Personalized Health Care
at
Ohio State University Medical Center

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I. INTRODUCTION

The Ohio State University Medical Center (OSUMC) is in the midst of unprecedented growth, having recently approved massive expansion plans charting its future in providing health care over the next few decades. Our physicians and scientists are driven by the promise of personalized health care (PHC), and our patients are eager partners. With the palpable excitement over a continuing stream of new molecular and genetic discoveries, however, we, like other major institutions, face enormous challenges in making sense out of the incredible volume of information. As one of our researchers said recently, "there is a lot of data out there, but not a lot of meaning."

The tremendous explosion of knowledge about the mechanisms and manifestations of health and disease has underscored the gap in translation of new knowledge into meaningful change in treatment and disease prevention. Our clinicians – like those at other institutions – face a fragmented and sometimes inaccessible infrastructure of informatics and communications support and network capability in a complex regulatory environment that often confounds our best intentions. Nevertheless, our vision is clear: As a land-grant university, The Ohio State University has a mandate for openness, accessibility and service to people throughout central Ohio and beyond. At OSUMC we extend that mandate to include our patients – our customers – who have come to expect medical care that includes an electronic record of their doctors' visits, office and hospital care, laboratory services, and virtually every other contact they have had with our institution.

We feel a patient's record should include all the information that impacts their risk of disease, their response to disease and their response to treatment of disease. This includes not only biologic, genetic and phenotypic information, but also behavioral and environmental information. The day is fast approaching when all of this information will be part of a protected and confidential electronic patient health record, immediately accessible to the caretaker as well as the patient – one of the principle goals of personalized health care.

Ohio State University Medical Center's interest in PHC is longstanding. Recently, OSUMC became the first major public academic medical center to join the Personalized Medicine

Coalition – a Washington, D. C.-based independent, non-profit group that works to advance the understanding and adoption of personalized medicine. It was a new initiative on our part, but perhaps more accurately, was a renewal of our longstanding commitment to PHC: Decades ago, some of our family physicians were already in the field, charting the course of a mysterious disease that caused sudden cardiac arrest among young members of a large family whose ancestors had left Germany in the mid-1800s to make a new home in the American Midwest. Investigators plotted their lives and deaths, identified the family history and followed hundreds of family members through the years. Today, the students of that original research team are still working on the project, having identified not only the genetic mutation that signals high risk of sudden cardiac arrest, but now, through early detection, identifying vulnerable family members and fitting some with the latest defibrillators, saving lives.

Personalized health care works; it is the future of medicine. OSUMC is so convinced of this that it has become part of our vision, our mission and our goals.

Personalized health care is an explicit part of the formal vision statement of the OSU Medical Center, which was adopted in June, 2004 following input of hundreds of leaders across the Medical Center and community as the first part of our Strategic Plan:

Working as a team, we will shape the future of medicine by creating, disseminating and applying new knowledge, and by ***personalizing health care*** *to meet the needs of each individual.*

We talk about it every day:

Thanks to an educational and awareness campaign over the past two years, and the development of a brand identity tied to personalized health, virtually every person at OSU Medical Center understands what personalized health care means and how it is revolutionizing what we do for our patients, our students, our scientists – and ourselves.

We've worked hard to define it so our patients understand, too:

Personalized health care is the integrated practice of medicine and patient support based upon an individual's unique biology, behavior and environment.

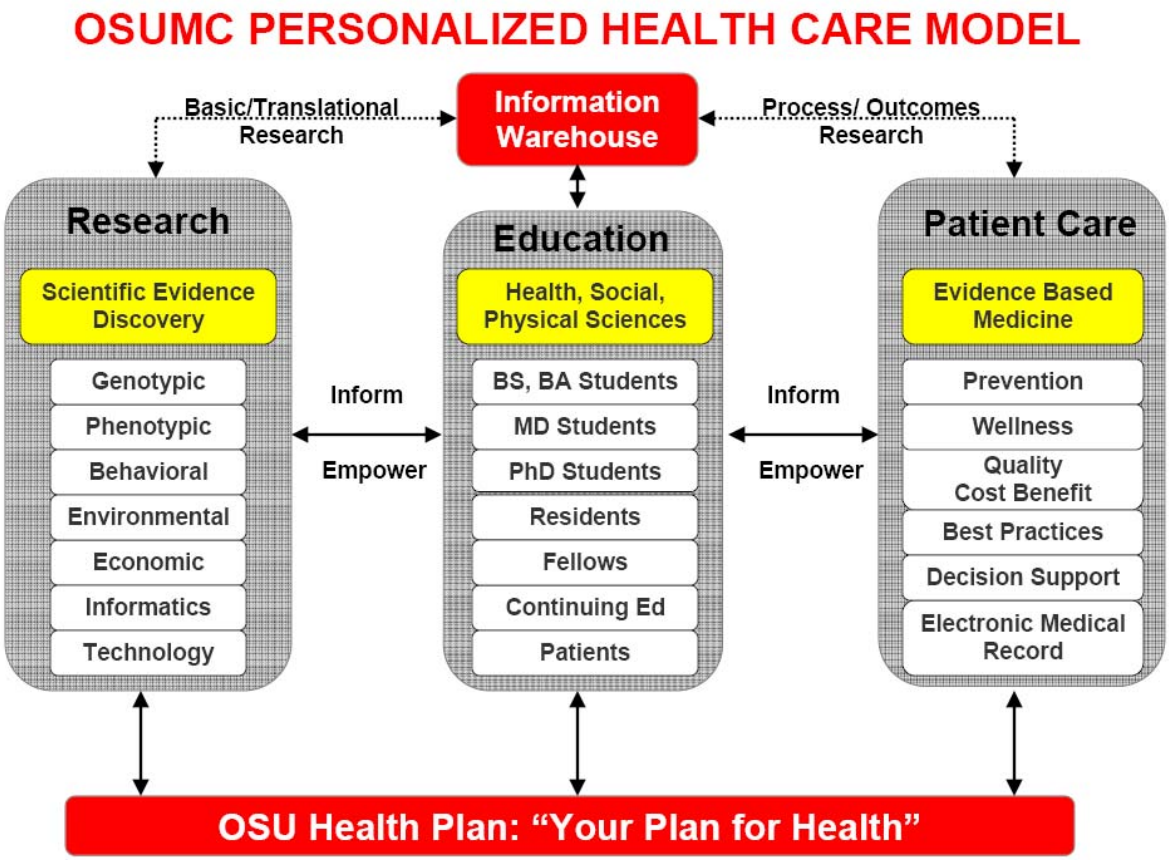
- It is a patient-centric, prospective, proactive and predictive system of health care
- It is individualized vs. population-based care
- It is individualized, evidence-based medicine
- It is the full and integrated application of information and communication technologies to health care

Personalized health care means different things to different people. To the patient, it means the delivery of appropriate care, at the right time, cost and place. To the clinician, it means doing what is necessary for each individual. To the physician-scientist, it means applying state-of-the-art diagnostic and therapeutic tools to understand the biological, genetic and environmental basis of disease.

II. PERSONALIZED HEALTH CARE AT OSUMC

The OSU Medical Center is so fully committed to developing and translating PHC principles to practice that we have made it a priority and the overall context for our research, education, and clinical missions. The goals of the OSUMC personalized health care model are threefold. In research they include expanding basic, translational and clinical research, creating test-beds, creating the IT infrastructure and developing new technology and applications. In education they include creating new degree granting programs, such as the health sciences undergraduate major and new educational offerings and modalities to students, health care providers and patients. And in health care delivery they include increasing efficiency and safety of patient care, identifying best practices and faster, predictive methods of decision support at point of need, reducing costs, improving outcomes and increasing consumer satisfaction. The activities and interactions among these three areas are shown in Figure 1.

