Public Health Informatics

A January 2006 Davos World Economic Forum report cites the woeful state of the world's public health infrastructure as the greatest obstacle to progress on global health goals. Health information systems remain inadequate, making it impossible to monitor and improve the delivery of interventions in a timely and effective way. Fortunately, eHealth tools offer novel ways to improve public health by gathering data from disparate sources and rapidly transporting that data to health workers on the ground.

Public health includes responding to the health needs of individuals as well as populations. Prevention is a primary focus. The Internet, computer resources and mobile devices such as cell phones and personal digital assistants (PDAs) are increasingly available in the developing world. Public health professionals are adapting these technologies to the health care setting. The avenues of technology and public health meet at the intersection of public health informatics (PHI). PHI is the systematic application of information and computer science and technology to public health practice, research and learning. PHI strategies are increasingly used to obtain a complete picture of a population's health and risk status and to support effective public health data flow and decision making in both urban and remote locales.

To address these issues, the University of Washington's Center for Public Health Informatics (CPHI) and the World Health Organization's Health Metrics Network convened *Public Health Informatics,* part of the Rockefeller Foundation's *Making the eHealth Connection: Global Partnerships, Local Solutions* Bellagio Center conference series. Participants focused on methods of accelerating progress in the public health informatics field and widening the discipline's relevance in low-resource and developing-world settings.

Public Health Informatics: Key Issues

Internet cafes, computer centers, and mobile devices from cell phones to handheld PDAs are tools in regular use among many health workers and policymakers. The challenge for public health informaticians is how to enhance the delivery of high-quality, contextually relevant content, focused on a broad range of data (such as disease incidence, immunization rates, morbidity, mortality statistics, practice guidelines, research findings, protocols, maps and images) so this content can be used on the ground at the local, district and national levels.

There is great potential for public health informatics innovations to improve health, particularly in these areas:

▶ Communication among geographically dispersed health workers and consumers

▶ Delivery of public-health services by strengthening and streamlining data collection

▶ Support of primary and secondary prevention via electronic health records and improved laboratory systems

▶ Data collection for research studies, such as drug and vaccine trials

▶ Environmental health interventions, such as biosurveillance, road safety and geographic mapping systems applications

However, public health informatics impediments remain, including the following:

▶ A lack of integrated, interoperable health information systems to support decision making at all levels

▶ System fragmentation at the donor, NGO, ministries of health, clinics and hospital levels

▶ Capacity shortfalls in technical support and technology availability for day-to-day health information systems tasks

▶ Data stewardship challenges, including the need to provide incentives for people to collaborate on collecting and sharing accurate and useful data

▶ The one-way flow of information that is sent upward, but not back to health workers on the ground

▶ Too many vertical disease silos across health sectors

▶ Short donor-funding horizons and investments that are not long-term, coherent or consistent

▶ Inconsistencies between "industrial" IT solutions and on-the-ground realities

▶ A need for national ownership

Public Health and Developing Nations: The Potential of eHealth

The rapid expansion of eHealth interventions in developing countries offers the public-health sector many improvements and efficiencies. eHealth projects, focusing both on medical and public health practice, have introduced new methods of expanding connectivity; brought breakthrough technology tools and devices; facilitated provider education and consultation; and built applications designed to meet the needs of specific disease or practice data collection and analysis. Two examples of public health informatics breakthroughs are in the areas of lab and pharmaceutical data.
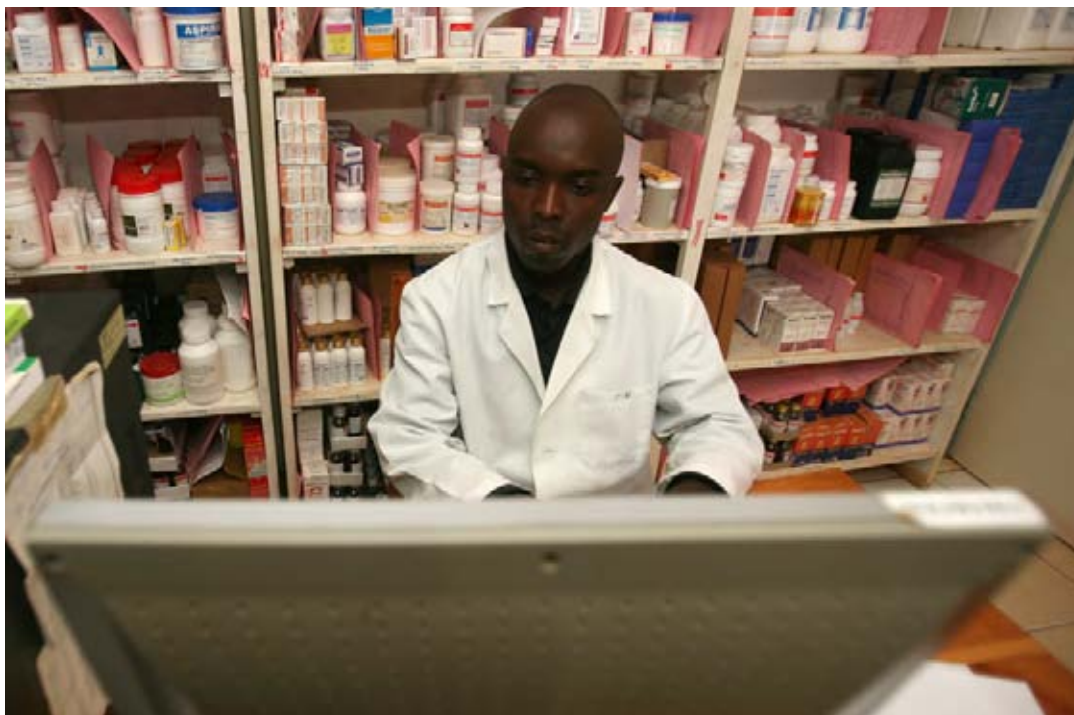
Laboratory Information Management Systems (LIMS)

