IBM Global Business Services

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U.S. Department of Health and Human Services

Personalized Health Care RFI – Attachments

Submitted to: U.S. Department of Health and Human Services
Room 434E, 200 Independence Avenue S.W.
Washington, D.C. 20201
Attention: Personalized Health Care RFI

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Attachment 1: IBM Systems Journal on Information-Based Medicine

The January, 2007, issue of the IBM Systems Journal on Information-Based Medicine contains papers on Interoperability and Standards, Imaging and Telemedicine, Clinical Decision Intelligence: Medical Informatics and Bioinformatics, Biobanking and Biomarkers. The electronic version of this journal is available at:

http://www.research.ibm.com/journal/sj46-1.html)

Interoperability and Standards

- A healthcare data model based on the HL7 Reference Information Model
- Varieties of interoperability in the transformation of the healthcare information infrastructure
- The Health Record Banking imperative: A conceptual model
- The seventh layer of the clinical-genomics information infrastructure

Imaging and Telemedicine

- The innovative bundling of teleradiology, telepathology, and teleoncology services
- Monitoring chronically ill patients using mobile technologies
- Remote healthcare monitoring using Personal Care Connect

Clinical Decision Intelligence

- MedTAKMI-CDI: Interactive knowledge discovery for clinical decision intelligence
- A graph-theoretical approach for pattern discovery in epidemiological research
- Infrastructure for a clinical decision intelligence system

Biobanking and Biomarkers

- BIMS: an information management system for biobanking in the 21st century
- IT solutions for imaging biomarkers in biopharmaceutical research and development

Attachment 2: Pharma 2010 – Threshold of Innovation

Refer to the file Pharma2010_Threshold_Exec.pdf

Attachment 3: Pharma 2010 – Silicon Reality

Refer to the file GE510-3600-01_Pharma2010_SiliconReality.pdf

Attachment 4: IBM Congressional Testimony on Wellness

Testimony of

Dr. Jane F. Barlow, MD, MPH, MBA
IBM Well-Being Director
Global Well-Being Services and Health Benefits

The IBM Corporation

Before the Subcommittee on Federal Workforce and
Agency Organization of the Government Reform Committee

March 15th, 2006

Chairman Porter and members of the Federal Workforce Subcommittee. My name is Jane Barlow and I am the Well-Being Director for IBM Global Well-Being Services and Health Benefits. I am a physician and have additional degrees in public health and business. My group is responsible for the health and health benefits of over 500,000 IBMers, retirees and dependents. The IBM Corporation spends over $1.7 billion on health care each year.

IBM appreciates the opportunity to testify in support of the Federal Family Health Information Technology Act of 2006. By providing federal employees with a health record that can link them electronically to their provider, the Act will allow federal employees to improve their health and satisfaction with their healthcare experience – while reducing health care costs.

In 2005 IBM announced that it would provide personal health records to its entire U. S. workforce. To protect employees' privacy, the personal health record system available to IBMers today is managed by an outside vendor and we have instituted contractual provisions and process controls in order to prevent inappropriate access to employee-specific data.

To establish their personal health record, our U.S.-based employees begin by entering basic information: medicines, allergies, major conditions, and details on their doctors and insurance coverage. Later this year, their personal health records will grow to automatically include medical and prescription drug claims history.

Even this basic information has real utility today. It can be emailed or faxed to a provider – and even sent from a Web-enabled mobile device – or simply stored or printed out for easy access in an emergency, or when an IBMer is traveling.

The ultimate goal is to enable all types of electronic health information, including one's lab results, prescription histories, medical images and more to flow into the record to form a comprehensive, portal portrait of a patient.

Equipping and empowering patients with personal health records is only the start. Enabling such data to flow electronically to doctors, hospitals and other providers authorized by the patient will allow health care to become a highly interoperable, and innovative, system … something it is far from today.

We expect that personal health records (and the standards-based systems to manage their exchange) will do for health care what the Web browser did for the Internet: create rapid growth and adoption of an entirely new platform for societal innovation.

The model for such high-level transformation is already evident in the global system for secure financial transactions we encounter daily: in ATMs and credit cards, stock markets and electronic billing systems.

The benefits of "wiring" health care into a coherent information exchange are far reaching, from saving lives by preventing medical errors and improving diagnoses, to saving billions of dollars by eliminating redundant tests and streamlining the byzantine payment and administrative processes in health care that vex so many Americans.

Chairman Porter's bill will help lead this critical transition to digital health care by requiring that federal employees be provided personal health records that allow the exchange of health information in standard electronic formats. IBM strongly supports the use of standards to exchange data within the health system, and applauds the role that our federal government can play in catalyzing the proliferation of electronic health records.