Figure 1: OSUMC Personalized Health Care Model



In developing the OSUMC Strategic Plan over the past 3 years, six signature programs were identified out of more than 75 existing programs, and the emphasis for each (cancer, heart, critical care, neuroscience, imaging and transplantation) has been to bring PHC to reality. Three enabling programs, informatics, genetics, and behavioral medicine, were also identified to help make this happen. Investments in faculty, staff, and facilities have been prioritized for the research, education and clinical care activities in these programs and across the Medical Center to enhance our overall effort in PHC. In addition, the Center for Personalized Health Care (CPHC, see below) was created in 2005 to help facilitate and coordinate activities within and across programs and missions. A few of the PHC activities developed in each mission area are highlighted as follows:

Research: Major areas of research strength and growth over the past five years at OSUMC have all contributed towards the development of PHC. These include biomedical informatics, human genetics, behavioral medicine and the six signature programs. In 2001, OSU created a new tenure-initiating academic department of biomedical informatics in the College of Medicine, under the leadership of Dr. Joel Saltz, to promote basic and translational research and their associated education programs. The success of this enterprise is demonstrated by the recruitment of numerous faculty, students and staff, the development of numerous interdisciplinary programs, high impact publications, and substantial extramural funding. In human genetics, the expansion has been similarly dramatic. Scores of new faculty and students are conducting clinical and translational research under the direction of Dr. Carlo Croce, who brought his internationally recognized research in microRNA to Ohio State two years ago. Similarly, years of groundbreaking work in psychoneuroimmunology under the leadership of Drs. Ron and Jan Glaser has evolved into its own institute – the OSU Institute of Behavioral Medicine Research. Each of the six signature programs mentioned earlier has also exhibited dramatic growth in basic and translational research activities related to personalized health care.

Education: As shown in Figure 1, the range of educational programs at OSUMC is extensive and each has developed activities contributing to PHC. Some are novel, such as the Center for Knowledge Management and the new undergraduate Health Sciences major in the College of Medicine. Four years ago, OSUMC became one of the first in the country to create an undergraduate a major aligned with the principles of PHC. The Health Sciences major allows students to select a health and wellness track based upon PHC philosophy and incorporates content drawn from PHC-based research and clinical care. Designed to prepare health educators for work with individuals or groups, studies concentrate on early detection, prevention and ways to reduce the impact of disease on a patient's quality of life.

The health and wellness concentration meets the certification requirements of the National Commission for Health (NCHEC), and students graduating from this concentration area are able to sit for the Certified Health Education Specialist (CHES) exam. NCHEC defines a Health Education Specialists as "professionals who design, conduct, and evaluate activities that help improve the health of all people". Our first student enrolled in 2002. Today, there are almost 300 students majoring in health science at OSU.

OSUMC also was one of the first to provide education to medical and graduate students about PHC research and clinical care. Largely through the efforts of Dr. Wolfgang Sadee, director of

the OSU pharmacogenomics program, students have been exposed to the principles of personalized health care for the past five years. Sadee not only incorporates lectures and discussions about PHC in the classroom, but has also taken his expertise world-wide, having appeared as a panelist on some of the PMC's educational teleconferences on personalized health care. His knowledge of PHC – its practice, limitations, economic implications and social consequences – has been helpful in shaping our initiatives in this area.

Health Care: Patient care as well as research at OSUMC is strategically focused on our six signature programs reflecting the Medical Center's greatest strengths: cancer, heart, critical care, neuroscience, transplantation and imaging. There are personalized health care research and clinical applications in virtually every program and, in several cases, like cancer and imaging, investigators are combining efforts to create even further innovation. It is important to note that nearly a thousand clinical trials have been conducted within these programs to help identify best practices based on scientific evidence. Through the years, the application of new technology and best practices protocols for patient care have remained major priorities. The development of an electronic medical record and the Information Warehouse both began at OSU Medical Center 12 years ago; developing decision support and communication tools remain a high priority to improve care delivery.

A major clinical "test bed" for PHC delivery is the OSU Health Plan, serving over 40,000 faculty, staff and their family members. In January 2006 a new, university-wide program called Your Plan for Health (YP4H) was adopted following a two year visioning and planning exercise among Human Resources, the Medical Center, and Managed Health Care Systems, Inc. (the OSU-affiliated entity that manages the OSU Health Plan). YP4H is a personalized approach to health and well-being, concentrating on prevention and implementing personalized health care strategies. For example, the plan provides incentives for members to undergo a Personalized Health Assessment and incorporates the findings into the participant's health record. Several other features have been instituted over the past year, such as personal health coaches, care coordination, and email consultations, and more are planned for roll out over the next several years. So far, the plan has been met with uniform enthusiasm. Further information about Your Plan for Health is in Appendix B.

Other activities have also been developed to help realize the promise of personalized health care at OSUMC. For example, we created the Center for Personalized Health Care (CPHC) over two years ago, with a steering committee of all major program directors and Medical Center leadership. The CPHC oversees the development and integration of scientific, educational, and clinical programs into a functional system to advance personalized health care at the Medical Center. A key long-term objective is the construction of a connected network of resources and skills that will enable furthering personalized health care throughout the community in a manner that can be scaled and potentially applied elsewhere. To this end, an OSU affiliated corporation, the Institute of Personalized Health Care (IPHC), was created in 2005 as a new, not-for-profit extramural entity designed to project personalized medicine into the community and to partner with other academic institutions, health care providers and commercial enterprises.
Further information about the CPHC and IPHC is in Appendix A.

Summary: Building on an unprecedented surge in medical knowledge, our goal is nothing less than reshaping medicine to improve health outcomes, cost-benefit, and patient satisfaction by: discovering new mechanisms and manifestations of health and disease; providing new educational content and methods to enable students, providers and patients to better understand health and disease; improving the predictive value of diagnostics and therapeutics to personalize individual therapies; defining new evidence-based pathways to treat disease; and utilizing new applications of communication and information technology to improve health care delivery.

We are delighted to submit to the Department of Health and Human Services a description of our personalized health care initiatives to date. What follows is a short summary of the programmatic background that informs personalized health care and a short discussion of the OSUMC information systems backbone that supports it. Subsequent sections will include a description of OSUMC's tissue banks and other biorepositories, a section highlighting significant applications in various programs, and then a conclusion noting some of the challenges ahead.

III. THE PHC INFORMATION BACKBONE

As Figure 1 illustrates, informatics and IT are key components of personalized health care. Personalized health care was an important focus in developing the OSUMC IT Strategic Plan. A key strategy in the IT plan is "to automate the patient's electronic medical record and the workflow surrounding patient care to enhance the quality, efficiency and personalization of patient care". This includes the migration of the inpatient electronic medical record (EMR) from 2nd generation to 3rd generation, including clinician-driven workflow and decision support. It also includes expansion of the EMR to the ambulatory environment and to the peri-operative and ICU environments. Also planned is extensive collaboration between various departments to integrate genomic and clinical data within the Information Warehouse (described in section II) and the online patient care systems. All of these create a strong IT backbone to promote personalized health care. This IS backbone serves three major functions that will:

1) Efficiently connect patients with their health care
    a. Give patients a more timely and complete understanding of their health data and care regimen
    b. Help educate patients about their conditions and therapies
    c. Help patients control or influence their health, even across multiple institutions

2) Promote the research and development of personalized therapies
    a. Improve research productivity by:
        i. Enabling collaboration
        ii. Enabling more efficient access to data
        iii. Making such data more manageable (genomics research often involves high volumes of data)
        iv. Making data more understandable (analytic tools and visualization)
    b. Help researchers understand why a given therapy applies better to some patients versus others, typically involving computationally intensive statistical analysis, data mining, and visualization techniques

3) Provide point of care decision support to help physicians choose the "best fit" therapy for their patients
    a. Enable physicians to efficiently understand the comprehensive ensemble of information available about each patient
    b. Enable physicians to understand the range of therapies available for a given array of patient attributes and health conditions
    c. Help physicians get in touch with relevant literature on demand at the point of care

