

OpenFurther: An Infrastructure for Clinical & Translational Research in a Distributed Environment

> AMIA Systems Demonstration November 19, 2013



Overview

- Introduction
- OpenFurther
- Technical Components of OpenFurther
- Deployments
- Demonstration of Federated Queries





Distributed Computing Environments

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Industry	Semantic Complexity	Penetration
Finance	Low	High
Travel	Medium	High
Retail	Low	High
Engineering	High	Medium
Defense	High	High
Translational & Clinical Sciences and Practice	Very High	Very Low



Federating Infrastructures







Heterogenous Federation

ADAPT (ADAPT) (ADAPT)





Design Goals

- Modular design to support component based implementation
- On-the-fly real-time federation of health information from heterogeneous data sources
- Data source partners do not need to extract data and/or build a new database
 - Data remains in its native format
 - Is as up-to-date as the data source
- Join data from multiple sources for research
- Framework to support granular security control to join targeted data across data sources





Typical Applications

- Cohort Finding for Prospective Research
- Comparative Effectiveness Research (CER)
 Infrastructure
- Public Health Surveillance
- Datasets for Observational Studies





OpenFurther : Demo Version

- Open Source Instance
- Demonstrative version that can be downloaded, tried, modified and deployed for testing and experimentation purposes.
- Public Datasets:
 - OMOP: Secondary data for Comparative Effectiveness Research
 - OpenMRS: Medical Record System
- Release: AMIA 2013
- http://openfurther.org/





OpenFurther Technical Architecture





OpenFurther

- Utilizes components available from standards organizations and open source initiatives
 - Service Oriented Architecture (SOA) and Enterprise Service Bus
 - Relevant to national projects
 - Architecture is open and sharable.
- Systematically support centralized and distributed governance models.



Component Overview

- · Query Tool
- Federated Query Engine
- Data Source Adapters
- Admin & Security Components
- Virtual Identity Resolution on the GO (VIRGO)
- Quality & Analytics
 Framework
- Metadata Repository
- Terminology/
 Ontology Server







i2b2/OpenFurther Query Tool Architecture



Federated Query Engine

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Security Components



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Virtual Identity Resolution on the GO (VIRGO)

On the fly demographics analysis for record linkage

- No permanent PHI storage
- Response composed of OpenFurther IDs

Algorithms

- Field-specific weights
- Adaptable to others

Technologies used

- Java, Groovy, Grails
- Web-services
- MySQL (temp storage)
- ElasticSearch (indexing)





Quality & Analytics Framework

A service oriented architecture that can assess the quality of heterogeneous electronic health data sources in a distributed environment.



Metadata Repository (MDR)

- Built in-house, standards-based
- Artifacts (Knowledge)
 - Logical Models, Local Models, model mappings
 - Administrative information
 - Descriptive information
 - XQuery Translation Programs
- Models supported Open Source Initiative
 - Local: FURTHeR, UUEDW, UPDBL, Intermountain Healthcare Datamart
 - Public: OMOP, i2b2, OpenMRS





Translating Metadata

Translating Coded Values

Data Element	Value Namespace	Value Code	Value Label
OpenFurther.Person.administrativeGender	SNOMED	248153007	Female
MDR Translate Metadata	Translate	Value	DTS
OMOP.Person.genderConceptId	OMOP	2940	Female

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Query Translation

Query: Females age 30 to 40 who have diabetes



Result Translation

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1,000 records require > 12,000 translations (Person data class only)



Terminology/Ontology Server

 Apelon's Distributed Terminology Server – an integrated set of open source components that provides comprehensive terminology services in distributed application environments

• Provides tools for:

- Management standard and local terminologies
- Mapping local to standards
- Browsing & Searching terminologies
- Creation subsets
- Extension of standards terminologies
- Versioning of terminologies
- OpenFurther includes a layer of web-services that leverage DTS APIs





DTS Terminology Content

Within UU's Installation

- ~25 Standard Namespaces (ICD-9,ICD-10, SNOMED, LOINC, RxNorm & More)
- ~33 Local Namespaces
- ~1 Million Concepts
- ~2 Million Total Mappings
- Subscribe for content updates

With Demo Installation

- Free content available from Apelon (subsets of ICD9, SNOMED, LOINC)
- Local content for two simulated data sources
 - Schultz Cancer Repository (OMOP Data Source)
 - Schultz Healthcare Systems
 (OpenMRS Data Source)
- Mappings between local data sources and standards
- Additional content could obtained from their respective sources or Apelon.





Deployments

- University of Utah FURTHeR: Cohort Identification & Datasets for Analysis
- PHIS+: Aggregated database for performing Comparative Effectiveness Research
- University of North Carolina: Cohort Identification







Vision for OpenFurther at the University of Utah





Comparative Effectiveness Research Infrastructure







- Augment Children's Hospital Association's (CHA) existing electronic database of administrative data - Pediatric Health Information System (PHIS) with clinical data to conduct Comparative Effectiveness Research studies.
- UU Biomedical Informatics Informatics Partners
- Agency for Healthcare Research and Quality (AHRQ) funded project.





PHIS+ Overview





5 Years Data	
2007 – 2011	
2009 – Development	
2012	







Developmental Process Overview



Narus et. al, Federating Clinical Data from Six Pediatric Hospitals: Process and Initial Results from the PHIS+ Consortium. AMIA 2011





PHIS+ CER Database – 2007-11

	🙀 Labora	atory	_		Radiolo	gу
Site	Results	LOINC Lab Test Code		Site	Reports	CPT Radiology Procedure Code
А	15,011,312	538		А	445,681	280
В	33,214,540	1,214		В	1,151,383	349
С	16,868,383	860		С	635,458	296
D	25,706,608	1,089	1,654,406 Kids	D	980,740	482
E	38,422,668	1,016		E	1,098,693	497
F	14,507,629	2,131		F	201,708	477
Total	143,731,140	*6,848 (2,992)		Total	4,513,663	*2,381 (714)

-	Micro	bio	logy
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Site	Culture Results	SNOMED Specimen Code	SNOMED Culture Procedure Code	SNOMED Organism Code	RxNorm Anti- microbial Code	Susceptibility Results	LOINC Susceptibility Test Code
А	247,933	114	70	113	57	487,813	97
В	359,780	58	42	56	58	393,594	85
С	231,071	179	46	162	59	340,100	99
D	335,606	110	34	145	57	376,844	75
E	486,315	130	56	160	59	605,000	76
F	176,848	264	71	121	51	283,865	89
Total	1,837,553	*855 (451)	*319 (95)	*757 (203)	*341 (74)	2,487,216	*521 (136)

* The first number is the total number of standard codes, the second in parenthesis is the distinct number of standard codes across all sites.



Thank You



Contribute to **PopenFurther**

Learn more at: openfurther.org

To contribute, join and/or post on our mailing lists, submit a pull request on GitHub, or a bug on JIRA.

Community email Lists:

openfurther-user@googlegroups.com for user and implementation discussion. openfurther-dev@googlegroups.com for development discussion. openfurther-security@googlegroups.com for security sensitive issues and discussions. otherfurther-commits@googlegroups.com for developer commits to version control

Source code: http://github.com/openfurther/



Reference manual:

https://github.com/openfurther/further-open-doc/blob/master/reference-manual.asciidoc

Bugs & feature requests: https://openfurther.atlassian.net XAtlassian



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- UU PPR/UPDB Team
- UU CHPC
- Collaboration Partners
 - Intermountain Healthcare
 - SLC VAMC
 - UDOH
 - PHIS+ Team members across 6 institutions
 - Children's Hospitals Association
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•Website: http://openfurther.org

