

SOA and Just-in-time Deployment of an Ad-hoc Surveillance System

Lessons from Katrina Relief Efforts at Houston

Parsa Mirhaji, MD

Arunkumar Srinivasan, MS

Narendra Kunapareddy, MS

S. Ward Casscells, MD

Raouf Arafat, MD

The University of Texas at Houston



The Problem





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- No existing or pre-coordinated information managements infrastructures, nor an established plan to address information acquisition and reporting needs
- Needs were immediate, no time for planning and new development



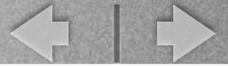
The Human Tragedy



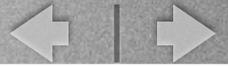
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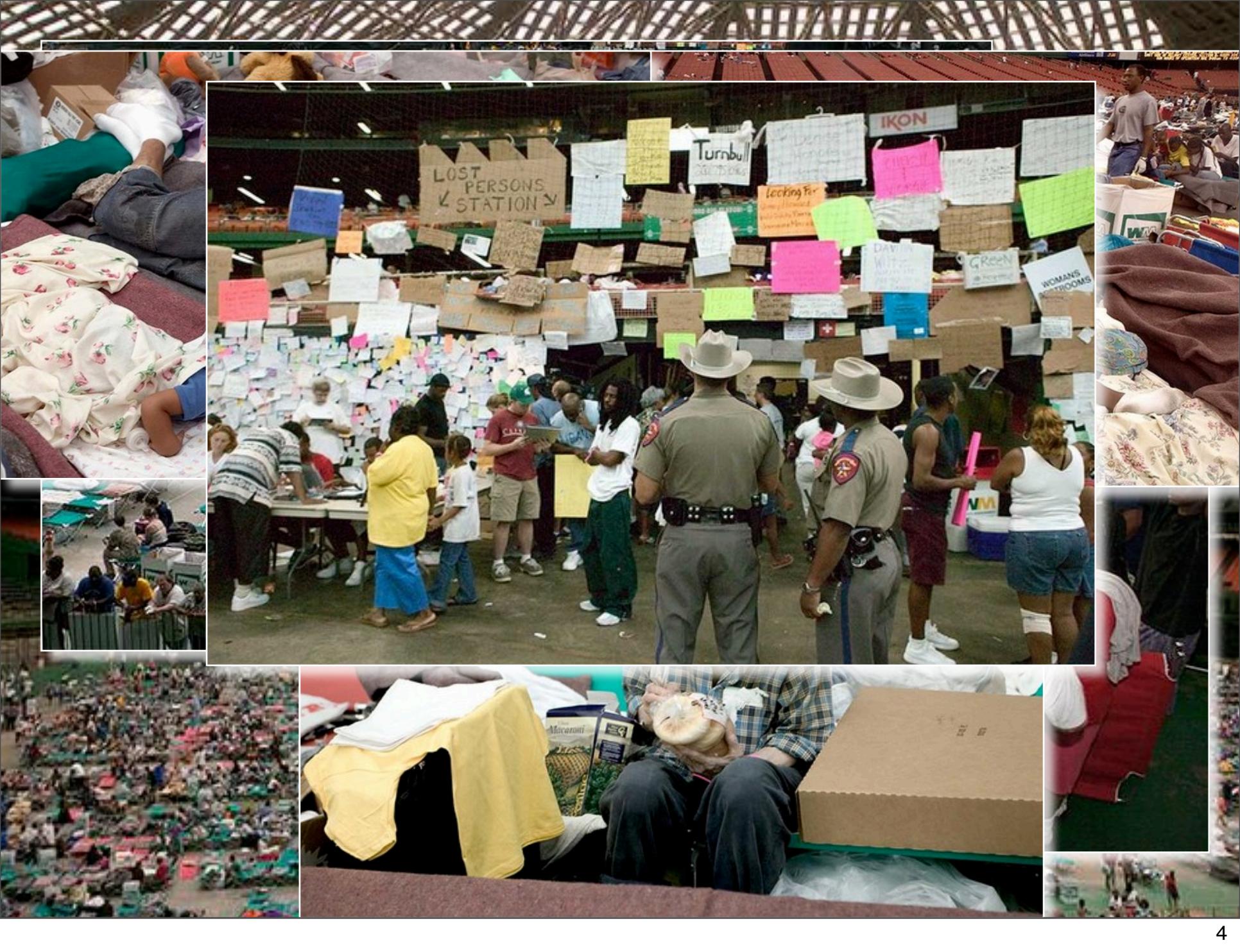