IV. OSUMC INFORMATION WAREHOUSE

A. Description and Technical Capabilities

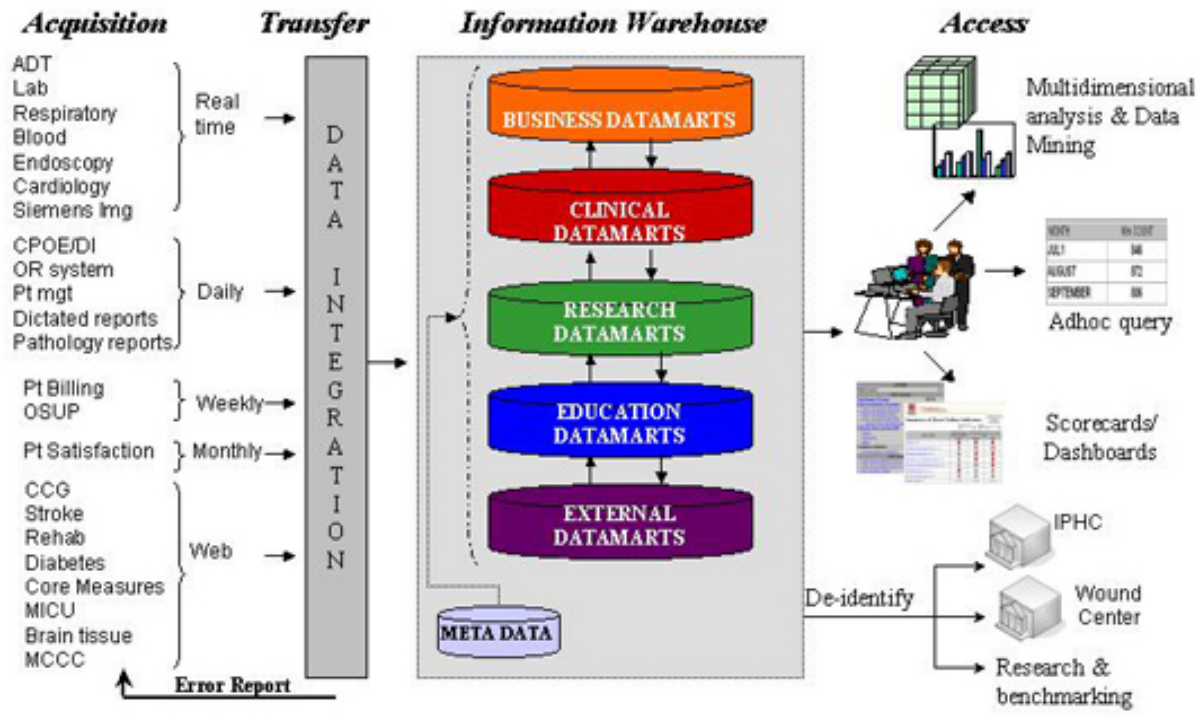
OSUMC depends upon the Information Warehouse (IW) to help us accomplish these goals. Ohio State University Medical Center has a rich history of innovation and achievement in managing information systems and patient care. OSU Medical Center was among the first in the country to adopt and implement a paperless patient record system, and for the past seven years, the Medical Center has been named one of the country's "Most Wired" hospitals.

The Information Warehouse, under the direction of Dr. Jyoti Kamal, is the most critical hub of information storage and management in the Medical Center, providing data integration, mining, training, and application development to researchers and clinicians system-wide. Initially a repository of business intelligence, the IW has grown to meet the demands of a personalized health care environment by routinely collecting clinical and research data that is used to enhance the quality, efficiency and safety of patient care. The IW manages patients' e-records.

Its roots are important: The OSUMC Information Warehouse is one the few nationwide that include billing, financial, and other non-clinical data into a patient's record, a paradigm that offers unique opportunities for research into such areas as administration, operations, quality analysis, finance, strategic planning and education, as well as both clinical and basic research. Additionally, it is one of the few IS centers that does not simply store data, but actively designs and promotes customized solutions to users' needs. To extend its services even further, the IW recently hired a translational research informatics architect, who holds a joint appointment in the department of biomedical informatics and who will be the key liaison between the IW and our growing number of translational scientists.

The IW's 22 specialists provide support for the health system as well as individual investigator initiatives. Information flows to a central repository from multiple internal sources, including procedures, medications, lab results, clinical reports, physician order entry, outcomes and demographics; and external sources as well, such as regional or national health industry data, geographic and census information and the Social Security Administration.

In addition, as part of the greater Medical Center IS department, the IW is tightly integrated with enterprise-grade IT infrastructure that provides around the clock monitoring of availability, security, and performance, secure offsite data backup, disaster recovery protocols, and industry-certified HelpDesk support.



The Information Warehouse takes in data from a broad array of medical center information sources (more than can be shown here), cleanses it, arranges it into efficient datamarts, and then provides access to the data through a robust selection of presentation, mining, and analysis tools. Through this integration the IW works to establish a truly translational research environment at OSUMC.

B. IW Services

The following examples demonstrate how the IW integrates important aspects of personalized health care, maximizing the potential benefit gleaned from research for rapid translation into practice.

***Honest Broker Protocol**:* This protocol addresses one of the most important aspects of handling personal patient data and permitting legitimate research to proceed without jeopardizing the patient's privacy. This process, approved by the OSUMC Institutional Review Board (IRB), enables the IW to supply de-identified clinical data for use in preliminary research without requiring the approval of a formalized protocol from each investigator. The protocol essentially authorizes the IW to safeguard patient privacy on behalf of the IRB while enabling researchers to explore new ideas without the high cost in time and effort that often accompany the creation and approval of a rigorous protocol. This enables faster validation of intuitive ideas or high risk hypotheses that could lead to the development of fully realized protocols.

***Grid Technology**:* We recognize that a major impediment to large-scale integration of databases stems from the fact that they are often incompatible with each other. The IW is working closely

with developers in the NCI's caBIG initiative in using some of its earliest models for data management and analysis. Details of these projects follow later.

***High Throughput Genotyping**:* The ease of large-scale genotyping has introduced new challenges to link the massive flow of data to clinical results. To facilitate extracting the important information embedded in such genotyping data, the IW has created a datamart to support the collection and reporting of data from the high-throughput genotyping laboratory in the department of pharmacology's program of pharmacogenomics. SNP genotype data in the datamart is integrated into the IW clinical warehouse, providing a phenotypic context that can yield tremendous research value for multiple projects.

Development of Novel Biomarkers: Use of a spectrum of novel technologies in clinical translational research at OSUMC is helping investigators discover and develop biomarkers suitable for optimizing individual therapy. This approach is increasingly applied to cancer chemotherapy where biochemical or genetic markers have been identified that predicts disease progression and response to therapy. Pharmacogenomic studies at OSUMC led by Dr. Wolfgang Sadee have led to the discovery of genetic markers with the potential to guide therapy of mental disorders, including drug addiction. The integration of novel biomarkers into clinical practice is a major challenge that can be successfully addressed within the emerging information structure of the OSUMC.

***Translational Research Portal (TRP)**:* Efficient data collection and handling will play an increasing role in shaping the direction of future clinical-translational research. The TRP is a portal dedicated to the rapid development of web-based applications for collecting, managing, and reporting data in medical research studies with tight integration into the IW clinical repository. This system can be extended and applied to other stakeholders as necessary. This project was initially developed last year in support of the Pulmonary Translational Research Core Group, which is pursuing multiple research projects in our critical care program. A good example of how this enabling better patient care is in the Core's project on sepsis, described below:

> Sepsis is a well-known but under-researched area of critical care medicine. Sepsis – often resulting in organ failure - kills approximately 215,000 Americans each year, the equivalent of two 747 jetliners going down each day. Care for septic patients costs patients and hospitals millions of dollars each year. In addition, the quality of care that septic patients receive is often uneven. OSUMC physicians and scientists hope to change that by taking advantage of a new, translational research portal in the Information Warehouse. Working closely with IW staffers, clinicians have developed a way to more closely track clinical feature of sepsis and patient care that are tied directly to patient outcomes. The application is linked to an existing information system, and updates the data fields more quickly. The new system loads patient information in "near real-time" offering physicians a more accurate and timely profile of the patient's condition – which is critical in managing sepsis. Dr. James O'Brien, one of the leaders of the project, says the data has enabled them to see barriers to the structure of care that they are now able to correct. The wireless system enables fast, secure transfer of information. Study leaders say it's been an informative way to study service delivery, and it has already led to better patient care.

Statistical Tools Server (STS)*:* The integration of large datasets increasingly requires novel statistical tools for successful analysis. Uniquely, the IW has taken steps to incorporate advanced statistical tools that can be customized for individual projects. Invaluable to the efficiency of clinical research run by our faculty, the STS is a high performance system (Xeon class) that supports statistical analysis on large datasets within the IW using either the SAS or R statistical packages.

PACS Image Integration Project: Medical imaging is one of the signature areas of the OSUMC, requiring novel capabilities in handling extremely large datasets and providing tolls for their electronic analysis. This developing framework will facilitate extraction of imagery from the OSUMC radiology PACS systems for use in image-based medical studies. A growing library of DICOM images includes X-rays, CT scans and MRIs. The IW facilitates Web-based tools for visualizing imagery, including an interactive slideshow tool for viewing multi-frame images. Work on volumetric visualization of multi-frame image types is under way.