Just as the value of a network rises exponentially with the number of devices connected to it – the so-called network effect – the power of the personal health record will rise dramatically the faster we can build a critical mass.

What's more, with a large enough base of personal health records, the private and public sectors will create strong incentives for physicians, hospitals, and other health system participants to begin to adopt the infrastructure for health care that will improve quality and reduce costs.

Of course, personal health records offer the federal government the same advantages – improved quality of care and associated cost savings – that persuaded IBM to become arguably the nation's largest enterprises to adopt PHRs

But personal health records will also drive two vital changes in the nature of health care itself. First, they will increasingly make the patient the centerpoint around which health care organizes itself. And second, personal health records and their related systems will support greater transparency across health care, and in many dimensions, including prices.

To this first point, national surveys tell us that nine of ten consumers want to be more involved in managing their health care (Hart Research). Fifty-two percent want to make final treatment decisions for themselves or a family member, and 38% want to make decisions together with their doctor (Rand).

President Bush in his 2006 State of the Union address, emphasized that Health care Savings Accounts, or HSAs, were a tool for consumer empowerment, along with personal health records.

To the second issue of transparency in health care President Bush also noted in the State of the Union that Americans should be more able to access information about the price and quality of health care. A digital information infrastructure will be essential to enabling this lever of innovation.

Indeed, President Bush also said that the Administration will work to develop nationwide IT standards to accelerate patient access to electronic records, so this bill strongly resonates with the will of the people and this President's agenda for health care.

It comes as no surprise that if the value of PHRs and digital health are to be fully realized, the security and privacy of patient information must be ensured. Fortunately, the Federal Family

Health Information Technology Act of 2006 includes sensible mechanisms to safeguard the privacy of the federal employees' health data, including controls to set access to the PHR.

Meanwhile, the bill offers innovative approaches to encourage providers to exchange health information with the patient's PHR. We believe that both privacy protections and provider incentives are critical if significant exchange of health information is to occur.

To put IBM's experience with personal health records in some context, I would first like to describe our broader efforts on improving employee health and reducing costs. That backdrop is, in fact, how we progressed to offer personal health records for our employees.

In today's information-rich, consumer-driven environment, we see patients seeking greater control over their health care, much as they have taken center stage in other spheres, from their finances to their entertainment. Information-empowered patients – which each of us undoubtedly want to be – can apply their greater knowledge to improve their health and to hold down costs.

As a result of our consumer-centric health programs for employees, IBMers are healthier and have lower health expenses than others in our industry. We have demonstrated that information-rich, patient-centric wellness programs aren't marginal benefits. They are very good business:

- IBM's employee injury and illness rates are consistently lower than industry levels.
- We have documented significant decreases in the number of health risks among IBM employees as a result of participating in our wellness initiatives.
- IBM's disease management programs have demonstrated a 9%-24% reduction in emergency room visits and a 13-37% reduction in hospital admissions resulting in an overall 16% reduction in medical and pharmacy costs adjusted for medical trend over a 2 year period.

With the health improvements, we have seen cost benefits – IBM health care premiums are 6% lower for family coverage and 15% lower for single coverage than industry norms. Our employees benefit from these lower-cost as well – they pay 26 to 60% less than industry norms. And IBM health care premiums have been growing significantly more slowly than US health insurance premiums.

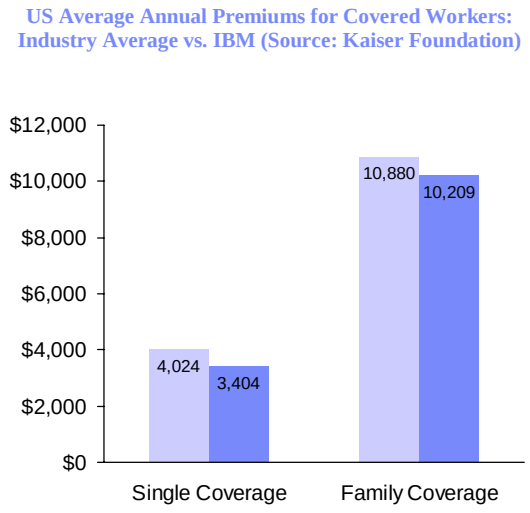

Figure 1: Annual Premiums

The health and improvements and cost reductions are the result of over 40 programs managed by my department. These programs include health promotion, industrial hygiene and safety, medical management, and benefit design.

We have also had significant success in improving the management of care for employees with chronic problems such as asthma and diabetes. In total, our well-being programs drive over $100 million in annual savings. However these programs have limits--they rely on retrospective data and in most cases patient self-selection.

