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# Research Information Management System: BioRio

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During the past 50 years, an accelerated understanding of sickness and health at the molecular level has advanced healthcare by providing new and powerful diagnostics and data sources. These advancements in sources of medical data have put an increased burden on medical information management. There is often no infrastructure to deliver medical information and no methods to make the information accessible to researchers and clinicians. Data relevant to disease processes includes patient records, clinical information, laboratory information, image data, molecular data, population data, and environmental data. These data are often difficult to access and analyze because the data may be in different formats, different systems, different locations, and different administrative units.

The management of patient information as well as specimen and test information is a challenge in a Public Health Laboratory. In this project we are developing a system for the management and analysis of biomedical information in cooperation with the University of Texas Houston School of Public Health–Brownsville Branch (UTHSPH-B). The emphasis will be upon developing database systems and analysis methods for the analysis of Texas/Mexico border health issues such as diabetes and infectious diseases.

## PREVIOUS WORK

Disease surveillance systems and public health information systems have been a source of research and development interest. Some of the systems developed are indicated below:

The Public Health Surveillance Knowledgebase (PHSkb) is a computer database for storing the information on notifiable diseases. The database was developed using Protege ontology and knowledgebase editing software. Required data on the notifiable disease domain were collected and integrated with other information used to support the National Notifiable Diseases Surveillance System (NNDSS)(1) (2).

A public web tool is designed in Sweden for easy retrieval of county and national surveillance data on communicable diseases (SMI)(3). Wisconsin's Public Health Information Network (WI-PHIN) is a robust web portal integrating both Health Alert Network and National Electronic Disease Surveillance System components. WI-PHIN is the information technology platform for all public health surveillance programs (4)(5).

Biologists often feel overwhelmed by the huge amount of and the great diversity of distributed heterogeneous biological information. An information management application called GeneNotes allows biologists to collect and manage multimedia biological information about genes (6)(7). The Brain Resource International Database is the first entirely standardized and centralized database, which integrates information from neuroimaging measures (8)(9).

A web-based system to interactively display electronic patient records (EPR), such as DICOM images, graphics, and structure reports and therapy records is developed for intranet and internet collaborative medical applications(10)(11).

The Open Microscopy Environment (OME) defines a data model and a software implementation to serve as an informatics framework for imaging in biological microscopy experiments. The OME Data Model, expressed in Extensible Markup Language (XML) and is realized in a traditional database (12)(13). A client-server approach to three-dimensional (3-D) visualization of neuroimaging data, enables researchers to visualize, manipulate, and analyze large brain imaging datasets over the Internet (14)(15). A general structure for semantic image analysis that is suitable for content-based image retrieval in medical applications and architecture for its efficient implementation was developed for content-based image retrieval in medical applications (16).

## STANDARDS

Public health information systems must adhere to standards to facilitate sustainable, real-time delivery of important data and to make data available to the public health partners who verify, investigate, and respond to outbreaks. To ensure this crucial interoperability, all information systems supported by federal funding for state and local preparedness capacity are required to adhere to the Public Health Information Network (PHIN) standards. Standards-based system development is critical for three major reasons. First, the need for real-time information from multiple sources can best be accomplished by standards-based electronic messaging. The specification for standard Health Level 7 (HL7) (17) messages for data permits health departments to leverage health-care delivery information technology (IT). Second, the use of standards enables health departments to leverage previous investments in their IT infrastructures. Systems to support public health capacity for outbreak management, response, alerting, and information dissemination have been under development since Fiscal Year (FY) 1999 investments in the Health Alert Network and FY 2000 funding for the National Electronic Disease Surveillance System (NEDSS). Finally, a consistent standards-based approach limits the burden on partners in the clinical-care delivery sector. Health-care providers and hospitals provide information to public health agencies for early detection and routine surveillance as part of their community responsibility. By using standard formats and electronic reporting, public health agencies can minimize the burden involved in reporting diseases and use information that is already available in electronic format within the health-care delivery system.

The National Committee on Health and Vital Statistics has recognized standards as an integral part of the National Health Information Infrastructure. The critical role of standards has also been endorsed by the U.S. Department of Health and Human Services and the federal government through the Consolidated Health Informatics. To define how these broad standards can be implemented in surveillance systems that support the specific needs of public health practice**,** CDC and its state and local health department partners have identified key specifications and functions described as the Public Health Information Network (PHIN) (18).

Laboratory Information Management Systems (LIMS) are information management systems designed specifically for the analytical laboratory. A full-featured LIMS will manage the various lab data from sample log-in to reporting the results using a mainframe, multiple hardware interfaces, a relational database, together with support and training from the LIMS supplier (19)(20)(21). Some of the open source LIMS are: HalX (22), caLIMS (23), Bika LIMS (24), BioArray Software Environment [BASE], and BASE (25).

## PUBLIC HEALTH RESEARCH INFORMATION MANAGEMENT SYSTEM (PHRIMS)

The management of patient information as well as specimen and test information is the main challenge in a Public Health Laboratory. Many commercial systems address these issues and provide solutions. However, there is no software available (as known to the authors) that incorporates the Laboratory information with public health research. Public Health Research Information Management System (PHRIMS) deviate a little from Laboratory Information Management Systems (LIMS). The tasks involved in a PHRIMS include those tasks of LIMS as well as research study management tasks. The main focus of PHRIMS is the research and research outcome. Patient Information in PHRIMS is collected based on the research study at hand. This means that each study will have its own data from the patient and the primary investigator (PI) of this research study will manage the sharing of this data. There is also a need to import available information from other health institutes, for a research study. For instance, if the research study is on a disease, possible patient records (which may be Deidentified) may be imported to the system from a participating institute, such as TDH or CDC.

CDC Wide-ranging Online Data for Epidemiologic Research [CDC WONDER] is an easy-to-use, menu-driven system that makes the information resources of the Centers for Disease Control and Prevention (CDC) available to public health professionals and the public at large. It provides access to a wide array of public health information. CDC WONDER is valuable in public health research, decision making, priority setting, program evaluation, and resource allocation.

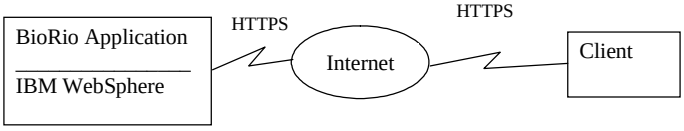
## BIORIO:

BioRio software system is designed according to the requirements of PHRIMS. This is designed to work on an application server middleware, namely IBM Web Sphere. A relational database is created using IBM DB2 software to store and retrieve laboratory information. The system is developed based on IEEE standards. Information transfer is made securely over the internet using the HTTPS (secure version of HTTP) the protocol of the World Wide Web. The main system architecture is given in Figure 1.

Bio-Rio software system is designed to have five subsystems:

1. User/Staff management : The functions performed are user registration, deactivation/activation, user account management.
2. Research study management: Functions related to data and specimen collection, regulatories, protocols, import/export rules are performed.
3. Specimen Lifecycle management: Used for specimen related functions like specimen tracking, specimen state management, signaling expired specimens.
4. Storage management: Used for creating and organizing the storage, check-in/check-out procedures.
5. Patient Information management: Helps in managing basic patient information and participation in research study.

*Figure 1.*

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