

# Science and technology advances in microbial forensics needed to better prepare

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Much as human DNA can be used as evidence in criminal trials, genetic information about microorganisms can be analyzed to identify pathogens or other biological agents in the event of a suspicious disease outbreak. The tools and methods used to investigate such outbreaks belong to an emerging discipline known as microbial forensics, but the field faces substantial scientific and technical challenges, says a new report from the National Research Council. The report offers an initial set of research priorities for advancing the capabilities needed to make microbial forensics a more effective tool for identifying and attributing the sources of biotreats. Many of these challenges are shared by other disciplines, such as medicine and public health, so bridging the gaps in microbial forensics could also strengthen capabilities and knowledge in these other areas, the report adds.

Biological outbreaks can include natural occurrences, accidental or negligent releases from laboratories, biocrimes aimed at individuals or small groups, or acts of bioterrorism and biowarfare intended to affect large populations. In all scenarios, the primary goal of microbial forensics and the public health system is to protect the [health](#) and safety of the public, which requires that the microorganism be identified quickly and its source located to stop further cases of exposure. However, the methods and processes involved in microbial forensics investigations must also meet legal standards for evidence for use in [law enforcement](#) or for policy decisions when outbreaks cross national boundaries.

Events that require application of the full range of microbial forensics techniques, such as an act of bioterrorism, are likely to be rare. Natural and accidental infectious disease outbreaks occur more frequently, and most will first be recognized through the [public health infrastructure](#). By creating, testing, and validating methods that are compatible with both rare and common occurrences, detection and response will not be delayed by lack of availability of and familiarity with tools and systems when a rare event does happen, the report says.

The committee that wrote the report identified needs in basic science, technologies, analytic methods, data sharing, and training and education, and grouped them in terms of how difficult it will be to achieve them and whether there are existing efforts that can be drawn upon.

One set of needs includes those that are especially technologically challenging or that require long lead times. For example, there is a dearth of even the most basic information about many microorganisms and a crucial need for high-confidence methods to distinguish among natural, accidental, and deliberate disease outbreaks. A needed international effort to identify, monitor, and characterize more [microbial species](#) should start with known pathogens and expand to include close relatives and emerging pathogens, and more systematic and comprehensive reference collections and databases should be established. International political and scientific communities should explore how to share microbial [forensic](#) data.

A second set of needs includes those that could take advantage of ongoing efforts, especially those that are common to both microbial forensics and [public health](#). Among these, priorities are research on pathogenicity and immune responses; improved global disease monitoring and surveillance in humans, plants, and animals; improved global access to molecular diagnostic techniques; and refinement of bioinformatics and statistical methods for evaluating evidence.

The third set of needs encompasses those with either relatively short lead times to make substantial progress or that can take advantage of existing markets that will provide incentives for industry to produce what is required. The development of faster, cheaper, and more reliable sequencing technologies, a compilation of all protocols being used and whether and how they have been validated, and the expansion of technical training fall into this category.

Additional challenges arise when a microbial forensics investigation crosses international boundaries. Currently, there is no international agreement or standard that governs what would be shared in a given set of circumstances. The need for access to scientific resources will have to be weighed against security and law enforcement concerns, and an international framework is required to both encourage and reward data sharing, the report says.

Provided by National Academy of Sciences

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