Prospective health care involves collaborating with the employee in a more coordinated fashion to prevent health care problems – in effect, heading problems off before they occur. IBM is developing patient-centric programs that are doubly proactive: they both reach out actively to a wider range of employees, and are more able to help them anticipate and manage health risks.

The personal health records that we are providing to all of our employees in the US are a prime example of this patient-centered approach. When an IBMer first goes to the Web site for their personal health record, they are offered a financial incentive to complete an employee health risk appraisal, develop a personal preventive care action plan and identify quality hospitals in their area.

The process surveys a range of issues including exercise level, family histories and cholesterol control, if applicable. Based on the results, an IBMer can subscribe to receive expert information, articles and advice on how to reducing their risks. It identifies eligibility for additional benefits and services such as disease management and refers employees to those resources. Decision support tools for drug comparison and interactions, hospital quality and Leapfrog results (from the Leapfrog Group's performance measurement system) provide individual support for optimizing benefits quality and costs.

For IBM, the risk assessment tools and the personal health records we provide our workforce are an investment that we recoup through improvements in employee health and the significant cost savings that result. For individual employees, the incentives we provide – to take the assessment, or track their self-paced exercise regimens – are essential to helping us capture these business benefits.

The effectiveness of these "carrots" are why IBM also supports the provisions in the legislation that would offer incentives to providers to adopt electronic health records. In fact, IBM is already implementing a similar incentive plan.

In New York's Hudson Valley, where many of our employees live, we are funding a program that rewards doctors each time they use a new electronic system for writing prescriptions (e-prescribing).

Even large companies, like ours, need incentives. IBM is one of four companies selected as prime contractors to build the prototype of the Nationwide Healthcare Information Network (NHIN), the prototype of just such an interoperable infrastructure that would transform care via personal health records and deeply interconnected medical communities. These contracts were awarded by the Office of the National Coordinator of Health IT (ONCHIT) at the Department of Health & Human Services.

* * *

I would like to turn now to highlight a few provisions in the Federal Family Health Information Technology Act that our IBM experience would support.

- Exchange of Data is eased by Use of Standards
  - The legislation would require that federal employee health benefit carriers provide carrier electronic health records that are able to exchange health information in open standards.
  - Health information will be enabled to be imported from a provider based electronic health record consistent with standards adopted by the Department of Health and Human Services/Office of the National Coordinator for Health IT (ONCHIT).
  - The legislation requires that federal employees who change carriers be able to transfer information between carrier electronic health records if the employee changes plans.

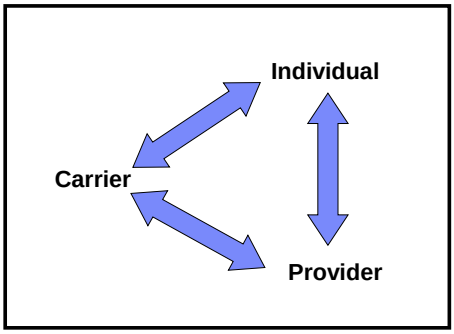

Figure 2: Health Information Flows

- Building on Existing Sources of Health Information
  - The legislation would leverage existing claims data by inserting it into the carrier electronic health records and move through stages to allow exchange of health information with the federal employee's personal health record and provider's electronic health record.
- Privacy and independence
  - The legislation restricts access to the personal health record to those with authorization from the federal employee and specifies full compliance with the Health Insurance Portability and Accountability Act (HIPAA).
  - The personal health records could be provided by a vendor independent from the carrier.

As the interoperable network grows, it will allow federal employees to view their prescriptions, treatments, and other health records – and exchange personal health information as they choose.

The legislation provides several incentives to drive the system of interoperable health records within the limitations of the federal employees health benefits program. First, the Act establishes a trust fund that can receive donations to be used to award grants to health care providers for implementing interoperable electronic health records. Second, the legislation provides that the office of personnel Management can use unused portions of contributions set aside in the Employees Health Benefits Fund to assist carriers.

These incentives will be helpful, but clearly additional incentive from other sources would increase the rate of individual use and provider adoption of electronic health records.

Improving the Quality of Care via the Internet and Interoperable Information

National surveys tell us that more and more Americans look to the Internet for health information. In 2004, half (51%) went online for health information; this equals 111 million Americans, up from 54 million in 1998 (Harris). In 2005, eight of ten (80%) Internet users searched online for health information (Pew). In addition, more than seven of ten Americans (72%) favor establishing nationwide electronic health information exchange, and six out of ten Americans (60%) support creating a secure online PHR (Markle).

A subset of consumers (12%) also used the Internet to research health providers' costs or quality in the past year, according to a 2004 survey (Forrester Research). As consumers take more responsibility for their own health care, this percentage will increase.

