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The mobile laboratory: a risk management tool

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To counter chemical, biological, radiological and nuclear threats (CBRN), expert assessment capability has been enhanced through the creation of one network of expert advisors and another of the Biotox-Piratox laboratories. Specific methods for risk analysis, protection and decontamination were developed and implemented in the various agencies charged with this intervention.
Among these methods, the mobile analytical laboratory plays an essential role in CBR risk assessment.
Following is a description of its objectives and how they are met, in accordance with Circular No.750/SGDSN/PSE/PPS of 18 February 2011, on the discovery of letters, parcels, containers and substances suspected of containing hazardous CBR agents.

The rationale for mobile laboratories is based on two fundamental requirements:

- the need for rapid notification about the nature of suspicious substances to the authorities, to enable them to order an appropriate response for the protection and care of the population, and eliminate the threat;
- the necessity of providing the network laboratories selected to perform confirmatory testing with properly prepared and packaged samples, along with all the information required for processing them.

Successful management of radiological, biological or chemical events depends primarily on gathering relevant information for an initial risk assessment and on the measures taken by first responders. This involves the correct selection and rapid implementation of analytical equipment by qualified scientific personnel.

To address this requirement, the mobile laboratory has detection and analysis equipment capable of identifying hazardous solids, liquids and gases. The experience and qualifications of its staff enable them to assess risk based on contextual factors and analytical data obtained on site.

Consideration of contextual factors is critical to risk assessment in order to avoid disproportionate responses that hinder effective management of the event (such as those that were adopted during the anthrax scare in the Paris area in 2003 for example). For this reason they are carefully reviewed by scientists staffing the mobile laboratory in close collaboration with the local law enforcement authorities in charge of the case and the *Cellule Nationale de Conseil* [National Advisory Committee] of the Centre Opérationnel de Gestion Interministérielle de *Crise de la Direction de la Sécurité Civile* [French Department of Civil Defence and Emergency Preparedness Interdepartmental Operations Centre for Crisis Management (COGIC)].

If feasible for a given context, as a critical first step **explosives** sensing is performed by a bomb disposal squad, to safeguard operators against the danger of a potentially misidentified risk. Mobile laboratory operators use suitable protection that ensures their own safety and restricts the dispersal of potential contaminants. Practice exercises while wearing equipment that can particularly heavy are conducted under the supervision of specialists such as fire fighters.

Radiation sensing is systematically performed by mobile laboratory personnel, who are aware of its control limits and draw any significant conclusions along with the appropriate reservations. It may not immediately determine the nature of the radioactive element or nuclide that may be present, but excludes irradiation and contamination risks. The laboratory has equipment designed to detect and take dose rate measurements of all types of radiation in the environment, allowing it to define a safety perimeter, most often with the assistance of fire fighters.

In the Paris Region, for example, most suspicious activity is generally found to be related to the use of **chemical** products. Their chemical nature must be determined in order to characterise their associated risk. Therefore, the mobile laboratory has equipment dedicated to the detection, and in most cases, the identification of these substances.

In addition to detection devices for revealing the presence of gaseous or volatile substances and identifying areas with the highest concentrations, special analysers are used.

For organic agents (and some minerals), this includes mass spectrometry for gaseous or volatile agents, infrared spectrometry for solids, liquids and gas, and Raman spectroscopy. Screening for toxic mineral substances is also carried out where applicable, using less sophisticated methods (colour comparison tubes, electrochemical cells, for example), since the most efficient laboratory equipment for agents of this type has not yet been scaled down to provide reliable and robust portable or transportable systems (Figure 1).

Identification of chemical agents poses several difficulties. With respect to gases, the concentrations may be too low on site at the time of the investigation to make an immediate identification. The same applies in the event of water contamination in fast-flowing rivers or pipelines. Regarding solids and liquids, interference due to the presence of complex matrices, such as plant debris or mixed materials, for example, complicates analytical interpretation. For this reason, operators must be thoroughly familiar with the physical principles involved in the functioning of the sensors and analysers, so as to take into account their limitations and the problems associated with each technique (interference, false negatives or positives,

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excessively high sensitivity thresholds). Interpretation of these data can only be carried out by scientifically qualified staff specialising in physical chemistry. Detectors and analysers perform complementary functions that must be understood, for example, some are more sensitive or more dedicated than others (Figure 2).

Whenever identification is possible, the data is reported to the authorities. In more difficult cases, it is usually still possible to provide some information about what is or is not included in the profile of each substance, or about its chemical group.
When examination of the context leads to the suspicion that a **biological** agent is present, it is dealt with through a special procedure. Accordingly, certain suspect items, such as tightly sealed and labelled bottles, may not be analysed on site since the contamination risk upon opening them is considered to be too great. If immediate analysis is expedient, tools designed to detect certain pathogens are implemented – typically real-time PCR and detector tickets – but the number of agents that can be detected on site is quite limited. In all cases, operators package the samples so they can be forwarded as quickly as possible to one or more of the specialised laboratories designated by the National Advisory Committee. The role of the latter in the process of selecting a Biotox-Piratox network laboratory and a forensic laboratory is described in the above-mentioned Circular.
Sampling is done according to defined protocols that comply as closely as possible with analytical and transport-related safety requirements.
Sample packages are checked to ensure that there is no residual or potential contamination of the external environment because of faulty sealing.
The samples transmittal slips proposed in the Circular are completed so that the receiving laboratories have all the relevant information about the accompanying hazards, and are familiarised with the context and the results of analyses performed on site.