A well-designed health management information system, constituting reliable, accurate and timely availability of data, is widely recognized as a cornerstone of a good public health system. A laboratory information management system, developed as part of a national health management information system (HMIS) in a public health setting, can support a variety of programs and functions, including epidemiology surveillance and monitoring; outcomes assessment; administrative activities (e.g., billing and utilization); program planning and evaluation; quality assurance; policy analysis; research; and information dissemination.[1]

Increasingly, many nations are adopting integrated disease surveillance and reporting processes to improve public health outcomes. Through computerized data entry and the access and retrieval of reliable laboratory data, LIMS addresses important issues inherent in the laboratory, including sample tracking; quality-assurance activities; automated interfaces for laboratory equipment; the acquisition of specimens; the creation of work lists and test scheduling; the generation of aggregate reports; and the automated delivery of patient reports.

The implementation of laboratory-information systems in developed countries first occurred in the clinical-laboratory environment. Public health laboratories either developed their own non-standard systems using in-house IT staff, or purchased proprietary products that were oriented toward the clinical laboratory and then customized for public health needs. Both approaches had advantages and disadvantages, but increasingly, the need for information systems in public health laboratories has resulted in the availability of more proprietary products. Currently, the situation for international laboratories in resource-limited settings is similar. Laboratories are faced with developing their own systems using tools such as Microsoft Access databases or Epi-Info—but often without attention to standards for vocabulary and messaging.

Some laboratories are working with vendors whose primary product is focused on the clinical laboratory and modified to address public health laboratory needs. An open-source product used by six Association of Public Health Laboratories (APHL) member state labs is also under consideration in Vietnam and Kenya and may provide alternatives to in-house development or vendor-supported software using open-source approaches. Developing a reliable LIMS is certainly a complex undertaking. When implemented utilizing best informatics practices, however, the system can yield valuable and timely results for public health action.

The Health Metrics Network (HMN)[2] has been established to help countries develop the capacity and expertise for collection and analysis of health information. HMN, along with its partners, has developed objectives that will have an impact on the implementation of LIMS in resource-limited countries. Those objectives include the following:

▸ Creating a harmonized framework for country HIS development (the HMN Framework) that describes standards for health information systems
▸ Strengthening country HIS by providing technical and catalytic financial support to apply the HMN framework

Catherine Omaswa,
Chairperson, National
eHealth Committee, Uganda

"ICT is important for disease surveillance. We [in Uganda] are one of those who had ebola. It was good that mobile phones had already spread throughout the country …within a short amount of time, it was possible to reach the Minister of Health, get a team together and get action."

▸ Ensuring access to and the use of information by local, regional and global constituencies

The work of HMN and its partners will bring uniformity and a common framework that sets standards for health information systems and laboratory information systems and will be an important component of a country's collective data systems.

Pharmaceutical Systems and Informatics

Without efforts to ensure that public health decision makers have accurate and timely pharmaceutical management information, there is a risk that significant resources could be wasted, poor-quality products could cause harm, and suboptimal use of medicines could adversely affect patient outcomes. Pharmaceutical systems informatics or efforts to understand and promote the effective organization, analysis, management and use of information in the pharmaceutical sector is providing important new avenues of innovation to address these challenges. Pharmaceutical systems informatics sits at the intersection of data, science, and technology and includes the basic functions of the pharmaceutical management framework, such as selection, procurement, distribution and use.

Medicines are an essential component of health care systems in developing countries, accounting for one-third or more of a government's health services budget. It is common for 20 to 50 percent of the recurrent government health budget in developing countries to be used to procure drugs.[3] The potential for medicines, including both drugs and vaccines, to improve the health of those in developing countries is widely acknowledged. For example, medicines are among the most important health interventions, their prominence illustrated by their rating by the Disease Control Priorities Project—an ongoing effort to produce evidence-based analysis and resource materials to inform health policymaking in developing countries—as some of the "best buys" in health. Medicines are used to vaccinate children; to prevent and treat childhood pneumonia, diarrhea and malaria; to attack the spread of HIV; and to treat tuberculosis patients.[4]

With the proclamation of the United Nations Millennium Development goals and the implementation of multinational programs such as the Global Fund to Fight AIDS, Tuberculosis and Malaria, both public and private donors to developing countries are making a new, concerted effort to improve access to medicines.