All of this evidence points towards the emergence of a new model of health care, one not centered around payers or providers, but consumers of health care. At IBM we call this market shift Patient-Centric care. And we are organizing our efforts, as a leading employee and facilitator of business innovation, to speed its arrival.

Because it is designed to be controlled by the consumer, the personal health record clearly differs from records that medical professionals may collect and maintain, so-called electronic medical records (EMRs). Today, the EMR systems that are in place are used to document episodes of care delivered within hospitals or in physician practices.

While patients are entitled under HIPAA rules to get copies of all their medical records from providers, in practice much of this information remains stranded, either in paper form, or because there is no uniform way to extract data from electronic systems. The President's initiative focuses on implementing interoperable electronic health records that would reach across time and place to create longitudinal personal health records for every American.

The PHR: A Digital Bridge

The transformation of health care from paper and analog records to digital medical data will not be instantaneous, but a gradual transition over several years. During the switchover, the personal health record can serve as an operational bridge, filling in the gap for the provider at the bedside or in the clinic, or helping a patient's various providers have a more complete picture, even before a fully interoperable health care network emerges.

The ultimate role of a personal health record is to capture the full range of data relevant to an individual patient from a variety of sources and institutions, and to be able to share that data with the electronic medical record systems of appropriate providers.

Such electronic sharing of patient data is even more pressing today in light of the Katrina hurricane tragedy, in which thousands of patients' paper records were destroyed, or were inaccessible when patients were relocated.

A personal health record, for example, should allow diabetics to track their daily blood glucose reading, upload the results directly and digitally from their glucometers into their personal health record, and make that information available to the electronic health record systems that providers use to help them manage their condition.

Advocates propose a wider range of content in future personal health records than is possible today, through linkages to multiple data sources and informatics tools.

Types of Data in the Future PHR

- Self Reported/Validated Personal Data
- Personal Emergency Response Clinical Data
- Comprehensive Lifelong Medical Summary
- Comprehensive Lifelong Dental Summary
- Medical and Dental Plan Benefits and Transactions
- Personal Clinical Reference Library

- Decision Support Tools
- Authorized PHR Custodians and Other Users

PHR Benefits

The personal health record is essential to efforts "to improve the quality and efficiency of health care and the ability of consumers to manage their care and safety" – the very same objectives of the Nationwide Health Information Network (NHIN). By giving consumers the tools and the information they need to actively manage their own care, personal health records serve as a trusted knowledge resource to enhance access, quality, and continuity in all sectors of health care.

Consumers report that they want the benefits personal health records promise. According to a survey by the Markle Foundation, Americans would use personal health records to check for mistakes in their medical record (69%), check and fill prescriptions (68%), get lab results over the Internet (58%), and conduct secure and private email communication with their doctor or doctors (57%). Clearly, these capabilities mean convenience and reassurance for the consumer, but they also promise better and safer care. As the private-public collaborative known as Connecting for Health reports, "inadequate availability" of patient information, such as laboratory test results, is "directly associated" with 18% of adverse drug events. Such events are not uncommon: "More than one in five Americans report that they or a family member had experienced a medical or prescription drug error." (Commonwealth Fund Website)

Chronically ill patients, major users of health care services, are also eager to use personal health records. This is no small matter. About half of all Americans (than 125 million) have one or more chronic illnesses, and care for these conditions amounts to 78% of the nation's health care expenditures. (State Official's Guide to Chronic Illness)

According to the California Health care Foundation, chronically ill patients indicated they would share their personal health information with doctors not involved in their care for better coordination of medical treatment (60%), enhanced coverage/benefits (59%), access to experimental treatment (58%), to find current information on medical developments (54%), or gain financial incentives (52%). As experienced users of the health care system, chronically ill patients realize the benefits of bringing together health data and information from multiple sources into a single, coherent record.

Health plans and employers understand that increasing patient compliance with clinical guidelines benefits them by keeping plan members healthy and employees productive. . As more and more of health care costs are assumed by employees, consumers will have greater motivation to search out quality data and take action on trusted recommendations for closing care gaps and optimizing benefits. Given the changes in pension plans and concerns about Medicare solvency, consumers are less confident that health care benefits will be available as they age. It is reasonable to expect the numbers of consumers who choose to leverage tax advantaged health savings accounts (HSAs) to increase over the next five years. Health plans are well prepared to meet the requirements of savvy consumers who expect their PHR to include the balance in their HSAs and realized investment returns – a view of financial preparedness to handle future health care costs.

Such knowledge in the hands of the consumer can improve clinical outcomes, is non-invasive to physicians, and saves real dollars across the ecosystem.