LOST PERSONS STATION

Turnbull

IKON

Looking For

DAVID

GREEN

WOMAN'S TOILETS





I. Clinical Information

- Register patients seeking medical attention
 - Clinical care
 - Billing and administrative purposes
 - Needs Assessment
- Participate in shelter surveillance

II. Situational Awareness and Shelter Surveillance

- To detect outbreaks and trends within shelter
- To prevent from spreading to the general population.
- Needs Assessment

III. Proactive Needs Assessment and Surveillance

- Person by person and family by family
 - Demographic distribution of evacuees
 - (Physical and Mental) Health Status
 - Chronic problems
 - Special needs
 - Exposures and risk factors
 - Social/Mental Health Support

IV. Ad-hoc Reporting

- Clinicians
- Epidemiologists
- Public health preparedness officials
- Policy and decision makers
- Politicians
- Intelligence Officials



Solution Framework (SARA)



◆ RESOURCE DEFINITION FRAMEWORK (RDF)



to enable unified Information Representation

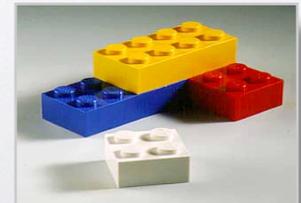
◆ ONTOLOGIES (OWL) AND COMPUTER REASONING (DL/ RULES)

(OWL-DL) To enable knowledge representation and reasoning



◆ SERVICES ORIENTED ARCHITECTURE

Dynamic interoperability and reuse

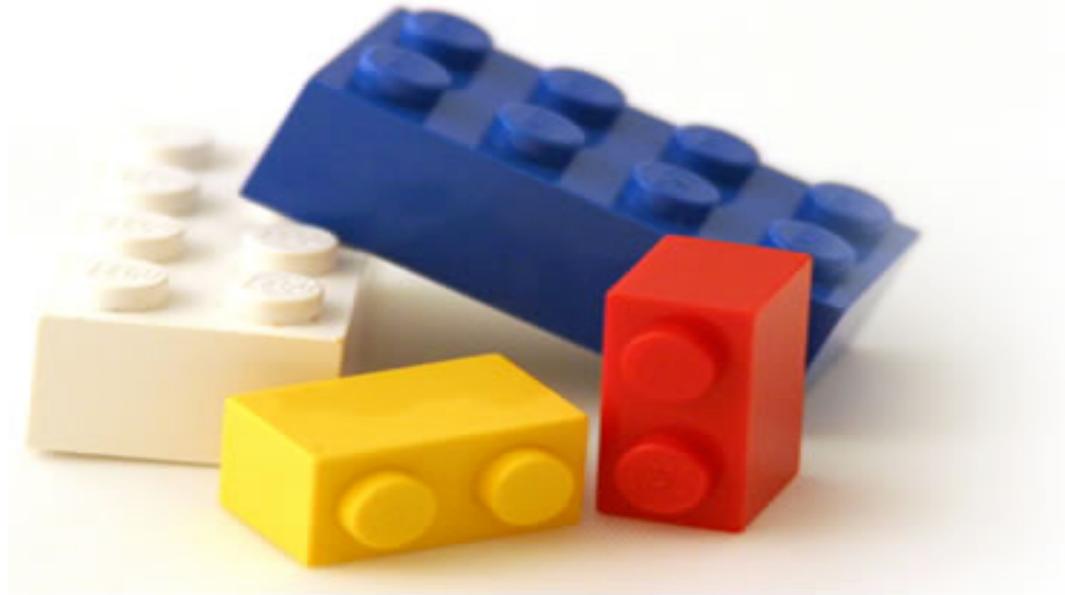




- A framework to define, create and use loosely coupled services in a distributed (Web like) environment
- Context independent services can be invoked without knowledge of their underlying platform
- Distribute and share best practices, upgrades, novel methods and capabilities within a network of collaborators
- Agility, adoptability, interoperability and collaboration in distributed environment

