic
- Lead
- Thallium
- Cadmium
- Mercury
- Chromium
- Other metals

Inorganic Anions

- Cyanide
- Sulfide
- Chloropicrin
- Pyridine

Insecticides

- Organo-phosphates
- Carbamates

Explosives

- Diazonium salts
- Nitro compounds
- Perchlorates
- Peroxides/RDX

Gases

- Ammonia
- Chlorine
- Carbon monoxide
- Cyanogen chloride
- Diazomethane
- Fluorine
- Hydrogen cyanide
- Hydrogen sulfide
- Methane
- Ozone
- Phosphine
- Phosgene
- Radon

Web Resources

- [High Toxicity Chemicals](#)
- [CDC ToxFAQs](#)

APPENDIX D: BIOLOGICAL AND CHEMICAL RESPONSE LABORATORIES ENVIRONMENTAL SAMPLE SUBMISSION FORM

STATE NAME
LABORATORY NAME
LABORATORY ADDRESS
TELEPHONE NUMBER

Biological & Chemical Response Laboratories Environmental Sample Submission Form

Do not write in this box; Laboratory Use Only

Laboratory Case ID: _____

Received By: Print Name _____

Signature: _____

Date Received: ____/____/____ Time Received: _____ am pm

High Risk Low Risk

1	Case ID #: _____	Incident Report Attached? ___Yes _No	<input type="checkbox"/> Evidence	<input type="checkbox"/> Public Health Sampling
Sample Description: _____				
Date Collected: / /		Time Collected: am pm		Method of Sample Collection: _____
2	SUBMITTING AGENCY: (Law Enforcement or Hazmat Team)			
Contact Name (Print): _____			Telephone: _____	
Organization: _____			Fax: _____	
Address: _____			E-mail: _____	
3	SAMPLE COLLECTOR INFORMATION: <input type="checkbox"/> Same as submitter		4	INCIDENT LOCATION:
Collected by (Print Name): _____			Location Name: _____	
Collected by (Title): _____			Collection Site: _____	
Badge Number: _____			Facility Address: _____	
Organization: _____			Telephone: _____	
5	<i>Do Not Write In This Box; Laboratory Use Only</i>			
Copy to: <input type="checkbox"/> Federal Bureau of Investigation		Copy to: <input type="checkbox"/>		
Copy to: <input type="checkbox"/> US Postal Inspector		Copy to: <input type="checkbox"/>		

SPECIMEN SCREENING INFORMATION

SPECIMEN WAS SCREENED FOR: (note: Fields marked with a * MUST be completed prior to laboratory submission)

RADIATION* Equipment used: _____

Is Radiation Present Above Background Levels? Background Reading: _____

YES NO Sample Reading (units): _____

Technician's Name: _____ Organization: _____

EXPLOSIVES* Equipment Used: _____

Is there an explosives or incendiary device risk? Results: _____

YES NO Technician's Name: _____ Organization: _____

CHEMICAL SCREENING

VOCs* Equipment used: _____

Results: _____

Narcotics Equipment Used: _____

Results: _____

pH Equipment used: _____

Field Data Attached Results: _____

YES NO Technician's Name: _____ Organization: _____

Other: Equipment used: _____

Field Data Attached Results: _____

YES NO Technician's Name: _____ Organization: _____

Use this space to communicate the types of submissions your laboratory does not receive (e.g. radiological and explosive substances)
Use this space to communicate special notes (e.g. unopened packages must be cleared from explosive threats by x-ray)

Use this space to communicate the contact information submitters should consult should they have questions regarding the submission process.

If you are submitting multiple samples for analysis, this page must accompany each sample the laboratory receives

SPECIMEN SCREENING INFORMATION

SPECIMEN WAS SCREENED FOR: (note: Fields marked with a * MUST be completed prior to laboratory submission)

Other:	Equipment used: _____
Field Data Attached	Results: _____
<input type="checkbox"/> YES <input type="checkbox"/> NO	_____
Technician's Name:	Organization:

Other:	Equipment used: _____
Field Data Attached	Results: _____
<input type="checkbox"/> YES <input type="checkbox"/> NO	_____
Technician's Name:	Organization:

Other:	Equipment used: _____
Field Data Attached	Results: _____
<input type="checkbox"/> YES <input type="checkbox"/> NO	_____
Technician's Name	Organization:

Other:	Equipment used: _____
Field Data Attached	Results: _____
<input type="checkbox"/> YES <input type="checkbox"/> NO	_____
Technician's Name	Organization:

Use this space to communicate the types of submissions your laboratory does not receive (e.g. radiological and explosive substances)
Use this space to communicate special notes (e.g. unopened packages must be cleared from explosive threats by x-ray)
Use this space to communicate the contact information submitters should consult should they have questions regarding the submission process.

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- APHL Environmental Health Committee

Association of Public Health Laboratories

The Association of Public Health Laboratories (APHL) works to strengthen laboratory systems serving the public's health in the US and globally. APHL's member laboratories protect the public's health by monitoring and detecting infectious and foodborne diseases, environmental contaminants, terrorist agents, genetic disorders in newborns and other diverse health threats.

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