Critical Issues to Consider

Standards

Technical standards are essential to achieving comprehensive interoperability of health care systems. Without technical standards, there will be multiple electronic health records that cannot "talk" to each other. Both regional health information organizations (RHIOs) and the contractors building the Nationwide Health Information Network (NHIN) are working to foster comprehensive standards so health care organizations implementing electronic health records and personal health records. Today, consumers are often unable to transfer or migrate their personal health information when they change health plans or providers, or change jobs, especially if their employer is the personal health record sponsor. Interoperable standards could allow the migration of data from one solution to another, but that is not a reality today and, given the use of unstructured text entries, may not be a reality for quite some time.

Translation of Health Data into Understandable Records

For PHRs to empower patients, the information in them must be presented in understandable terms and language, not medical or scientific jargon. Despite growing momentum for technical standards to create electronic interoperability, "a mechanism for meaningful translation to engage consumers is lagging." Even if, for example, a diabetic can use his PHR to find the results of his hemoglobin A1c test, the information may not be useful. "Without standards for translating raw health data into simple terms and integrating the data with other essential information and infrastructure tools, individuals who manage their own health records may still feel overwhelmed or lost."

Privacy

According to a 2005 survey, two-thirds of all Americans report high levels of concern about the privacy of their personal health information, with ethnic and racial minorities and the chronically ill showing the greatest concern:

- Is of a racial/ethnic minority: 73%
- Is not of a racial/ethic minority: 52%
- Has been diagnosed with a disease: 67%
- Has not been diagnosed with a disease: 63%

One in four consumers report being aware of incidents where the privacy of personal information was compromised. In addition, they believe (erroneously) that paper records are more secure than electronic ones (66% vs. 58%). (California Health care Foundation)

These attitudes about privacy are reflected in the requirements consumers indicate are important for electronic health information exchange. Nine of ten consumers want a system that confirms the identity of anyone accessing it. Eight of ten want to personally review who has accessed their information, and to be asked before their information is shared. (Markle) Clearly, privacy issues, and the public's perceptions of those issues, must be addressed in order for personal health records to succeed. One way to accomplish this would be to develop a standard and simple format to be incorporated into personal health records that would explain privacy policies and rights available to consumers.

Incentives for Adoption and Use

Establishing a system of electronic health records will be limited by the availability of incentives. Individuals, providers, and other participants have to bear the direct costs of establishing the electronic health records, and the indirect cost to transform their established processes to use them. The current U.S. health care system pays providers based on volume and not quality. Those reimbursement flaws have also retarded the establishment and use of interoperable electronic health records. While the legislation establishes some additional incentives, reforms in reimbursement and additional sources of funding will have a dramatic impact on the adoption and health value of the electronic health records created by the Act.

Summary

- Personal Health Records (PHR) are a central component in transforming health care into a more innovative and efficient system. In 2005, IBM implemented a PHR for its U.S. workforce and strongly endorses legislation to make a PHR available to all federal employees.
- PHRs are one critical component in the larger effort to create a comprehensive infrastructure for the electronic exchange of health care information: from patient to doctor, between doctors and other providers, and for the advance of public health on many fronts, including clinical genomics and pandemic preparedness.
- PHRs, Health Savings Accounts (HSAs) and many other aspects of the move toward digital health care reflect the emergence of a new model of health care, one in which the patient is the center and organizing principle around which care will evolve.
- Managing the health and wellness of a workforce, whether at IBM or across the federal government, is today a strategic investment that can pay very substantial dividends and promote greater economic competitiveness and capacity to innovate.

Use or disclosure of data contained on this sheet is subject
to the restriction on the title page of this proposal.

Attachment 5: EHR's Sharing Knowledge While Preserving Privacy

Refer to the file hcm-elec-health-records-share-knowledge.pdf

Attachment 6: University of Virginia Study Paper

Refer to the file Virginia paper.pdf

Attachment 7: Overview of IHE Integration Protocols

The excellence of the IBM HIE technology in integrating data from other clinical systems was demonstrated in two recent activities: the IHE Connectathon and the Interoperability Showcase hosted by the Healthcare Information and Management Systems Society (HIMSS).

The Connectathon sponsored by the IHE is one of the most important yearly industry events to promote interoperability in healthcare. This IHE testing process provides coordination, tools and an opportunity for face-to-face interoperability testing for vendors of imaging and information systems who wish to implement IHE integration capabilities. This process culminated in the face-to-face Connectathon held in Chicago in January 2006. Vendors who meet the Connectathon's required level of performance are permitted to participate in an important industry demonstration, the Interoperability Showcase at HIMSS 2006 in San Diego in February. IBM participated in several important roles and received a Connectathon Gold Star, the highest honor from the IHE, for all roles we chose to play. (We were the only systems integrator to receive a Gold Star.) Our XDS Registry interacted with systems from all major medical IT vendors – e.g., GE Healthcare, Siemens, and Kodak – as well as with many other smaller vendors. In fact, we were able to show interoperability with a total of 28 vendors. Refer to Attachment 10 for a list of the 28 vendors, and what IBM components were tested with each one.

