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A National Healthcare Data Network for India

Vishal Batra[a], Tyrone Grandison[b], Sumit Negi[a], Ashwin Srinivasan[a]

[a] *IBM India Research Lab, Block C, ISID ,Vasant Kunj,, New Delhi 110 070, India*
[b] *IBM Almaden Research Center, 650 Harry Road, San Jose, California 95120, USA*

Abstract

The Indian healthcare sector is going through a period of significant transformation; moving from paper-based systems to electronic solutions. In order to be accessible to the current population and be able to cope with societal and technological advances, the new system has to be guided by present well-established medical practices in India and be designed and engineered to adapt and interoperate with other systems, both local and international. At the core of such a system has to be a well-designed data network. In this paper, we present our work on building such a network. We also highlight our design imperatives, which include the ability to address the issues of interoperability, scalability, privacy, security and extensibility in a very large data system.

Keywords:

India, Healthcare Systems, Healthcare Delivery, Healthcare Reform

Introduction

A safe and scalable information system is the essential backbone for building a nation-wide healthcare system to improve the quality of care, maximize operational efficiency, enhance planning & research and introduce cost-effective channels for delivering healthcare. The system needs to be able to evolve incrementally, build on the current traditions of medical practice and being able to explore new opportunities to eliminate inefficiency and reduce operational costs. In this paper, we describe the design of such an information system for the healthcare industry in India. We start off by discussing the current state of Healthcare in India and by presenting the factors driving the adoption of the National Health Data Network.

Method: The National Health Data Network

Most of the healthcare records in India are on paper and the health transactions are managed manually, with the exception of a few private hospitals. Manual data management invites error, inefficiency and significantly reduces the possibility of timely analysis of data to detect health-related emergencies such as an outbreak of a communicable disease in a particular city or state. The manual practice for exchanging the health data outside the enterprise introduces errors and inefficiencies into the system. The IT infrastructure in the private-sector hospitals cannot be utilized effectively for information exchange with the agencies having limited or no IT support.

The lack of data standards for integration and communication under-utilize the investments; as the health data will lie un-leveraged and fragmented across the primary, secondary and tertiary health institutions. The fragmented data continues to add to errors and duplication and will in the future demand higher technology investments to integrate diverse systems hosting data. Thus, it became clear that it is crucial to establish a standards-based, safe and secure IT backbone that can naturally enable the collaboration of health institutions nationwide and could virtually tie together a network of providers so that operational, clinical, and financial synergies can be realized.

Keeping the unique attributes of the Indian health industry in mind, IBM submitted a report in early 2005 entitled "Improving India's Healthcare System through Information Technology" to the President of India. This report made three principal recommendations:

- Adoption of electronic storage of data at all stages (including health records)
- Adoption of standards for communication and storage
- The construction of a nationwide health data network for sharing health information

These recommendations were expected to benefit the Indian society in the following areas:

- Operational efficiency (insurance, drug supply chain processing improvements, etc)
- Planning and management (disease surveillance, resource mapping etc)
- Education and research
- Cost effective and improved healthcare delivery

Our work takes an initial step towards addressing the recommendations in the IBM report to the president of India. The IT backbone infrastructure that we have designed facilitates sharing of information among heterogeneous data sources. The health institutions can use the infrastructure as an underlying network to collaborate in a safe, secure, scalable and fault-tolerant environment.

Discussion

Deployed over the Internet, NHDN is a special-purpose network to facilitate collaboration among health enterprises in a safe, secure, scalable and extensible environment based on the healthcare industry standards. The healthcare application service providers (HASP) can deploy their applications and services over this *virtual private health network* in the same way ASPs deploy their e-commerce applications on the Internet. In the healthcare sector, examples of such applications include Hospital Information System, Electronic Health Record and Claim Processing applications.

Applications deployed over the health data network, naturally gain the ability to establish collaboration among healthcare enterprises and their IT infrastructure. The collaboration is based on *hub-and-spoke* architecture that is better than point-to-point communication that lacks scalability and extensibility. The hub-and-spoke model is organic in design and deployment and allows enterprises to adapt to business transformations, new partnerships, vendors and business expansion.

The following are the key design considerations for NHDN:

- The network should be ***safe and secure***
  - Only authorized entities should connect to the network
  - All communication on the network should be encrypted
  - All communication on the network should be delivered to the targeted entity and should not be accessible to other entities. Effectively, network should prevent any sniffing.
  - The network should allow data privacy policies and enforce them
- The network should be ***standards-based***
  - Industry standards should be used to write and read information from the network.
  - The network should be specific to the healthcare industry and should use industry standards to represent information packets on the network.
- The network should integrate with legacy systems and should provide data ***integration and federation*** from disparate systems
- The network should be ***scalable and fault-tolerant*** for a nation-wide deployment

A **NHDN Access Point** is designed and developed to include all the above considerations and enable the healthcare enterprises and application service providers to connect to the NHDN. The technical details of NHDN access point for each of the above considerations are described below:

- **Security**
  - The health data network is deployed over Virtual Private Network technology that offers authentication and data encryption over the network.
  - Authentication technology prevents any unauthenticated access and retrieval of information
  - Hippocratic Database technology is used to specify fine-grained disclosure policies based upon the role of the user, purpose of access, intended recipient.
- **Standards**
  - Structured Query Language (SQL) is adopted to read and write information on the network.
  - Clinical Document Architecture (CDA) is adopted to represent health information on the network.
- **Integration and Federation**
  - IBM WebSphere Information Integrator (WS-II) is deployed to perform data integration and federation and enable the network to integrate with the legacy and disparate information systems.
- **Scalable and Fault-tolerant**
  - Grid technology is used in the design and development of Health Data Network that offers scalability and discovery to integrate disparate health data repositories available on the network.

Healthcare software vendors can package and deploy applications (ex: claim processing application) on NHDN access point and leverage the safe, secure and scalable collaboration among healthcare enterprises on the health data network. The generic data federation and integration capability of NHDN access point offloads the applications from the need to integrate data from disparate systems. The grid capability of the data network transparently enables the healthcare applications to adapt the business transformations of a healthcare enterprise as new customers, vendors join the network or the existing ones drop off the network. The applications coded for and deployed over NHDN, can naturally adapt to the entities connected on NHDN without the need of redeployment.

Conclusion

India is undergoing massive change in the healthcare market. There is a push towards transforming all the paper-based system to their electronic equivalents. Obviously, there are obstacles in the way of this renovation. One of the biggest hurdles is to ensure that all these electronic systems can collaborate seamlessly and securely in an effort to reduce transaction cost, increase quality of care, increase efficiency and lower administration overhead. To enable this, a safe and

scaleable data network is critical. In this paper, we present the National Healthcare Data Network (NHDN), which enables secure and privacy-preserving collaboration, while being scaleable and fault-tolerant. NHDN is standards-based, extensible and is able to evolve as the healthcare landscape changes.