Text Mining Tools (TMT): We have made strong advances in overcoming problems in classifying text (e.g., from patient charts) in such a way that it can be efficiently analyzed in digital format. TMT provides more advanced and efficient methods for extracting knowledge from the IW's extensive and growing repository of over 2 million clinical free-text reports. Employing both word-based and UMLS concept-based indexing, the framework provides a means of knowledge mining text reports in a de-identified manner. We hope to enrich and expand these tools in the future.

Protein Electrophoresis (PEP) Tools*:* Proteomics data is another example where a highly promising new technology can only be optimally exploited if efficient data storage and interpretation are readily accessible to clinical investigators. The developed system provides integrated tools for collecting and analyzing 1D urine, serum, and Immunofixation. PEP data from instrumentation in the laboratory can be accessed from any prepared desktop system in the network. Integration with the IW enables the use of historical results and clinical context during diagnosis. This project demonstrates the versatility of the IW data systems and development team.

Midwest Critical Care Consortium (MWCCC)*:* We rank among the most critical challenges and needs our ability to reach a broader medical community to leverage our information technology on a broader scale. This MWCCC is an ongoing multi-center research study collecting data from 6 major academic health centers in the Midwest. The IW facilitated this project by developing a multi-tiered web application enabling secure data management and delivery through the OSUMC DMZ. Data resides in the IW. The tools developed for this project can be extended to support additional multi-center collaborative projects.

Microarray and Tissue Data Portal: Novel technologies continue to generate large and complex data sets of increasing size that need to be seen in the context of other medical information. This datamart and portal include an integrated suite of tools supporting tissue banking and tissue analysis. Recently, researchers assessing genetic variation in wound healing

used **caBIG** tools such as **caTissue, caWorkbench and caArray** to correlate gene expression analysis with clinical phenotypes.

V. PHC-SPECIFIC RESEARCH /CLINICAL CARE PROJECTS

a. The Gene-Screen Project

This project, under the direction of Drs. Chanden Sen and Gayle Gordillio, is perhaps the most mature PHC project within OSUMC. It involves the integration of genetic data into a patient's EMR and partnership with a large, off-campus network of wound centers. The rationale is based upon the fact that six million Americans suffer from chronic wounds, resulting in an annual $8 billion wound care industry nationwide. It is a rapidly expanding market tied to a growing population of elderly patients who are either diabetic, obese, or both.

OSUMC also partnered with the nation's largest wound management company, National Healing Corporation (NHC), that expects to have 100 wound care centers up and running by 2007.

One of the product lines from this partnership will capitalize on the ability to collect data from all 100 NHC wound centers. OSU's strength in information technology, supercomputing, and mathematical modeling will be utilized to develop a wound information and clinical network and a commercialization and marketing infrastructure. The networked centers are already generating large amounts of data that could be used for clinical validation of new products.

To achieve the above, we are working on three key strategies:

1. Development and deployment of a grid-enabled data integration and management system

Management of data types is critical to facilitate data integration and database federation. A formal description of the data types – a schema – defines the complete structural representation of the data. A schema can be a stand alone description of particular a dataset, or it can be elaborate composition of new attributes and references to multiple existing schemas and data types. We will adapt or develop common schemas for the types of data that will be collected and referenced in studies to be carried out in this project.

These categories of data include clinical data pertaining to wound healing, images, gene expression data and wound tissue oxygenation data. In developing schemas for our data types, we will leverage the caBIG common data elements and controlled vocabularies. When a data type generated in this project has an equivalent common data element and model in caBIG, as will be the case with gene expression data and much of the clinical information, we will use that data model to implement the corresponding database schemas. If our data model has attributes that are not captured in the caBIG common data elements, we will extend those data models to fit our needs. Schemas will be registered under namespaces. Use of namespaces will facilitate authoritative control over schemas representing metadata definitions and controlled local extensions to common, accepted definitions.

The information management system will employ a federated database system consisting of the Information Warehouse, caArray and additional databases supported by the Mobius Mako data management system. In this caGrid-based data management system, data resources are accessed through a set of well-defined interfaces, thus exposing specific data resource operations as XML operations. The information warehouse will be used to manage clinical and wound image data, caArray will be used to manage gene expression data and Mako will be adapted to manage tissue oximetry/ EPR image data. All databases will be exposed as caGrid data services.

caArray is a suite of tool that includes a microarray database and microarray data analysis and visualization components developed by the National Cancer Institute Center for Bioinformatics. It is an open source software system with server and client side APIs for code development (http://caarray.nci.nih.gov). There is already a reference implementation of caArray as a Grid service using the current release of caGrid. Mobius Mako is a strongly typed storage service, with which data sources can be exposed and interacted with as XML data sources. Mako provides support for on-demand database creation, storage, retrieval, and query of instance data, and organization of instance data into collections. Each collection in Mako can be restricted to only accept XML documents from a set of certain types. Mako natively provides interface implementations for accessing XML views of relational databases, native XML databases via the XMLDB API standard, and a custom backend named MakoDB. MakoDB provides many advanced features such as:

- The ability to uniquely reference and retrieve individual elements
- The creation of optimized on demand databases from XML schemas, and
- Optimized storage and retrieval of binary data.

Web interfaces and data ingestion programs will be developed to import new data into the respective databases. A common way of storing data in investigator laboratories is tab-delimited files or Excel spreadsheets. These files can be generated when data captured by an instrument is exported for analysis. In addition, the laboratory technician or data manager may enter the data to a spreadsheet for error checking, data cleaning, and analysis.

In order to facilitate importing of data collected by research project laboratories, schemas will be developed that describe the format of data files and the structure of data elements stored in the data files. The researcher will specify via a web interface the locations of data files to be uploaded to the information management system and their type. The client program will read the files from the local machine and submit them along with the schema information to the backend server of the information management system. Server side data ingestion methods will parse the files and populate the respective databases based on the schema description.

Data validation will be performed at two levels. First, each data file format will be validated against the schemas stored in the system. Second, an investigator will be able to define upper and lower threshold values for attributes defined in the schema. The system will check the values of attributes stored in the data files against the investigator-defined thresholds to ensure incorrect results are not imported into the system.

2. Support for secure and controlled access to clinical information through the development of identified and deidentified data marts

All patient and clinical data are stored in the OSUMC IW The information is maintained in two data marts. An *integrated identified data mart*, referred to as the WISE Data Mart (WDM), contains both inpatient and outpatient OSUMC patient data. The OSUMC Comprehensive Wound Center (CWC) and its clinics provide inpatient and outpatient data. NHC provides other outpatient data from its clinic network nationwide. This information includes patient identifiers enabling linking other data associated with that patient from other OSUMC IW data marts.

A deidentified data mart contains patient information from all participating National Healing Corporation's clinical centers. This is referred to as the Comprehensive Wound Data Mart (CWDM). These wound data marts are available as a stand-alone data mart within the OSUMC-IW. In the case of the identified OSUMC patients, the wound data marts may be linked to other data marts (Physician Order Enter, Pharmacy, Emergency Visits, Lab Results, etc.) to provide a complete view of patient encounters, wound analysis, diagnosis and outcomes.

The two data marts are also wrapped as caGrid data services behind the OSUMC firewall to enable easier federation of the data marts with caArray and additional databases supported by Mobius Mako. The support for clinical information management is shown in Fig 2.