For a mobile analytical laboratory to ensure public safety, it must be able to perform all of the functions described above, at minimum. It has a key role as the first link in the risk-management chain. In the Paris Region, the ***Laboratoire Central de la Préfecture de Police***, equipped with its 'chemical emergency' mobile laboratory, is able to fulfil these missions round the clock.

Figure 1. Mass spectrometry for gas analysis

Figure 2. Preparing a powder analysis using infared spectrometry

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Standards activities to support a biothreat mission capability in the United States

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Since the letters laced with *Bacillus anthracis* spores were mailed in 2001, U.S. law enforcement entities have responded to over 30,000 incidents involving suspicious samples [1]. Emergency responders still receive calls on a daily basis throughout the U.S. involving suspicious powder materials. In many instances, responders perform field assessment of these samples. Stakeholders from across the U.S. recognize that to support responders in their mission to collect and assess suspicious materials and take appropriate public safety actions based on the result requires voluntary consensus standards for (1) a concept of operations; (2) training and certification of the responder; (3) proficiency testing of the responder; (4) sample collection; and (5) a certified detection technology [2]. The purpose of this article is to summarize the standards developed to date that support three of these critical areas in response to a suspicious powder or package: a concept of operations, sample collection, and the certified detection technology.

Development of Voluntary Consensus Standards

In the U.S., Federal agency participation in the development of voluntary consensus standards is facilitated by the National Technology Transfer and Advancement Act of 1995 [3] and Office of Management and Budget Circular A-119 [4]. The intent of the law is at least two-fold: (1) to ensure that standards are developed to meet the needs of all relevant stakeholders; and (2) to guide the Federal government to preferentially develop standards using a voluntary consensus standards body (VCSB). Standards development by a VCSB follows an open, documented, consensus-based process allowing full participation by all stakeholders impacted by the standard. For biothreat response and the standards described in this document, the stakeholders include representatives from Federal, state, and local governments, the first response and public health communities, academia, and industry. Including these stakeholders and following the due process of the VCSB yields standards that provide economic and security benefit to the many rather than the few. In addition, the VCSB ensures longevity to the standards by continually reviewing and renewing the documents it develops and publishes.

Concept of Operations (ConOps) Standard

A coordinated and synchronous response to a suspected act of bio-terrorism requires advanced planning and preparation prior to the incident. The coordination and communication necessary at all levels of government in the US is laid out in the National Response Framework and further defined in the National Incident Management System (NIMS). In order to support a coordinated field response to suspicious samples, the stakeholder community developed ASTM E2770-10 *Operational Guidelines for Initial Response to a Suspected Biothreat Agent* [5]. Development was led by the *National Institute of Standards and Technology* (NIST) with extensive involvement of first responders and public health communities from across the U.S., as well as state and Federal agencies. ASTM E2770-10 focuses on coordinating the initial response to suspected biothreats with the first responders, receiving public health laboratories, and law enforcement. The ConOps recommended by these stakeholders covers: (1) response planning, training, and protocol development; (2) coordinating the approach and deciding when to collect a sample; (3) sample collection method and packaging; and (4) transporting, and submission of a sample to a reference laboratory in the CDC Laboratory Response Network (LRN)(1) for confirmatory testing.

Sample Collection Standards

ASTM E2458-10 *Standard Practices for Bulk Sample Collection and Swab Sample Collection of Visible Powders Suspected of Being Biothreat Agents from Nonporous Samples* [6] outlines best practices for emergency responders for the collection and transport of suspicious powders to the CDC Laboratory Response Network for confirmatory and forensic evaluation led by the FBI (Method A). The standard provides guidance for sample conservation during field screening for explosive, radiological, and acute chemical hazards. ASTM E2458-10 ensures preservation of the integrity of the material in the event that it becomes evidence, while recognizing that the main focus of the standard is on public safety response. ASTM E2458-10 should be used in conjunction with ASTM E2770-10 which provides guidance on determining when to collect a sample and how to coordinate with FBI and CDC. ASTM E2458-10 also provides guidance on sampling of residual powder (Method B) for first responders to utilize in any on-site biological assessment capabilities they have on hand. Use of the sample collection standard along with the guide ensures reduced exposure risk, minimizes on-site sample consumption for preservation of public health samples and forensic samples, and reduces variability associated with sample handling and

(1) The CDC Laboratory Response Network is the public health laboratory network responsible for handling clinical specimens and environmental samples containing suspected biothreat agents.