Like other parts of the world, developing countries need essential, quality-assured medications to be available continuously and distributed in a timely manner to those who require them. Stakeholders at every level need information to make decisions that affect the overall functioning of medication systems. For example, a good pharmaceutical management information system should alert staff to problems and trigger critical actions on multiple levels—whether the problem is related to the supply chain or to patients' use of prescription drugs. Medication systems informatics could greatly benefit the following areas:

▶ Prescribing. Clinical decision support to facilitate evidence-based, rational and cost-effective prescribing

▶ Dispensing. Interpretation, translation and verification of medication orders, including informatics and technology in dispensing

▶ Pharmaceutical care. Chronic disease monitoring, assuring that patients adhere to their medications and that medication is persistent[5]

▶ Administration. Information flow and decision support with electronic medication administration and documentation

▶ Patient monitoring. Pharmacoepidemiology, pharmacovigilance and pharmacoeconomics to enhance patient outcomes performed on a complete medication continuum

▶ Education. Promoting professional and patient education suited to cultural norms

▶ Supply-chain management. Beginning with procurement and proceeding to inventory control, order management and point-of-service delivery

▶ Monitoring and evaluation. Careful tracking of program performance

Overall, medication systems informatics enables more routine, systematic data collection and analysis, increased prevention of adverse reactions to medicines and support for scaling up treatment programs, which is particularly critical in resource-challenged regions with high disease burdens and co-morbidity.

Revolutionizing Public Health Informatics: Ingredients for Success

Public health informatics (PHI) is a rapidly emerging field with many successes, but additional initiative is required to expand the PHI community and its initiatives, particularly in the developing world. *Public Health Informatics* conference participants recommended the following critical steps to achieve success in these efforts:

1. COLLECTIVE VISION ⇨ Create a shared sense of priorities for information and communication

technology (ICT) contributions. Adopt a broad ecological approach to health, using a systems view and framing the case for an integrated national public health information capability or for national health enterprise system architecture. To create a collective vision, local access to information tools and data is vital. This approach requires understanding eHealth in relationship to the needs of its primary users (health care workers) as well as of its secondary users (public health officers).

2. ARCHITECTURE⇨Define the preferred public health information system architecture by taking into account local, district/regional and national needs. Include necessary components, connections, players, stakeholders and human resources at each of these levels. This architecture will inform personal health care, population-based services, and health policy at all levels. It will also leverage the most efficient ways to collect, organize and share routine health information. Such architectures are needed to guide countries in strengthening their own health systems and to guide developers in providing effective tools to help countries achieve this aim.

3. ARTICULATE IMPERATIVES FOR GLOBAL COOPERATION⇨Identify the essential contributions that can and should be made by global partners in public health informatics organization.

4. REGIONAL HEALTH INFORMATICS CENTERS⇨Establish a Network of Regional Centers in Health Informatics based in leading health universities located in resource-constrained countries. Create a long-term funded program plan for training, research and development at these centers.
In the United States and other developed countries, these centers bring together researchers, developers, educators and health practitioners to work on challenging problems. Creating such centers at key health universities in resource-constrained countries would ensure that training and development are contextually and culturally appropriate and relevant to the needs and priorities of the nations in question. Centers like these would also provide a synergistic setting for faculty

(both from health schools and from computers science and information technology programs) to work collaboratively with ministries of health, public health agencies, nongovernmental organizations (NGOs), WHO programs, foundations and the private sector.

Models for such health centers exist now or are currently being developed. One is in Peru at Cayetano University, which has a long-standing relationship with the University of Washington's division of biomedical and health informatics training. A second is a newly created Center for Public Health Informatics at Mahidol University, in Bangkok, Thailand. To build necessary synergies and to test various approaches to center development, five to seven geographically dispersed regional centers should be the goal for initial planning and development.

Conclusion

Public health informatics tools are enabling practitioners, regardless of their location and resource level, to obtain a more complete picture of a population's health and risk status and gather information from disparate sources. Advancing public health informatics partnerships and centers of learning—and putting informed and complete technology tools in place— represents the next phase in the public-health revolution.

Notes

1   Becker SJ, Blank EC, Martin R, Skeels M. Public Health Laboratory Administration. In: Novick LF and Mays GP, eds. *Public Health Administration.* Gaithersburg, MD: Aspen Publishers; 2001: 623-645.

2   The Health Metric Network Framework 2nd Edition, January 2008. Available at: www.healthmetricsnetwork.org.

3   Falkenberg T, Tomson G. The World Bank and Pharmaceuticals. *Health Policy Plan.* 2000 Mar; 15(1):52 8.

4   Disease Control Priorities Project. Available at: www.dcp2.org.

5   Bisson GP et al. Pharmacy Refill Adherence Compared with CD4 Count Changes for Monitoring HIV-Infected Adults on Antiretroviral Therapy. *PLoS Medicine.* May 2008; Available at: http://medicine.plosjournals.org/perlserv/?request= get-document&doi=10.1371/journal.pmed.0050109.