The IHE Profiles are central to our architecture. The following are the relevant IHE Profile Definitions as specified in the IHE ITI-TF1:

- **IHE Patient Identifier Cross-Referencing (PIX)**

The PIX profile provides cross-referencing of patient identifiers from multiple Patient Identifier Domains. These patient identifiers can then be used by identity consumer systems to correlate information about a single patient from sources that know the patient by different identifiers.

- **Patient Demographics Query (PDQ)**

The PDQ profile provides ways for multiple distributed applications to query a central patient information server for a list of patients, based on user-defined search criteria, and retrieve a patient's demographic (and, optionally, visit or visit-related) information directly into the application.

- **Cross-Enterprise Document Sharing (XDS)**

The XDS profile enables a number of healthcare delivery organizations belonging to a clinical affinity domain (e.g., a community of care) to cooperate in the care of a patient by sharing clinical records in the form of documents as they proceed with their patients' care delivery activities. This profile is based upon ebXML Registry standards, SOAP, HTTP and SMTP. It describes the configuration of an ebXML Registry in sufficient detail to support Cross Enterprise Document Sharing.

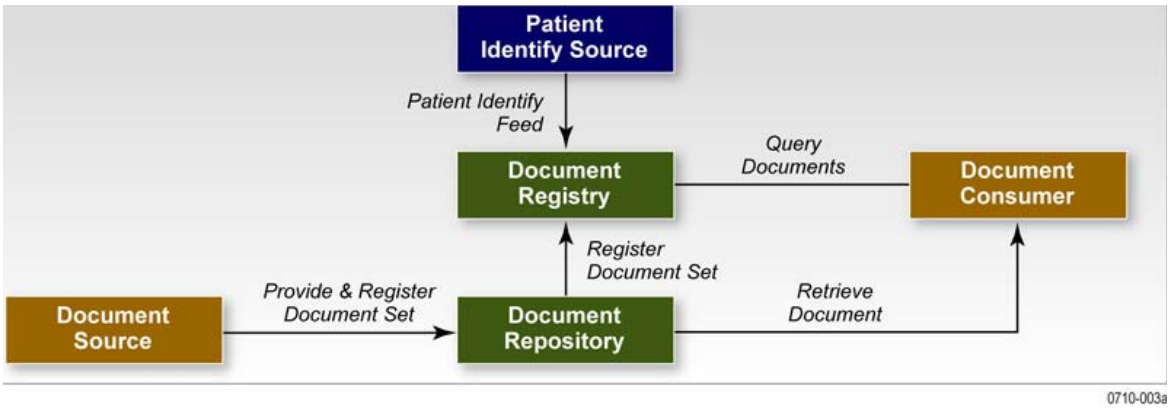

Figure 3: High-Level View of Architecture Comprising an IHE XDS-Compliant System

When a data source wants to become a member of the healthcare network (an **XDS Document Source)**, it provides its document set to the **XDS Document Repository,** which supports a set of clearly defined protocols. Alternatively, it can itself become an XDS Document Repository. The XDS Document Repository then registers the document set with the **XDS Document Registry** by providing pointers to the data in the Document Repository (typically a set of URIs), along with enough metadata to enable retrievals of individual documents in the set (e.g., patient id, record type). At the same time, the global patient id is substituted for the local patient id, based on a query on demographics to the **PIX/PDQ Patient Identity Source**. These steps are sufficient to make data available to other members of the same Clinical Affinity Domain (e.g., the same healthcare market). In a large setting like PHCIE, the XDS Document Registry must also propagate this metadata to the **Federated XDS Document Registry**. While the current XDS profile prescribes a means of sharing documents within a single Clinical Affinity Domain, the IHE IT infrastructure roadmap for 2006 indicates upcoming support for the concept of sharing documents between several Clinical Affinity Domains. IBM Research is a key player in defining this hierarchical document registry.

Retrieving clinical data on a particular patient is done in the XDS profiles by an **XDS Document Consumer.** The Document Consumer asks the Document Registry for pointers to the relevant data in the XDS Repository, based on input metadata values. The PIX/PDQ Patient Identity Source provides the global patient identifier, based on the input local patient identifier and demographic data. Once the Document Consumer has retrieved pointers to the documents in the Repository, it can display a summary view of the data, allowing the user to retrieve the desired full documents from the appropriate Document Registry. In a larger, state-wide setting, the query might be passed up the Document Registry hierarchy to identify relevant documents in other communities. The Consumer would then be able to retrieve data from a faraway community, without having to know where the data resided.