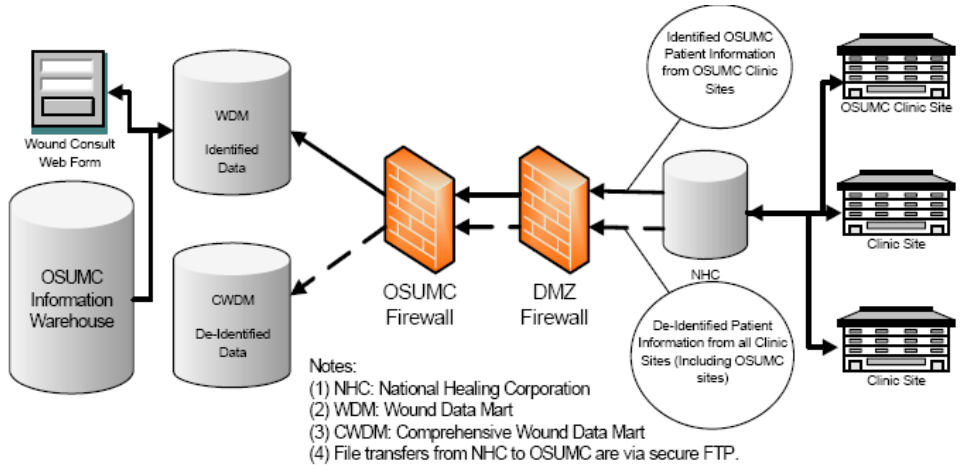


Figure 2: The support for managing clinical information

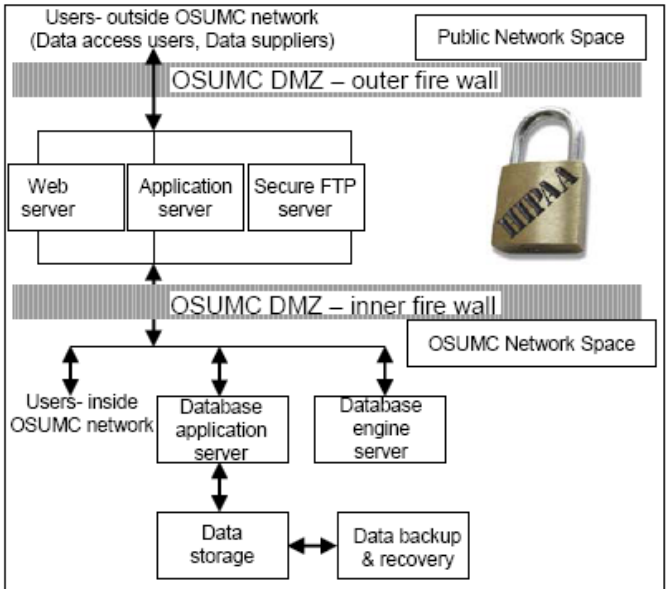


Figure 3: E18. **Overall Architecture**:
in relation to physical hardware/software components

Data access and security will be maintained in a number of ways.

- The data marts are housed within the OSUMC network and protected by a Demilitarized Zone (DMZ), which is a protected sub network that acts as a buffer between the OSUMC and the "outside world" (Fig. 3). User requests and other data transmissions are authenticated by components within the DMZ and forwarded to the appropriate system only after permissions are validated.
- Data access is limited through individual user accounts/passwords created by OSUMC system administrators. Access can be controlled and audited for each individual data mart at the data element level.
- Data entered by individual clinicians or researchers remains the property of the principal research investigator or the faculty member to whom the data belongs and is not accessible by others without permission.
- Access to deidentified data marts (or data subsets) is available as defined by HIPAA guidelines.
- As a subsequent development of the wound data curation process, wound image data will be added. Each wound data record will be modified to contain a list of associated image ID's. The images will be packaged as image files with image ID's as their file names. These images will be stored in the IW and indexed by their ID as another data mart.
- Additional metadata will also be stored along with each image. This data mart will be wrapped in caGrid grid service interfaces as well to facilitate federation with other data marts and other databases in the WISE-IM.
- A deidentification process will be developed to scrub the images of any potentially identifying information so that this valuable resource will be available for research use while ensuring the protection of patient privacy. These filters will be run on all images before they are packaged and transferred to the OSUMC IW. The process will seek to scrub images of patient identifiers that occur on ID cards within the images.

The use of standard ID cards will be ensured through operational procedure so that the software can be designed to identify the areas within the images where patient information is written. The scrubbing process will overwrite pixels within the image with a neutral color so as to blank out any written information contained there. Each image de-identified in this manner will be marked in the database as cleansed of ID tags so that it can be cleared for second stage de-identification and delivery. Facial wound images will be excluded from the de-identification process and will not be included in the image data set. Should the scrubbing application have difficulty locating the ID plate within the image, that image will be marked as not cleansed and will not be available for delivery until it is manually de-identified and signed as deliverable by an authorized staff person.

Applications for offloading and reloading specific images to a desktop computer for manual de-identification will be developed to facilitate this process.

In general, de-identification of patient information will include: removal of protected health information (PHI) in accordance with the OSUMC (IRB), the "common rule" guidance outlined in the Office of Human Research Protections 45 CFR 46, and the HIPAA guidelines for privacy and mapping OSUMC key identifiers (medical record number, encounter number) to random values and retaining that mapping for future use in data updates. Without retention of the key mapping each update would require a full data drop and reload. Shielding the actual encounter dates from the user to prevent identification by isolating the date of service. If possible, some alternate parameter may be included to enable some form of analysis of the interval between encounters. Although the data is expected to be de-identified, reports and result sets will be audited for privacy prior to delivery to a third party organization or individual data customer. This precaution is especially recommended for data sets derived from unstructured text data sources, which by its nature, variance and unpredictability is subject to a less than 100 percent certainty of full de-identification.

3. Development of software to support wound healing related exploratory data analyses and hypothesis generation.

The goal is to develop a user-centric system that will make it easier for researchers to build, integrate and manage descriptions that pertain to wound healing, and to compose queries that will find, compare and analyze existing descriptions.

Using the system to be developed in this project, a researcher will be able to:

- Report experiments and how they related to each other. This information is typically captured and documented in an ad hoc manner and incompletely, rendering it nearly impossible to efficiently manage this information and to facilitate sharing of it among researchers and querying of information gathered in multiple research studies.
- Describe and manage information pertaining to associations observed through experiments.
- Compose queries to search for, retrieve and compare descriptions maintained in the system. In order to provide this functionality, we will work closely with the investigators in this project and develop common data elements and vocabularies (ontologies) that can precisely report experiments and results of data analysis algorithms.

We will also develop customized web interfaces to support investigator queries based on these data elements and vocabularies. We will leverage the caGrid infrastructure to support federated queries. The query interface will be presented to the researcher as a web page. All the attributes will be listed on the web page either as pull down menus (when there are a fixed number of values that an attribute can take) or query forms for easy formulation of queries. Querying of clinical information will be supported for clinical trial design and screening. By means of query tools, an investigator will be able to probe the historical collection of patient information to determine whether a viable number of patients would be available to support a specific set of clinical trial criteria. This provides a certain benchmark to aid the researcher in designing a study that is likely to find a suitable number of eligible candidates in the general population. The IW supports a wide variety of data mining and statistical analysis reports and applications within the Medical Center.

Additional work continues on the IW front, including the planning for several future initiatives including the following:

- Design of a screening mechanism to find potential candidates for clinical trials. This is a high-priority item
- Deeper integration of the IW into the clinical health system, including curation of data from additional clinical and external data sources
- Creation of better tools to provide physicians with decision support through more efficient presentation of historical context for any given patient

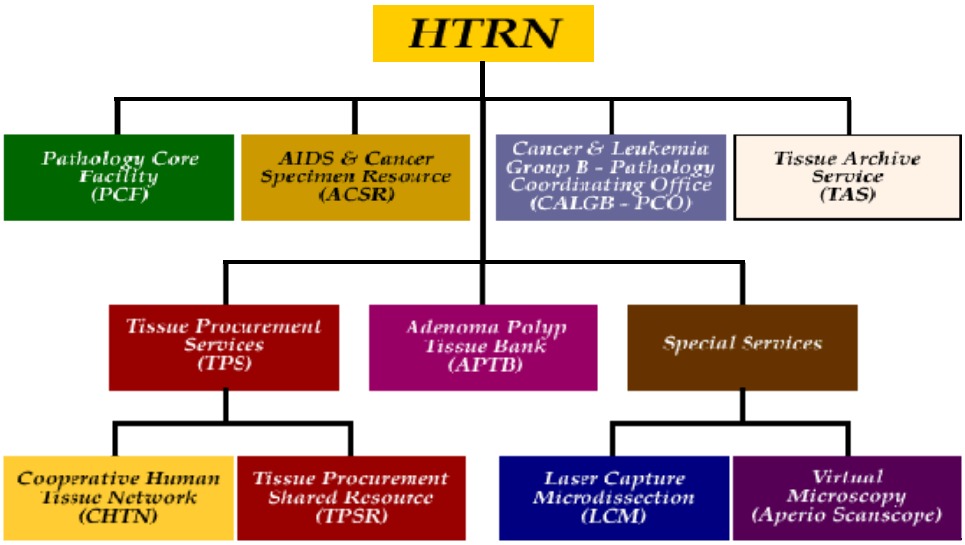
VI. BIOSPECIMEN REPOSITORIES

Introduction

OSUMC has multiple biorepositories devoted to research, clinical trials and medical-decision making. Our resources include solid and liquid tumor banks, human tissue and fluid repositories and libraries of RNA and DNA derivatives, largely administered through the Human Tissue Resource Network, a division within the department of pathology. The National Cancer Institute has also recognized OSUMC as a correlative sciences center, home to the central imaging core and tissue repository for the CALGB research consortium.

