Query Health: standards-based, cross-platform population health surveillance

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Outline

- Introduction
  - Background
  - Objective
- Materials and Methods
- Results
  - Implementation
  - Pilots
- Discussion
  - Future Directions
What is a Learning Health System?

“The increased complexity of health care requires a sustainable system that gets the right care to the right people when they need it, and then captures the results for improvement. The nation needs a healthcare system that learns.” – Institute of Medicine, “The Learning Healthcare System”
What is a Learning Health System?

- Population Health Surveillance
- Improve care quality
- Post-market drug surveillance
- Comparative Effectiveness Research
- Dissemination of Evidence Based Medicine
What is a Learning Health System?

- Meaningful Use is an initial step toward LHS
  - Encourages adoption and use of EHR
- Query Health is a large-scale test of LHS functionality
  - Public-private collaboration
  - Developed standards and services to enable distributed, secure, standards-based population health measurement.
  - Distributed query model
    - Brings questions to the data and returns only minimum necessary information
  - “Query Health makes health data useful.”
Objective

- Define a **methodology** for distributed, secure, standards-based clinical queries.
- Develop a **reference implementation** using best-of-breed technological components.
- Implement components of this reference implementation at three **pilot sites**, to gauge the effectiveness of Query Health in real-world healthcare scenarios.
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Query Health Ontology

- C-CDA based instantiation of the National Quality Forum’s Quality Data Model
Query Health Ontology

- C-CDA based instantiation of the National Quality Forum’s Quality Data Model

MU2 CCD Profile
- Demographics
- Vitals
- Current List Of...
  - Problems
  - Medications
  - Allergies
  - Immunizations
- Procedures
- Family History
- Plan of Care
- Smoking, cognitive, and functional status
  ...

C-CDA

XML

Incentive Program

Health IT.gov

International
Query Health Ontology

- C-CDA based instantiation of the National Quality Forum’s Quality Data Model

![C-CDA based instantiation](image)
Query Health Ontology

- Demographic
- Patient Contact Information
- Payer Information
- Healthcare Provider
- Allergies & Adverse Reactions
- Encounter
- Surgery
- Diagnosis
- Medication
- Procedure
- Immunization

- Advance Directive
- Vital Signs
- Physical Exam
- Family History
- Social History
- Order
- Result
- Medical Equipment
- Care Setting
- Enrollment
- Facility
Query Format

National Quality Forum

113 CQMs

CMS

93 MU2 CQMs

S&I

HQMFr2 Revision

Anatomy of an HQMF query

- NQF 0059: Uncontrolled diabetes
  - The number of diabetes patients between 18-75 who have had a hemoglobin A1C test greater than 9% in the past year
Anatomy of an HQMF query

- **The Measure Period**: 1 year
- **The Data Criteria**
  - 18-75 years old [AGE]
  - Diabetes diagnosis [DX]
  - Diabetes medication [MED]
  - HgbA1C>9 [A1C]
- **The Population Criteria**
  - All Of:
    - AGE
    - A1C
  - At least one of:
    - DX
    - MED
Query Health Design

Investigators
Providers
Payors

Hospitals
Outpatient Clinics

Clinical Data Repositories

Data Partners Using Query Health Data Model

Query Composer

Request
Review
Response

HQMF

QRDA
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Query Health Reference Implementation

Investigators, Providers, Payors

Hospitals, Outpatient Clinics

Clinical Data Repositories

Query Composer

i2b2

Request

HQMF

hQuery

Data Partners Using Query Health Data Model

QRDA

Response

PopMedNet™
Secure Portal

DataMart Clients

NIH Collaboratory
Health Care Systems Research Collaboratory

MDPHNet

Mini-Sentinel
i2b2

Informatics for Integrating Biology and the Bedside
i2b2: Executing a Query
i2b2: The Timeline View

The image shows a screenshot of the i2b2 Query & Analysis Tool. The tool is used for querying and analyzing patient data. The screenshot includes a timeline view where specific data points are highlighted, such as dates and patient IDs. The timeline is accompanied by a list of conditions and disorders, along with patient information and demographic details. The interface is designed to help researchers and healthcare professionals access and analyze patient data efficiently.
i2b2: The SMART view
i2b2 for Query Health
i2b2 for Query Health

- PopMedNet Adapters and HQMF Translator
Step 1: Build Query (Investigator)
Step 2: Run Query (Data Partners)

Data Partners

i2b2

PopMedNet™

PMN Server Adapter

Data Repository (CRC)

File Repository

Project Management

Ontology

Optional Cells

HQMFTranslator

Workplace
Step 2: Run Query (Data Partners)

Data Partners

- i2b2
- CCD Document Database
- Developed HQMF query converter
Step 2: Run Query (Data Partners)
Step 2: Run Query (Data Partners)
Step 3: Wait for Results

PMN Client Adapter

PMN Server Adapter

i2b2

Finish Query: "Women" [4.8 secs]

Number of patients for "Women"
patient_count: 481±3

Number of patients for "Women"
patient_count: 481±3
Query Health Ontology

- A QDM-based instantiation of CCDA
- Implemented as an i2b2 ontology
Query Health Ontology: Modifiers

- Problem
  - Problem Code
    - Category Attribute
      - ICD9
      - NQF
        - NQF 0059
          - Diabetes
            - Category Attribute
              - Problem Date
              - Problem Status Code
                - SNOMED
                  - Active
                  - Inactive
                  - Resolved
                  - Problem Status Text
                - Problem Type Code
                  - SNOMED
                    - Cognitive function finding
                    - Complaint
                    - Condition
                    - Diagnosis
                    - Finding
                    - Finding of functional performance and activity
                    - Problem
                    - Symptom
                  - Problem Type Text
                - ICD10
                - ICD9
                - SNOMED
                  - Diabetic Retinopathy
                  - Gestational Diabetes
                  - Polycystic Ovaries
                  - Steroid Induced Diabetes
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Results: Query Health Pilots

Massachusetts Department of Health

The New York City Department of Health and Mental Hygiene

FDA Mini-Sentinel
Massachusetts eHealth Institute in collaboration with the Massachusetts Department of Public Health. MDPHnet is a population-based EHR surveillance network targeting a broad array of health indicators across multiple providers and delivery systems.