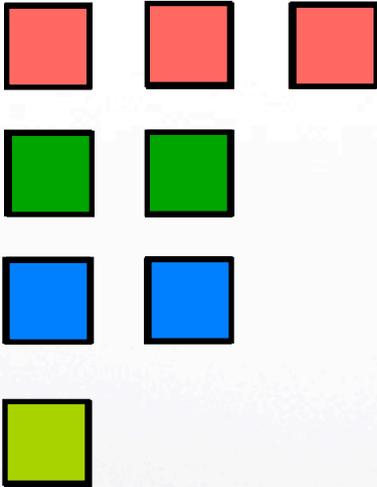


Internet





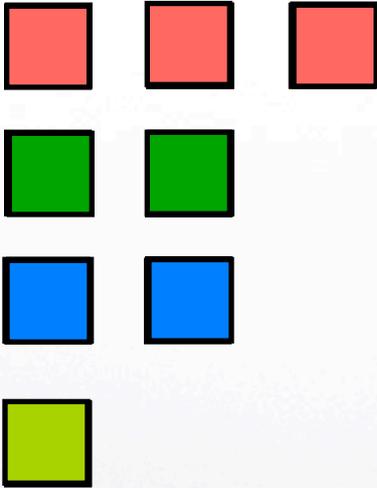
Context Independent Distributed Services





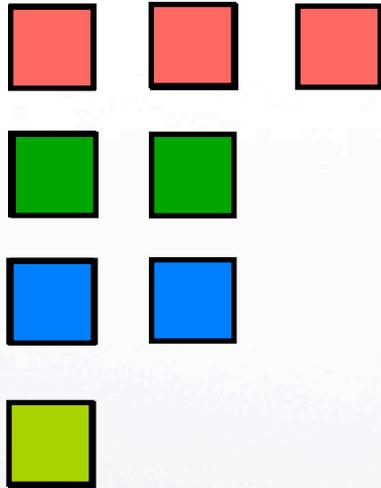
Context Independent
Distributed Services

SOA Applications



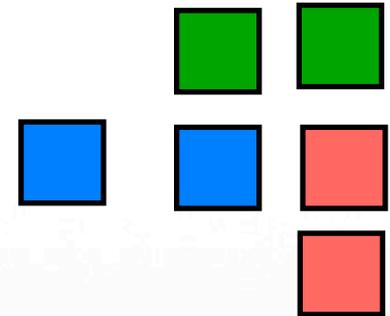


Context Independent
Distributed Services



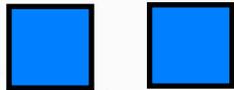
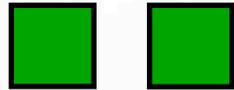
Configuration A

SOA Applications





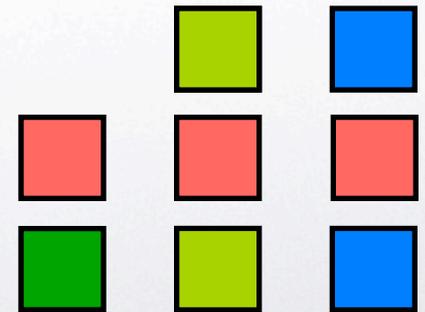
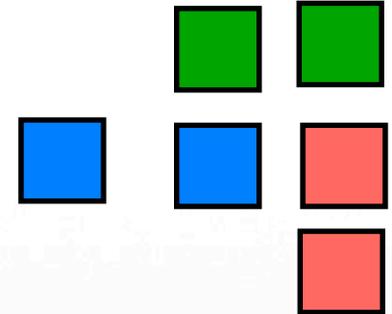
Context Independent
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Configuration A

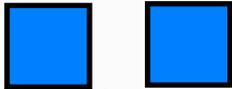
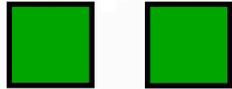
Configuration B