In addition, dozens of individual investigators at Ohio State have created their own tissue repositories for personal and team research. OSUMC investigators manage biospecimen repositories in many types of cancer, including head and neck, breast, brain, colon, cervical and leukemia and lymphoma. Some of the Medical Center's newest initiatives include emerging repositories in muscular dystrophy, heart disease, sepsis, neuroscience and inflammatory bowel disease, among others.

Administration of Biorepositories – The Human Tissue Network



Tissue Procurement Services

Tissue Procurement Shared Resources (TPSR) began in 1975, one year before The Ohio State University was designated a Comprehensive Cancer Center (OSUCCC) by the National Cancer Institute (NCI). The shared resource program was the impetus for the Human Tissue Resource Network (HTRN) that today receives additional funding from other NCI banking grants, including the Cooperative Human Tissue Network. The TPSR procures and provides malignant and normal tissues from solid tumors to the OSUCCC membership. The TPSR has received merit descriptors of "outstanding" in two of the last three OSUCCC competitive renewals.

The service is a prospective tissue procurement service for basic science applications including pre-surgical (biopsy) and post-surgical collection of specimens for the purpose of clinical correlative studies by OSUCCC investigators. TPSR staff provides quality control of the research specimen and direct interaction with pathologists and OSUCCC investigators to better assist in procurement of tissues and to foster hypothesis - driven cancer research. Approximately 3,000 tissue specimens are distributed each year to OSU investigators.

The HTRN is just beginning to work with the Information Warehouse to coordinate tissue samples with clinical data. The project enables researchers to obtain de-identified tissue samples according to generalized qualities of interest from the HTRN and then to request clinical data associated with that tissue sample. Because both data sources are de-identified, this service can be provided under the purview of the Honest Broker Protocal.

Tissue Archive Services

The Tissue Archive Services (TAS) was established within the department of pathology at OSU Medical Center in June 1998 to serve as the custodian of diagnostic archival formalin - fixed paraffin tissues and hematoxylin and eosin stained slides. Since its creation, specimens have

been organized and policies have been instituted for the use of archival material by OSU investigators in collaboration with OSU pathologists. IRB-approved applications are required to access these materials. TAS requires that specimens be handled anonymously. The Tissue Archive Services processes and distributes annually more than 20,000 blocks and slides to research investigators across campus. The paraffin block and slides archives contains tissue from surgical cases from 1967 to the present and is estimated to contain approximately 1,200,000 surgical cases and 12,000,000 paraffin blocks.

The lab also serves as the tissue bank for Adenoma Polyp Tissue Bank (APTB) national clinical cancer treatment group, whose focus is to study the efficacy and safety of the drug celecoxib in preventing the occurrence of new adenomatous polyps – growths that put people at increased risk for colorectal cancers.

AIDS and Cancer Specimen Resource

The AIDS and Cancer Specimen Resource is a tissue and biological fluids bank of HIV-related specimens. The National Cancer Institute established the AIDS and Cancer Specimen Resource to encourage and facilitate research in HIV-related malignancies. Malignant and other tissues from HIV infected patients are needed more than ever to provide opportunities for critical translational research focusing on the pathogenesis of AIDS related malignancies and other human tissue for study. ACSR provides qualified researchers with tissue, cell, blood and fluid specimens, as well as clinical data from patients with HIV-related malignancies and other HIV diseases.

Cancer and Leukemia Group B Pathology Coordinating Office

The Cancer and Leukemia Group B (CALGB) is a national cooperative cancer clinical trials group supported by the National Cancer Institute. More than 250 academic medical centers, hospitals and physician practices enroll patients on CALGB clinical trials in breast, GI, GU, lung and breast cancers, melanoma, leukemia and lymphoma. For many years, a major goal of CALGB studies has been to understand the biological factors that determine the prognosis or predict response to therapy of various tumor types. The CALGB has made important contributions to identifying cytogenetic sub-groups within certain forms of leukemia that have prognostic importance, as well as the relationship between Her2/neu expression in stage II breast cancer and treatment outcomes associated with the dose intensity of doxorubicin-based therapy. Conducting correlative science studies require a coordinated system that includes the centralized collection of tumor cells and tissues, storage under controlled conditions, a comprehensive inventory, a process to distribute specimens to investigators and to receive the assay results from research laboratories and policies to address responsible research including safeguarding patient confidentiality. Ultimately, the results of the laboratory studies must be linked to and correlated with the clinical outcomes of patients treated on CALGB clinical trials so that useful conclusions can be drawn regarding the relationship between tumor biology and treatment outcome. The CALGB has developed tissue repositories located at OSUMC that hold viable leukemia cells as well as formalin-fixed paraffin-embedded solid tumor specimens for use by the investigator community. The CALGB-PCO distributes approximately 50,000 specimens annually for research.

Leukemia Tissue Bank

The OSUCCC Leukemia Tissue Bank Shared Resource (LTBSR), supports clinical trials and research conducted within the OSU Comprehensive Cancer Center. The ability to successfully translate basic research in leukemia and related malignancies to the clinical setting, as well as to better understand the relevance of observed clinical phenomena through laboratory-based research, is greatly facilitated by the availability of an extensive repository of tissue samples. The LTBSR was established in 1997 and currently has over 35,000 vials of cryopreserved viable cells, over 13,000 vials of matched frozen plasma and/or serum samples from more than 2300 patients treated at the OSUCCC.

VII. SELECTED EXAMPLES OF EMERGING PHC RESEARCH UTILITZING SPECIFIC BIOREPOSITORIES

This section includes brief descriptions of key Medical Center projects involving current or newly created tissue banks. It also includes mention of several biorepositories of specimens from special populations.

- **Dr. Electra Paskett**, director of the Center for Population Health and Health Disparities at Ohio State, is using part of a $7.5 million grant from the NCI to study the unusually high rate of cervical cancer in Appalachian Ohio. As part of that effort, she and her colleagues are collecting cervical tissue and blood samples from women entering any one of 14 rural health clinics throughout that region.. Genetic analysis of the specimens will enable them to understand which genotypes are related with higher risk of developing cervical cancer. They will also be analyzing various lifestyle habits, including diet and tobacco use, Pap smear history and sexual history – all elements of designing personalized intervention to increase use of appropriate health screenings.

- **Dr. Carlo Croce**, director of the human cancer genetics program at Ohio State, is continuing to discover, analyze and organize a huge library of microRNAs, and how these tiny snippets of genetic material may reveal not only who is most vulnerable to developing cancer, but which treatments may be most effective for any given patient. Croce is a pioneer in human cancer genetics research, and the first to identify some of the key genes that malfunction in the early stages of carcinogenesis.

- In contrast, other researchers are looking at *epigenetic* changes in cancer, including **Dr. Christoph Plass**, who is using Ohio State's extensive repository of head and neck tumors (and others) in trying to further understand changes in methylation patterns in cancerous vs. normal tissue, and how that chemical process contributes to malignant growth. The head and neck tumor repository at Ohio State holds over 1200 samples of tumor and matched normal tissue taken from patients at the James Cancer Hospital and Solove Research Institute over the past 10 years. It is one of the largest (if not *the* largest) head and neck tumor banks in the U.S.

- **Dr. Glen Cooke**, a cardiologist and assistant professor of medicine at OSUMC, is working closely with members of the Information Warehouse in researching genetic variation in patients' response to anti-platelet medication. The results could lead to the ability to personalize patient-care strategies in the roughly 30 percent of Americans with heart disease who carry certain genes. Cooke, who is also a member of the Davis Heart and Lung Institute, has also discovered that a particular gene will render some cardiac care patients more vulnerable than others to problems with their stents.

- **OSUMC's Pulmonary Translational Research Core Group** is also working closely with IW staff in piloting at least 10 different data mining tools supporting individual research studies. Many of these systems involve support and management of clinical trials. Members of this group are also the leaders of the sepsis project described earlier.

