Jairam Lingappa and Mary Lou Lindegren

What is an Acute Public Health Investigation (APHI)?

An Acute Public Health Investigation (APHI) is a timely assessment of adverse health events followed by rapid application of prevention and control measures. APHIs use epidemiological and laboratory methods, and have long been recognized as the responsibility of the nation's public health system. State and local health departments, as well as the health ministries of other nations, often invite CDC to assist in field investigations to determine the cause and extent of a particular acute public health problem. These investigations typically evaluate demographic, behavioral and exposure-related risk factors. APHIs accomplished through federal, state and local public health partnerships have earned the public health system both national and global recognition.

Incorporating Human Genomics into APHIs

The translation of genomic information for public health research and practice presents a unique opportunity for enhancing APHIs. As our knowledge of the role of human genomics in human susceptibility and disease causation increases, so does its potential to sharpen our response to acute public health events. Health investigations where human genomics may be important include:

- disease clusters (e.g., infectious disease outbreaks, cancer or birth defect clusters),
- exposure clusters (e.g., environmental, occupational and bioterrorism), and
- adverse reactions to therapeutics (e.g., vaccines, antibiotic prophylaxis and blood products).

The decision to collect human genomic information during an Acute Public Health Investigation must be informed both by scientific potential and by available resources. Investigations that could incorporate human genomics need to be evaluated using scientific criteria (e.g., what is known about human genomic factors and the disease, etc.) Resources also must be evaluated, as there may be challenges involved in sample collection, specimen and data banking, genomic testing, and possible delays (due to protocol review or increased demands on participants and investigators).

Incorporating human genomics into APHIs has great potential to benefit public health, including opportunities to learn more about diseases that occur largely in epidemic settings (e.g., cholera, SARS), or as a result of mass exposure to rare threats (e.g., toxic releases, anthrax), or where interventions could be more effectively targeted or genomic tools more efficiently utilized. In addition, as detailed exposure data is often collected during an APHI, the incorporation of human genomics would allow for the assessment of gene-environment interactions. Finally, banked specimens from AHPIs may provide a key resource for addressing long term research questions about human genomic factors in relation to disease causation and prevention interventions.

Research approaches that could lead to enhanced prevention, detection and control of future adverse health events include the assessment of:

- genomic profiles (e.g., relation to susceptibility, resistance, severity, prognosis, interactions with other risk factors and response to therapeutics),
- exposure profiles (e.g., the use of mRNA transcripts to estimate exposure levels or characterize exposure), and
- outcome variation (e.g., the use of protein expression to characterize outcomes).

This information may aid in identifying causes of adverse health events and directing public health and clinical interventions, such as vaccination, exposure reduction, behavioral intervention, and therapeutics.

APHI Working Group

CDC has formed a multidisciplinary APHI Working Group in collaboration with the Council of State and Territorial Epidemiologists (CSTE) to develop a plan and tools for incorporating genomics into APHIs. The Working Group will engage state public health departments and other partners to address several core areas:

- science – selection of genes and gene pathways for study;
- technology – collection, storage, processing and banking of biologic specimens, technologies for human genomic testing, database issues and **bioinformatics**;
- epidemiology and statistics – study design, implementation, and analysis;
- ethical, legal, and social implications (ELSI) – informed consent, Institutional Review Board (IRB) issues, confidentiality, and security.

Bioinformatics
The science of managing and analyzing biological data using advanced computing techniques; especially important in analyzing genomic research data.

The Working Group is planning a workshop in 2004, and is inviting external consultants who will provide additional expertise and guidance for developing a research agenda for including human genomics in APHIs. Workshop participants will offer input on priority research areas such as:

- assessing criteria for prioritizing investigations that should incorporate human genomics,
- identifying information gaps and needs,
- developing standard tools and protocols for the field and laboratory work as well as the informed consent process,
- making tools available to epidemiologists and public health officials involved in the acute public health investigation,
- creating educational materials for the public health workforce both within CDC and with the states involved in APHIs, and
- developing pilot studies and just-in-time protocols.

Conclusion

The genomics revolution can refine our ability to conduct effective investigations of acute public health events. Enhancing our understanding of disease pathogenesis and susceptibility improves future public health prevention and control efforts.