**Goal:** Implement Query Envelope security and authentication in existing public health surveillance network.

**Feedback:** The Query Envelope enhancements provide standards-based approach for distribution of queries and return of results.

**Composer:** PopMedNet

**Envelope:** PopMedNet

**Processor:** EHR Support for Public Health (ESP)
Electronic Support for Public Health (ESP)

Query

Response

Practice EMRs

diagnoses
lab results
meds
vital signs
demographics

Health Department

Massachusetts League of Community Health Centers
Atrius Health

Cambridge Health Alliance

JAMIA 2009;16:18-24
Am J Pub Health 2012;102:S325–S332
The New York City Department of Health and Mental Hygiene currently has a network of over 650 primary care practices that respond to distributed queries. This enables their teams of quality improvement specialists to provide regular feedback to the practices in order to respond to public health concerns for both chronic and acute conditions. The Department is adopting the Query Health platform to add additional practices and health information exchange organizations.

| Initial goal: Demonstrate standards-based vendor-neutral distributed analytics solution using Query Health Standards. | Composer: i2b2 |
| Current goal: Launch health information exchange-based solution to obtain aggregate city-wide healthcare statistics | Envelope: PopMedNet |
| Feedback: Standards-based aggregate distributed analytic solutions are now capable of delivering valuable results. Challenges remain in cross-site data harmonization. | Processor: i2b2 |
| | Other: HQMF, Ontology |
“The Hub” allows secure exchange of aggregate data with PCIP practices on the eClinicalWorks EHR
- Send out queries
- Receive patient counts overnight

The Hub currently covers:
- 700+ practices
- ~1.8 M patients per year
- 5 M+ patients since 2009

New York City Department of Health

Information Requestors

NYC PCIP

NYS DOH

Data Sources

HQMF

PopMedNet™
i2b2

New York City Department of Health

New York City Department of Health
The FDA's Mini-Sentinel project aims to monitor medical product safety using electronic health data. Mini-Sentinel is using Query Health standards implemented through PopMedNet for distributed querying and receiving results within a network of over 130 million individuals. The Query Health pilot investigates adding i2b2 clinical data repositories to the Mini-Sentinel network to expand the medical product safety monitoring capabilities of the network.

**Goal:** Expand medical product safety surveillance capabilities to i2b2 clinical data sources.

**Feedback:** Clinical data sources can provide important additional data for medical product safety surveillance. Resources required for data normalization and maintaining additional software at data partners must be carefully considered.

**Composer:** i2b2

**Envelope:** PopMedNet

**Processor:** i2b2

**Other:** HQMF
Query Health Reference Implementation

https://community.i2b2.org/wiki/display/queryhealth/Home

- HQMF<-> i2b2 Translator
- i2b2 Query Health Ontology
- PopMedNet v3 and adapter cells

http://www.popmednet.org

https://www.i2b2.org/software

https://github.com/hquery

https://code.google.com/p/query-health/downloads
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Discussion

- Query Health is a powerful test of the nation's progress toward an LHS.

- Query Health has:
  - Created a vendor-neutral, standards-based approach for distributed population health queries
  - Delivered an open-source reference implementation with several alternative configurations;
  - Co-developed a new revision of HQMF
  - Validated our system for three very different use cases.

- Challenges
  - Data access and interoperability
  - Maturation of standards (HQMf, QRDA, C-CDA)
Lessons Learned from Pilots and other activities indicate that implementing distributed queries across the nation will require multiple incremental steps each of which develop the capabilities required for distributed queries and Learning Health System in the long run.
Klann J, Porter A, Wattanasin N, Murphy S. Importing Continuity of Care Documents into i2b2 and SMART. In: AMIA Joint Summits. 2014. 143.
New York Population Health Registry

Stage 2 Meaningful Use Proposal

Information Requestors

- NYC PCIP
- NYS DOH

Data Sources

- Hospital
- Practice
- Other

Stage 2 Meaningful Use Proposal

NYC PCIP Sends Query to HIE

NYS DOH Returns Aggregate Results

Statewide HIE CCDA Repository (SHIN-NY)
A “network-of-networks” to support clinical research.

PCORnet Central to individual networks

Over 1/3 of PCORnet sites

pSCANNER network

Other Initiatives

- ONC Clinical Quality Framework
  - Harmonize HQMF and HeD
- Analysis of CQMs on clinical data
- NIH Research Collaboratory
  - New distributed networks involving PopMedNet and i2b2
- New SHRINE networks
- Learning Health Community
  - http://healthinformatics.umich.edu/lhs
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Questions?

- Jeff Klann, PhD
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- i2b2 wiki:
  - https://community.i2b2.org/wiki/display/queryhealth/Home