- **Dr. Stephen Cook,** another cardiologist and assistant professor of internal medicine, is just beginning to develop what may be the first genetic database of young children with muscular dystrophy. He is comparing genotype with phenotype in hopes of discovering why some of the children develop cardiomyopathy and others do not.

- **Dr. Rebecca Jackson,** professor of medicine, was just awarded $4.1 million to mine the WHI database for a study seeking to identify common genetic variants that alter risk for hip fracture in postmenopausal women participating in the Clinical Trial or the Observational Study. The rationale is grounded in studies showing a significant genetic component to fracture risk. Investigators will use a three-stage design, using Illumina's HumanHap550K to help them discover which SNPs (single nucleotide polymorphisms) are most significant in determining risk of fracture. Secondary aims are to identify SNPs that are associated with hip fracture in younger or older women, and SNPs that are associated with fractures at the neck of the femur or intertrochanteric hip fractures. This will be the first genome-wide association study of hip fractures.

VIII. Issues in Accessing/Using Stored Data

While there is an enormous amount of molecular and genetic information stored in all of these repositories, access to, use and analysis of the data is limited by a complex set of legal, social, technical and ethical obstacles. Each repository is protected by its unique set of regulatory restrictions. Major issues impeding access to these rich lodes of information include a lack of standard formats in gaining patient and IRB approval at the outset of building a dataset and a corresponding lack of standards in the technical means of actually getting to the information. A detailed discussion of these issues is not within the parameters of this document, but the following short Q and A with one of our administrators highlights only the most superficial barriers involved in getting access to valuable biospecimens needed for research: Speaking is Donna Bucci**,** the administrator of OSUMC's Leukemia Tumor bank, noting issues with both the CALGB shared resource and OSUMC's Leukemia Tumor Bank:

1. What kind of consent do patients have to sign to have their tissue samples stored and available to researchers?

"Patients sign a specific IRB approved consent permitting their materials and PHI (separate HIPAA consent) to be used for research. For CALGB, all consents are approved by the CTEP (Cancer Therapy Evaluation Program) which is a branch of the National Cancer Institute which oversees Cooperative Group clinical trials. Consents for Cooperative Group trials must be approved at the Cooperative Group level and also the individual institution level."

The implication here is that consent is a multi-level, multifactorial process and that getting access to data retrospectively may involve complicated and time-consuming tasks that are even more taxing because there is no standard consent form across systems.

2. Is there any kind of direct access to the data in the repository that is open to outside users? If not, is there any talk of building access?

"There is currently no direct access for investigators to obtain data about samples stored in the repositories. OSUCCC and CALGB operate according to guidance documents from the NCI – Cooperative Group Banking Committee. The NCI-GBC, along with the caBIG initiative at the NCI, is currently developing guidelines by which outside investigators may have access to some level of repository data through web-based tools that are caBIG compliant."

There is, however, early use of some caGrid tools, as mentioned earlier in the wound healing project. These tools have been helpful.

3. What kind of history is there of requests for access coming from outside Ohio State?

"Since its inception, more than 150 abstracts and over 100 peer-reviewed publications for studies supported by the CALGB and the Leukemia Tissue Bank. Access to both repositories must be obtained through an application process managed by another university (Duke) which also manages biostatistics in the database. Applications are reviewed for their scientific relevancy. The protocols under which the repositories operate do not permit releasing materials for exploratory laboratory studies that are not linked to the relevant clinical data."

This response identifies multiple barriers across various institutions for access to biospecimens. While some might argue that such rigorous guidelines are not just typical, but necessary, others might just as successfully respond that the promise of personalized health care will not be realized until networks are built to manage standardized consents and permissions that support common language queries linked to shared ontologies/resources.

IX. BUILDING ONTOLOGIES ACROSS CLINICAL DATA REPOSITORIES

Benefits

With scientists churning out new genome-based discoveries every day, never has the need for new ontologies to help translate that information been more critical**.** A key issue in fulfilling the promise of personalized health care is how to create, access, analyze and query multiple privately and publicly held databases of genomic information. There is an enormous amount of molecular and genetic information available, but much of it is stored within isolated environments encumbered by social and regulatory constraints. Current information technologies do not generally enable abstraction, integration or interpretation of data. Only when technology advances and new ontologies emerge will clinicians be able to truly practice personalized medicine.

Feasibility

Happily, the NCICB notes that there are several cyberexperiments underway that may change that: the Biomedical Informatics Research Network (BIRN), which is developing virtual communities using shared resources, focuses heavily on imaging and storage; myGrid, which allows individuals to pose distributed queries through the Internet using a shared language, primarily devoted to asking and answering questions in biology; and caBIG, something of a hybrid between the two, which is designed to help researchers carry out coordinated investigation across multiple institutions. CaBIG supports translational research, clinical trials and tissue banking and pathology.

OSUMC holds a leading role in the development of caBIG, in large part due to the expertise of Dr. Joel Saltz, professor and chair of the department of biomedical informatics at OSU. The NCI launched the caBIG project in 2004, recognizing the need for a global, computerized system that would enable cancer researchers world-wide to be able to collaborate with each other. Project leaders responded with an initial release of a plan (called caGrid.5) that put forth a federated approach to interoperability and functionality that enabled the creation of individual workflow within virtual communities and access to large, geographically disparate data sources.

Just a little over month ago, caBIG researchers released the next “chapter” of the project, - caGrid1.0 - a refined suite of tools, resources and computer software that expands the functionality of caGrid.5, including these features:

- A tool that enables creation of a graphical environment for rapidly developing caBIG-compatible data and analytical grid services;
- Dorian, Grid Group and Grid Trust Service, which are tools for managing and administering the federated security infrastructure in caGRID
- caGRID Portal, which provides a dynamic view of services running on caGRID, along with information about research institutions and service providers

As noted earlier, researchers at Ohio State and elsewhere have already begun to successfully use some prototypic caGrid tools and models. Funding for this initiative will run out fairly soon,

however, and with no additional money to support the creation, awareness and use of some the project's new tools, the project may fall short of its potential to bring about change.

CONCLUSION

OSUMC is committed to the practice and advancement of personalized health care. Our leaders stand ready to work with any and all partners in reaching that goal. We hope this overview has been instructive. Please feel free to contact any of the clinicians or researchers mentioned in this report for further information about their plans or projects. For specific numbers, please call Medical Center Communications at 614-293-3737.

Appendix A: CPHC and IPHC

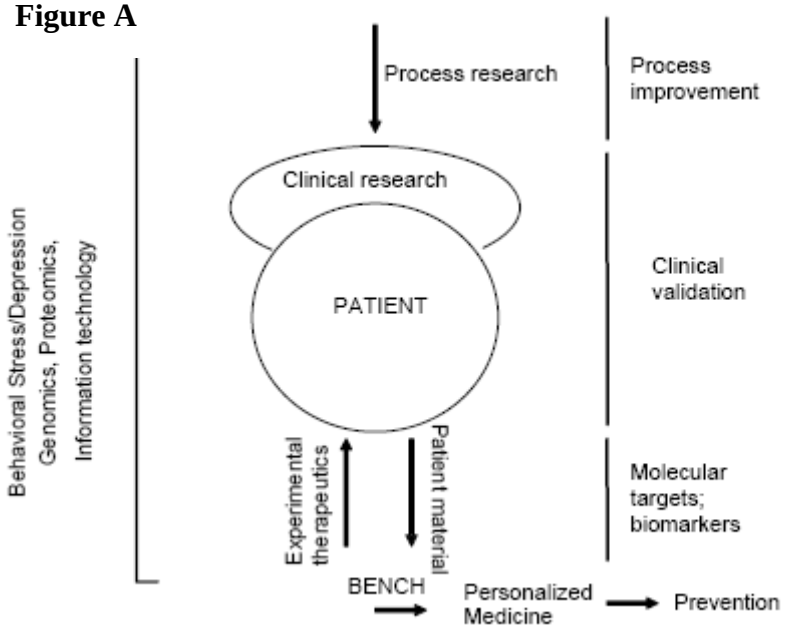
Partners and Financial Support of the Program

This program integrates investigators from nine Colleges and Schools, including Medicine, Dentistry, Pharmacy, Veterinary Medicine, Business, Public Health, Psychology, and Engineering, involving multiple Departments and Centers. As the immediate outreach partner, the Institute for Personalized Healthcare (IPHC) received commitments from corporate partners in Ohio (including Battelle Industries, Pinnacle Data Systems, Omeris, Ohio Biorepository Center, Ambulatory Care Associates, Phylogeny); in California (Xpaseo, Thrasys, Globecom21, SAIC), and international (Siemens).