SOA Applications



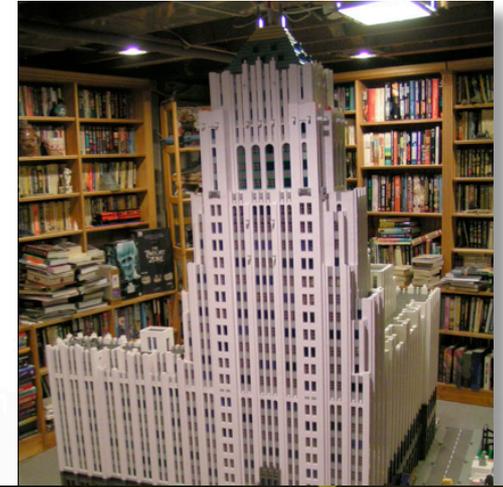


Context Independent Distributed Services



Configuration A

Configuration B

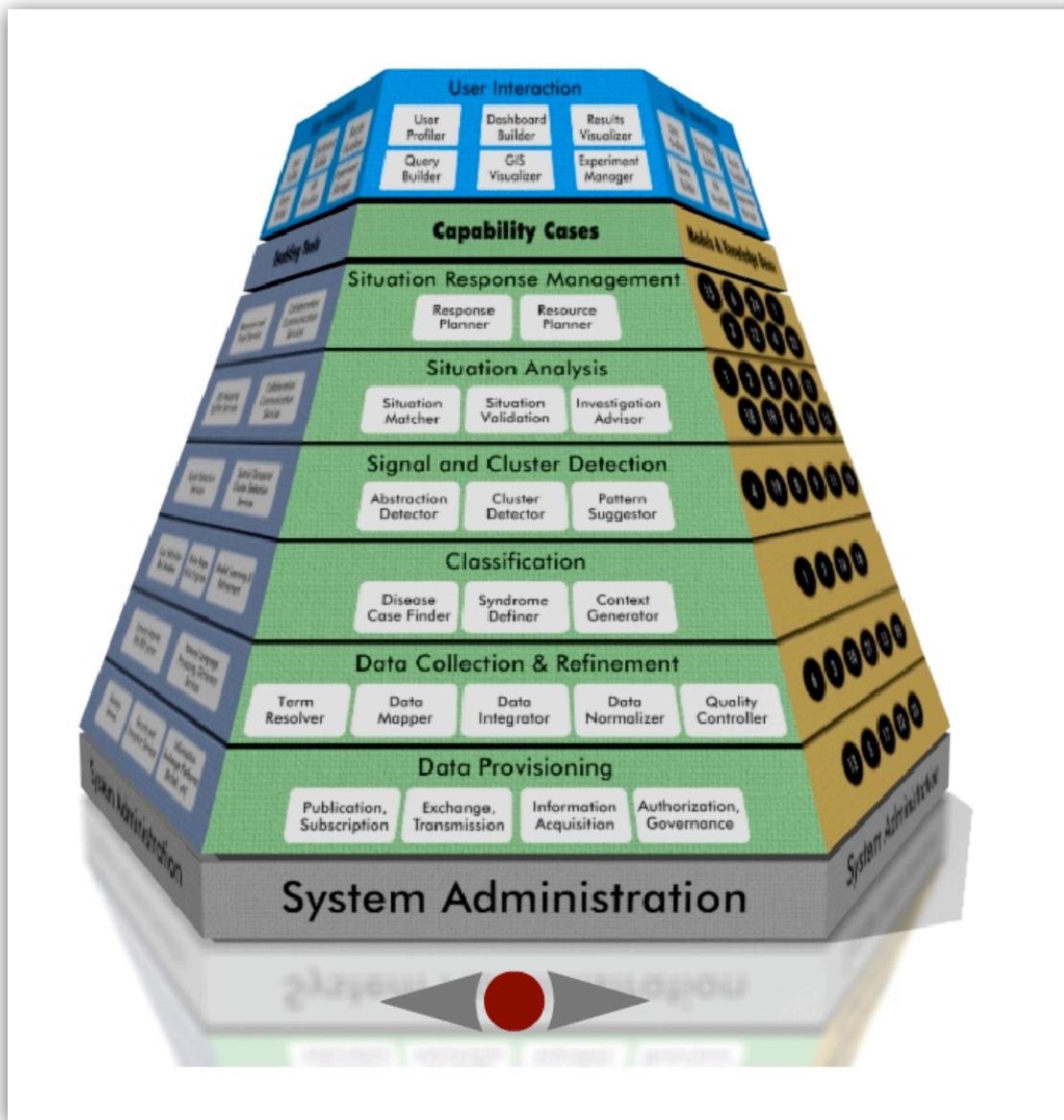




The Katrina Implementation Story

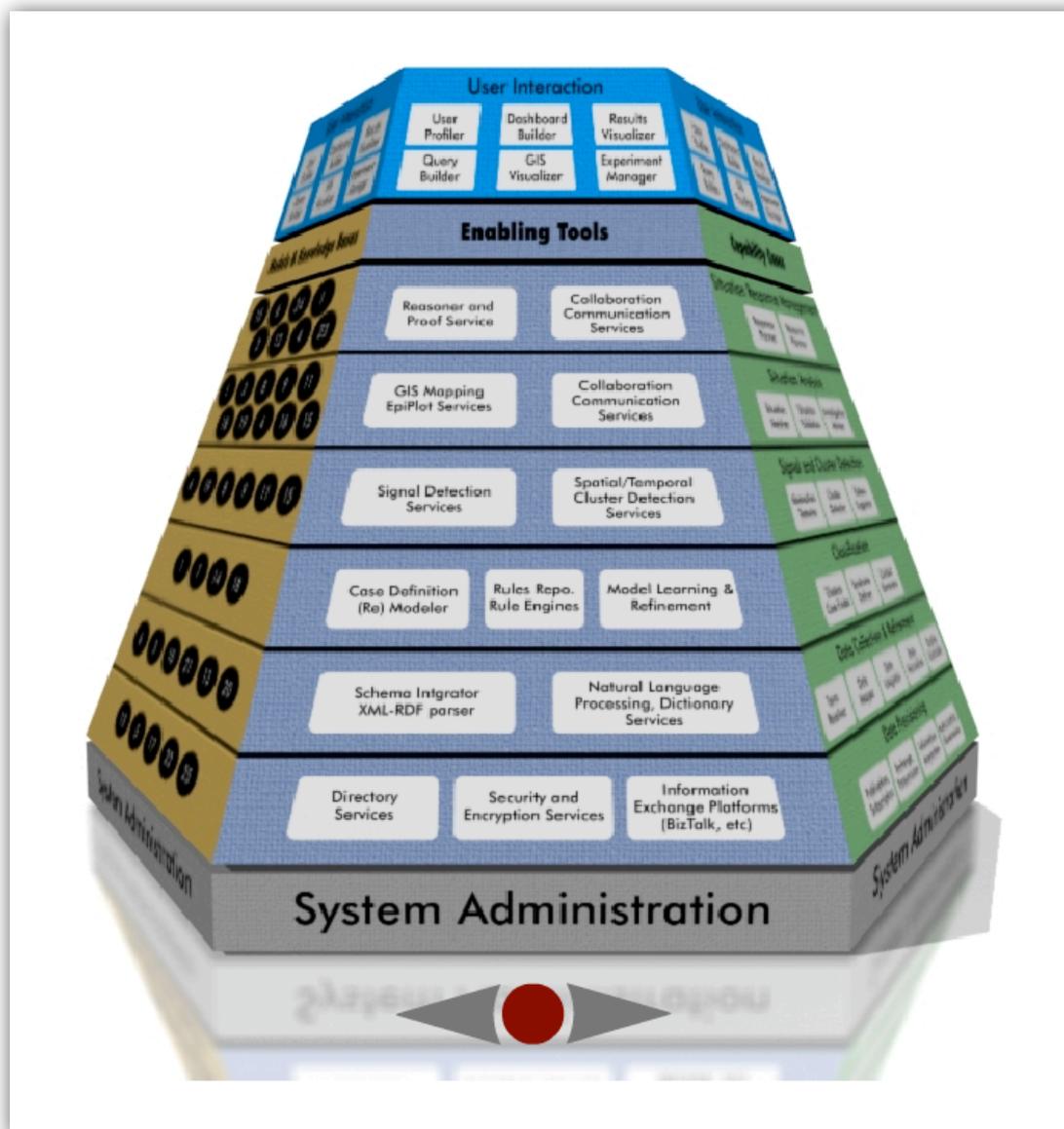


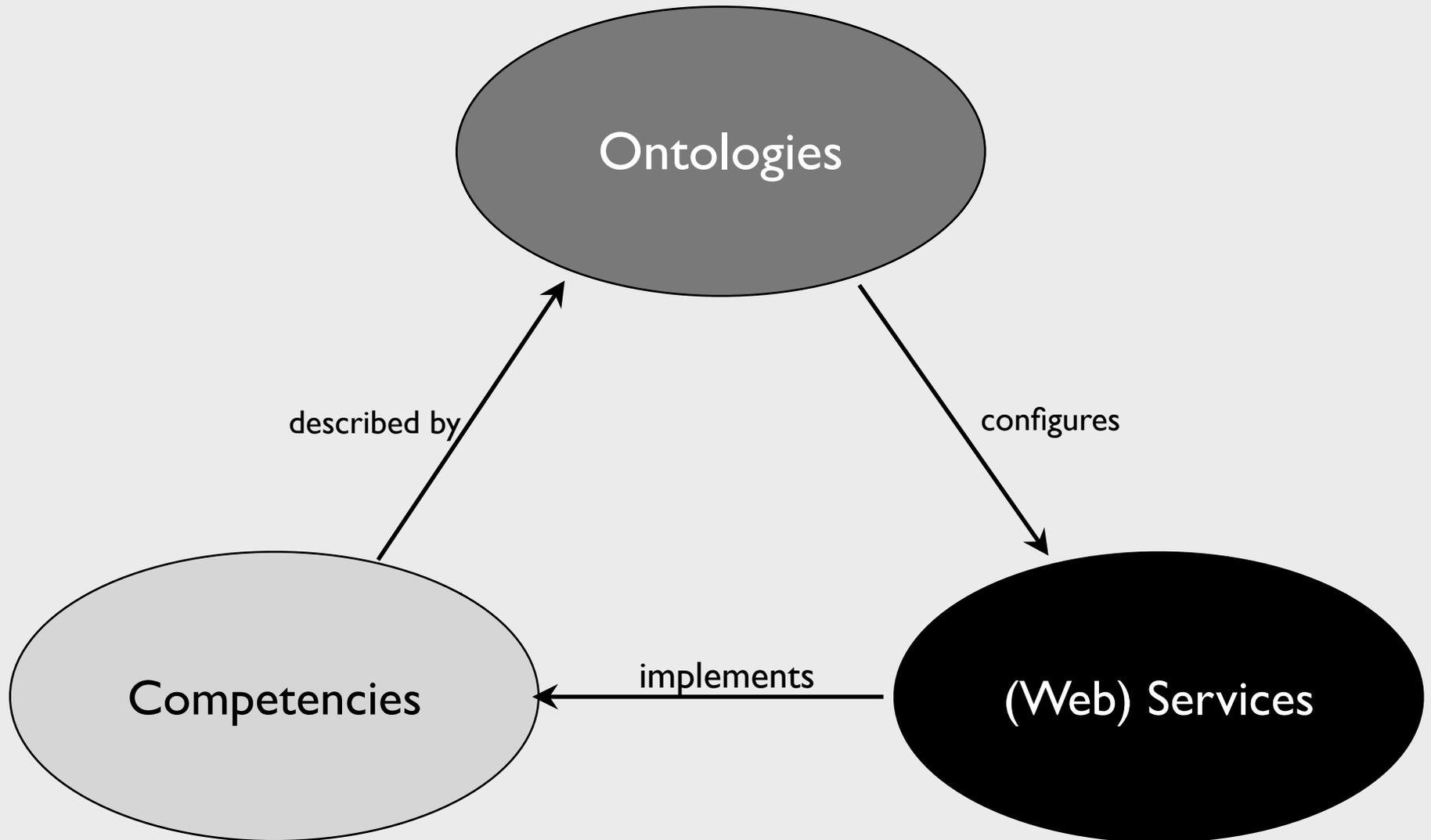
Situation Awareness Reference Architecture





Situation Awareness Reference Architecture







- Information Exchange Services
 - Authenticate and Authorization Services
 - Publication, subscription services
- Heuristic, Statistical and Semantic Text Processing Services
 - Medications
 - Signs or Symptoms
 - Disease or Disorders
 - Healthcare Procedures (Therapeutic and Diagnostic)
 - Anatomical Structures, Body Systems
 - Trauma and Injuries
 - Toxicity and Poisoning
 - Anatomical Disorders, Congenital conditions
 - Negation, Uncertainty, Modifiers, Descriptors etc...



