# Information Integration for Healthcare Interoperability

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## Background and Motivation

Health-care costs are rising dramatically. In 2003, the U.S. spent $1.7 trillion on health care, an increase over 2002 of four times the rate of inflation.[1] Errors in medical delivery are associated with an alarming number of preventable, often fatal adverse events. According to a recent estimate from the Institute of Medicine of the National Academies, "…at least 44,000 and perhaps as many as 98,000 Americans die in hospitals each year as a result of medical errors….Deaths due to preventable adverse events exceed the deaths attributable to motor vehicle accidents (43,458), breast cancer (42,297), or AIDS (16,516)."[2]

A promising strategy for reversing these trends is to modernize and transform the health-care information exchange (HIE), i.e., the mobilization of health-care information electronically across organizations within a region or community.[3] The current HIE is inefficient and error-prone. It is largely paper-based, fragmented, and therefore overly complex, often relying on antiquated IT. To address these weaknesses, projects are underway to build HIEs on the local, regional, and national levels.

On May 1, 2006, the White House stated that applying modern IT was one of the five key policies to make health care more affordable and available to all American families. The President observed that health-care providers take advantage of the most advanced technology for diagnosis and treatment, but continue to manage their medical records using antiquated paper-based filing systems.[4] A nationwide information network will protect the privacy of a patient's medical information while making health information available in real time. We are making good progress toward the President's goal that most Americans have an electronic health record (EHR) by 2014.

Healthcare Information Exchanges are being proposed and built on the local, regional and national level throughout the world. Some regional U.S. examples are California,[5] Massachusetts,[6] Delaware,[7] and Maine.[8] Examples on the national level are Canada,[9] the United States,[10] and the United Kingdom.[11] These large-scale interoperability efforts call for integrating data from a variety of organizations and agencies involved in clinical, public health, and population health information—including primary care physicians, hospitals, pharmacies, academic medical centers, and local, regional, and national public health organizations.

Critical to the success of this effort is a framework to promote interoperability among health information systems, both legacy and emerging. But different clinical use cases are best addressed by different interoperability approaches and architectures. For example, providing broad, integrated access to critical patient-care data by means of longitudinal EHRs might be best served by a loose federation of autonomous members of a provider network. In contrast, a population health analysis for disease management or clinical research requires periodic downloads of aggregated de-identified patient data. A one-to-many (publish-subscribe) architecture may be a good choice for public health monitoring and alerting scenarios. A healthcare claims processing system may best served by a one-to-one, peer-to-peer messaging architecture. For a more detailed description of healthcare interoperability use cases and architectures, see BA Eckman, CA Bennett, JH Kaufman and JW Tenner, “Varieties of interoperability in the transformation of the health-care information infrastructure”, forthcoming in the IBM Systems Journal Special Issue on Information-Based Medicine (2007).

## Information Integration Problems

Some of the information integration problems that need resolution to support healthcare interoperability (the HIEs of the future) include:

- Ontology integration/mapping (eg SNOMED to ICD9)
- “Wide area”, secure, auditable, fault-tolerant data federation supporting a declarative query language, for interoperability on the community, regional, and national levels
- Fast, semantics-aware XML data transformation (eg HL7 v2 -> HL7 v3 CDA) and normalization using ontologies
- Fine-grained privacy policy specification and enforcement within and across HIEs
- Tools to help users define favorite subsets/transformations of existing ontologies through which they prefer to query/retrieve data, based on already-defined atomic concepts
- Easy-to-use, lightweight, inexpensive, efficient ESBs, and a means to easily make legacy software available on the bus

## References

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