Translational Research Program

Figure A below outlines center of the program. Materials from the patient are secured and evaluated at the bench using genomics and proteomics to define molecular targets and biomarkers. A hallmark of novel therapies increasingly entails a tight link between a therapeutic agent (drug) and a diagnostic biomarker to achieve optimal outcomes. Once these targets are identified, we will approach therapeutic opportunities by leveraging outstanding OSU resources in Experimental Therapeutics, with research progressing from molecular and cellular studies to animals to patients - providing bedside to-bench-to-bedside capability. Surrounding the patients is clinical research, validating bench-to bedside therapeutics. This is supported by the Institute for Behavioral Medicine Research (IBMR) as an exceptional resource. Importantly, informatics and information technology is germane to acquiring, integrating, and evaluating information that will facilitate novel approaches to therapy. Ultimately, process-based knowledge will allow us to re-engineer medicine and become leaders in competing for NIH grant dollars in translational research, as outlined by the NIH roadmap which includes bioinformatics, behavioral medicine, and biostatistics as critical areas of study (http://grants2.nih.gov/grants/guide/rfa-files/RFARM-04-015.html).

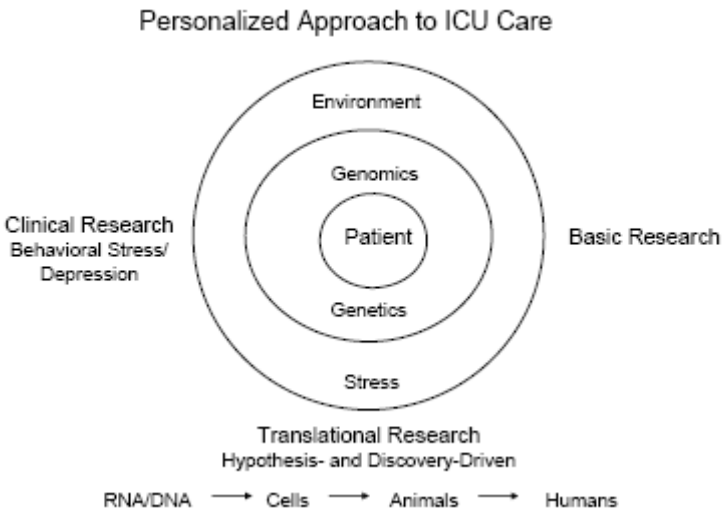
Figure A



Because personalized health care is the future of medicine, we have adapted the following model for the scientific program development for the CPHC (**Figure B**). Note that we will focus on the IBMR for the

environmental impact with leadership of Drs. Ronald Glaser and Janice Kiecolt-Glaser and pharmacogenomics/genetics under the leadership of Dr. Wolfgang Sadee.

Figure B



Strategic Objectives of the CPHC

The projects executed by the CHPC will save health care expenses for the State of Ohio and improve the quality of care for patients, as outlined in the OSU Medical Center Strategic Plan. It will also position the State of Ohio as the leader in personalized health care. The four key aims of the CPHC are:

Aim 1) Construct an informatics program to drive data exchange, data acquisition, integration and application and train the next generation of experts in this area.

Aim 2) Create an integrated patient-centered research program that focuses on bedside to bench to bedside research.

Aim 3) Create a Center of Innovation in personalized medicine.

Aim 4) Create innovative education and training programs in personalized health care.

Appendix B: Ohio State University's "Your Plan for Health"

Launched in 2006 by the strategic partnership of the OSU Medical Center, Ohio State University's Office of Human Resources, and Managed Health Care Systems, Inc., "Your Plan for Health" is a personalized health promotion and prevention program aimed at addressing important needs for the entire university and its employees.

The goals of "Your Plan for Health" are to improve overall health and increase productivity of faculty and staff through timely preventive care and wellness programs at the individual level; to provide an overall benefits package that will help make The Ohio State University an employer of choice; and to gain control over rapidly rising health care costs, while preserving quality, continuity, and affordability of health care for the university and its faculty and staff. The program and its enhanced benefits are developed under the principles personal empowerment, holistic health management, and personalized health care.

The program includes a number of key components that have individuals' needs in mind:

- **Personal Health Assessment** - an online, confidential questionnaire about well-being and lifestyle risks. Approximately 7,000 faculty and staff completed it in 2006.
- **Biometric screenings** - free 20-minute appointment to obtain biometric health data for PHA (cholesterol, blood glucose, blood pressure, height, weight).
- **Secure E-mail** - a web-based resource that allows secure, HIPAA-compliant messages to be sent electronically between the patient and the Ohio State physician, is being phased in. Any e-mail exchanges that occur between the patient and the provider are also added to the patient's confidential electronic medical record.
- **Health coaching and Care Coordination -** programs to complement an employee's current health care management team.
- **Lifestyle Management programs -**weight management, tobacco cessation and stress management) help make lasting behavioral and lifestyle changes that also lead to better health. A personal health coach works to develop a step-by-step plan for achieving goals.

YOUR PLAN FOR HEALTH

What's Stopping You from Feeling Your Best?

Live Healthier

You deserve to feel your best everyday. Whether your goal is to become more active, lose weight, quit smoking, reduce stress, or just staying fit, the resources offered as part of *Your Plan for Health* will start you on your long-term plan for health and help you make a lifelong difference.

What's *Your Plan for Health*

Your Plan for Health is a multi-phase approach to how Ohio State thinks about health. The focus is on helping you and your family reach the healthiest state possible by offering programs, tools, and incentives for identifying and acting on health care risks, promoting smart, cost-efficient choices based on your needs, and taking control of health care spending.

Why Do We Need *Your Plan for Health*?

The goals of *Your Plan for Health* address important needs:

- To improve your overall health and increase productivity through timely preventive care and wellness programs
- To provide an overall benefits package that will help make The Ohio State University an employer of choice
- To better manage rapidly rising health-care costs while preserving quality, continuity, and affordability of health care

Resources offered through *Your Plan for Health*

Personal Health Assessment (PHA)

- Online questionnaire about health and lifestyle habits to help you learn about your potential health risks
- Secure, confidential process
- 20 minutes that could change your life
- Free annual health screening for faculty and staff, including cholesterol, blood pressure, and blood glucose

PROMOTIONAL MATERIALS:

CareAllies

Three programs to compliment the care you receive from your health care provider at no additional cost.

CareAllies 24-Hour Nurse Line

- Help from a registered nurse – anytime, anywhere.

Call (800) 579-0534

Health Coaching

- Certified health educators can help you develop goals to improve your health

• One-on-one guidance and support by phone and e-mail on health topics, including nutrition, exercise, high blood pressure, high cholesterol, and pre-diabetes
• Assistance in finding resources and programs
• Tobacco cessation, stress and weight management programs
• Prevention and more

Care Coordination

• Team of registered nurses can help you manage a variety of chronic conditions including asthma, diabetes, chronic obstructive pulmonary disease, and heart disease
• Easy-to-understand educational materials
• Ongoing communications by phone and mail
• Help and encouragement

Health/Lifestyle Management Programs

• Benefits for:
  – Nutrition services
  – Tobacco cessation programs
  – Weight management
  – Fitness center discounts

Alternative Treatments

• Benefit options for:
  – Medical massage therapy
  – Acupuncture
  – Chiropractic care

Incentives for Healthy Behaviors

• Rewards for activities that promote prevention, education/consumerism, wellness, and health management

How do I benefit from *Your Plan for Health*?

Your Plan for Health can help you and your family reach your highest potential for health. You'll have new programs, tools, and incentives to help you address potential health risks, manage an illness or chronic condition, and live as healthy as you can. Being healthy isn't your only reward – as the OSU community gets healthier, *Your Plan for Health* can help control and minimize health care costs.

Office of Human Resources, Benefits
1590 North High St., Suite 300
Columbus, OH 43201-2190

For information on eligibility requirements or to learn more about *Your Plan for Health*, visit **www.yourplanforhealth.com**, e-mail **yourplanforhealth@hr.osu.edu**, or call (614) 292-1050 or (800) 678-6010.