Attachment 8: Summary of Supported Healthcare Standards

	2006 Standard	IBM Support for Standard/Comments	2010+ Standard	IBM Support for Standard/Comments
1) Administrative and Financial	ASC X12 HIPAA	HIPAA transaction sets are fully supported by IBM's WebSphere product suite.	ASC X12 HIPAA	As they evolve, the HIPAA transaction sets will continue to be fully supported by IBM's WebSphere product suite.
2) Allergies	N/A		N/A	
3) Clinical Documentation	ASTM HL7 v2.x	HL7 v2.x message sets are fully supported by IBM's WebSphere product suite.	HL7 v3.x + CDA	IBM's WebSphere product suite can (already) be used to convert HL7 v2.x message streams into HL7 v3 message streams and/or HL7 v3 CDA formatted documents. IBM WebSphere products will continue to fully support HL7 v3.x as it evolves.
4) Imaging	DICOM for Radiology (Messaging)	IBM is an active member of the DICOM Standards Committee. IBM uses commercially available DICOM libraries to integrate imaging devices, archive storage, analysis, and display systems into enterprise solutions for healthcare and biomedical research customers.	DICOM for Imaging	IBM is an active member of the DICOM Standards Committee. IBM products will continue to provide support for DICOM standards as they evolve.
5) Immunization	HL7 v2.x	HL7 v2.x message sets are fully supported by IBM's WebSphere product suite.	HL7 v3.x	IBM WebSphere products will continue to fully support HL7 v3.x as it evolves.
6) Lab Results	ELINCS HL7 v2.x (Messaging)	HL7 v2.x message sets, including the three ELINCS HL7 message types, are fully supported by IBM's WebSphere product suite.	ELINCS HL7 v3.x	IBM WebSphere products will continue to fully support HL7 v3.x as it evolves. The three ELINCS HL7 message types are no exception.
7) Medication	HL7 ePrescribing NCPDP SCRIPT	HL7 v2.x message sets and NCPDP SCRIPT are fully supported by IBM's WebSphere product suite.	HL7 v3.x (mapped)	IBM WebSphere products will continue to fully support HL7 v3.x as it evolves.
8) Services	Non-existent	IBM has demonstrated its support for the IHE XDS, PIX, PDQ, ATNA, CT integration profiles at HIMSS. IBM's WebSphere product suite also fully supports WSDL/SOAP web services.	HL7 (OMG)	IBM personnel are active on many HL7 & OMG committees and interest groups , including SOA4HL7. IBM products will continue to provide support for HL7 and OMG issued standards & specifications as they evolve.
9) Vocabulary	SNOMED CT, LOINC, ICD-9, CPT-4	The proposed solution provides code set and medical nomenclature management and mapping, supporting a variety of medical vocabularies, including SNOMED, LOINC, ICD and CPT	SNOMED CT ICD CPT	IBM is committed to utilizing vocabulary standards in its projects and will continue to support initiatives that aim to provide common terminology services.

Attachment 9: Initiate Systems' Probabilistic Matching Algorithm

The PHCIE's PIX/PDQ server uses a probabilistic algorithm to compare records. Through integration with our Initiate Systems business partner, our PIX/PDQ server uses one of the most proven and field-tested algorithms on the market. During the past 17 years, the algorithm has been used to analyze over 2 billion records. Importantly, a significant number of those predictions have been field verified during the course of data cleansing/MPI remediation projects. The results of the on-site verification have been channeled back to data scientists resulting in a natural continuous improvement loop, resulting in few false positives (mistaken matches) or false negatives (missed matches).

Technology to enable probabilistic matching is imperative if computers are to replicate, consistently and effectively, the evaluation and judgment processes of human clerks attempting to link common records. Ideally, computers would emulate the intuitive thought processes of human beings as they review, judge, evaluate, measure, and score linkage qualifications of records representing commonality. Neither the technique of shared identifiers nor the deterministic matching method is able to match records under conditions of uncertainty. Only probabilistic matching mimics the human ability to recognize that two slightly dissimilar records are in fact the same object.

Probabilistic Algorithm

The theory of probabilistic matching, pioneered by statistical decision theorists Fellegi and Sunter in the 1950s recognizes that each field-by-field comparison is subject to error. This approach considers both the probability of a mismatch between data values in two records that represent the same entity and the probability of a coincidental match between two records representing distinct entities. When one calculates the likelihood ratio that the records refer to the same entity as compared to the hypothesis that they refer to different entities – while allowing for incomplete values and/or error conditions within the records – the process is said to be probabilistic.

The Importance of Probabilistic Algorithms

The problem of record matching can be addressed by one of three standard approaches:

- Matching through shared identifiers
- Deterministic matching (sometimes called exact match logic)
- Probabilistic matching

Matching through shared identifiers only works when there is a reliable identifier (such as an MRN number) that is completely and consistently populated in the data sources and is absolutely free from recording error. When such an identifier is not available, as is often the case, one of the other two techniques is required.

Deterministic matching examines a subset of attributes and marks two records as referring to the same member if they agree on this subset. A simple example would be to link two records if they agreed on last name, first name, and phone number (many real-world examples have complicated rules which deal with missing attribute values and other anomalies). The two main drawbacks to this approach are that it often misses matches because of variations in data values (e.g., "ROBERT" versus "BOB") and that this technique does not scale well to large

datasets because it does not take into account attribute frequency. For example, a match on the last name “SMITH” does not mean as much as a match on the last name “EINSTEIN.”

Probabilistic matching avoids the drawbacks of the other two approaches by recognizing the variability in attribute values and incorporating that knowledge into the decision whether to match or not. Among the approaches to record matching, probabilistic matching allows the greatest flexibility and provides the highest accuracy. Neither the technique of shared identifiers nor the deterministic matching method is able to match records under conditions of high variation in the data. Only probabilistic matching mimics the human ability to recognize that two slightly dissimilar records are in fact the same object. Enhanced Soundex and NYSIIS phonetic encoding is used so that thorough searches are completed on the names. Look-up tables are used to equate formal and informal names (e.g., James and Jim will receive the same phonetic encoding).

Our scoring algorithm addresses facility or source system-specific variations in population names and demographics. The weight table is derived from source system specific data. A typical example deals with a last name of Hernandez. Hernandez in California would receive a lower score than Hernandez in Wisconsin if name attribute value “Hernandez” occurred less frequently in the Wisconsin data source than in the California data source. Construction of the weight table and threshold settings based on the organization’s own data takes advantage of the uniqueness and nuances of the actual data. The algorithm can also be configured to take advantage of different weight tables depending upon the sources being compared. This is an important feature in an enterprise spread across large geographical areas where significant differences in the data are expected.

Comparison functions operate at the attribute level and determine the degree to which the attributes match. These functions can be simple binary functions, either the attributes agree exactly or not, or complicated hierarchical comparisons involving phonetic coding and edit distance functions. The algorithm relies upon a unique library of comparison functions to catch a wide range of recording errors across many different types of attributes. Based upon analysis of the data, it selects the right comparison function for each attribute available for matching to yield the highest levels of matching accuracy. These functions include:

Name comparison that:

- Uses a comparison hierarchy for each name token, considering exact match, nickname match;
- Examines name-to-initial match, and phonetic match;
- Tests possible token arrangements between the two records; and
- Eliminates anonymous values, such as TEST, before comparison.

Address and phone comparison that:

- Standardizes the address;
- Employs intelligent parsing when the address cannot be standardized to extract useful match information;
- Tests for typographical errors; and
- Recognizes and comprehends the statistical correlation between address and phone matches.

Date evaluation:

- Comprehends year frequency
- Eliminates anonymous dates as determined by frequency analysis
- Comprehends typographical errors
- SSN and other license number comparisons that comprehend typographical errors
- Email address comparison
- Credit card number comparison
- General frequency-based comparisons that can be applied to many types of attributes such as birthplace, race, gender, and key words
- General distance comparisons that can be applied to attributes such as part numbers and account numbers

The set of robust comparison functions (listed above), based upon data experience, provides a good foundation for an accurate matching system. Scoring and thresholding apply statistical theory to build from this foundation.

The algorithm is designed for configurability, so it can be tuned to meet the specific needs for the HHS PHC HIE. The implementation effort involves establishing the right set of weights and criteria which is the most effective for an organization's particular goals.

Attachment 10: Vendors Testing with IBM Systems at Connectathon 2006

	IBM Registry/ Repository	IBM PIX/PDQ	CapMed/IBM PHR
Allscripts	X	X	
Blueware	X	X	
CapMed	X	X	
Compasscare	X		
Dictaphone	X		X
Eclipsys	X	X	
Epic	X	X	
GE	X	X	
HIPAAT	X	X	X
HXTI	X		X
Infinitt		X	X
Intersystems	X		
JohnChardin			X
Kodak	X		
Kryptiq	X	X	
McKesson	X		
Medinotes	X	X	X
Mieweb	X	X	
Misys	X	X	
NextGen		X	
Philips	X	X	
Quovadx	X	X	
Siemens	X	X	
Soft Medical	X	X	
Sovera	X	X	
St. Jude Medical	X	X	
Tiani-Spirit	X	X	X
Veterans Administration	X		

Attachment 11: Healthcare 2015

Refer to the file Healthcare_2015_Executive_Summary.pdf