- Syndrome Definition and Case Finding Services
 - Semantic Classification Engine
 - CDC II Syndromes of Bioterrorism
 - Influenza Like Illness
 - Nationaly Notifiable Disease
 - Bayesian Classification Engine (CoCo from RODS lab)
 - Respiratory Syndrome
 - Gastro-Intestinal Syndrome
 - Neurological Syndrome
 - Hemorrhagic Syndrome
 - Botulinic Syndrome
 - Rash Syndrome
- Aberration Detection Services
 - CI, C2, C3
 - CuSum Generic (CG)
 - Moving Average
 - Moving F
- Interactive Reporting Services (OLAP –XMLA, Interactive OLAP Charting)
- Survey on Demand Service



I.A Clinical Information System to capture

- Patient identifiers and demographics
- Clinical representation
- Discharge diagnosis
- Follow ups recorded and reported

II.A Shelter Surveillance System

- Demographics, vital signs, chief complaints, disabilities, injuries, chronic conditions, current and past medical, surgical and medication history
- Exposure to substances or toxic materials
- Clinician Notes (text entries): chief complaints, follow-ups, discharge notes and diagnoses, and any other free text entries
- Follow ups recorded and reported

- Stationary and mobile data capture stations at all points of encounter (clinic, red cross, FEMA, etc) entry on any available network-enabled device: PCs, laptop/tablet and handheld devices.
- Integrated view to all data from all sources
- Reports on demand and at least every 12 hours.
- Ad-hoc classification of observations based on vital signs, chief complaints, medication information and discharge diagnoses data
- Eight syndromic classes used in the RODS system for biosurveillance.
- HIPAA compliant, secure and protected

III.A Mobile and Distributed System of Survey on Demand

- Needs assessment
- Proactive surveillance



I.A Clinical Information System to capture

- Patient identifiers and demographics
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In less than 12 (8+4) hours

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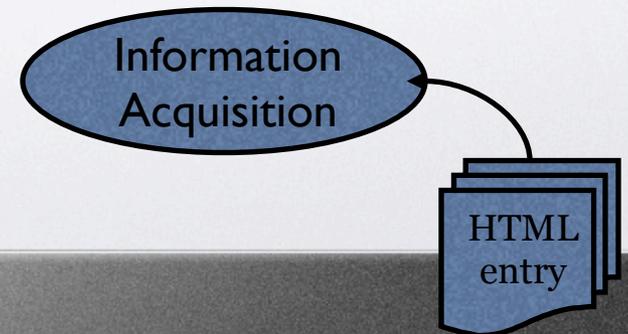
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Shelter Survey



Center for Biosecurity and Public Health Informatics Research

Katrina Relief Effort, George R Brown Center, UT Houston

[Add Data](#)

[Search and Edit](#)

[Contact](#)

Patient ID#:

GRB Visit ID:

Service Date : 09/01/2005

Service Time:

LastName:

FirstName:

Date of Birth:

Illness 1: --Please Select--

Illness 2: --Please Select--

Illness 3: Hypertension
Heart

Illness 4: Diabetes - Insulin
Diabetes - Non Insulin

- Coumadin
- Asthma
- COPD
- Psych
- STD
- HIV
- Hepatitis
- GI
- Headache
- Other
- dialysis
- Derm
- OB/Gyn
- Pediatrics
- Ophthalmology/Eye
- Ortho
- Colds
- GU

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Shelter Survey



Center for Biosecurity and Public Health Informatics Research

Katrina Relief Effort, George R Brown Center, Houston DHHS

[Add Data](#)

[Search and Edit](#)

[Contact](#)

PatientID:

License:

SSN:

VisitID:

Visit Date (mm/dd/yyyy - 05/15/1977 for May 15, 2005):

Arrival Time:

Discharge Time:

LastName:

FirstName:

Address:

Date of Birth:

Age:

Sex:

Height:

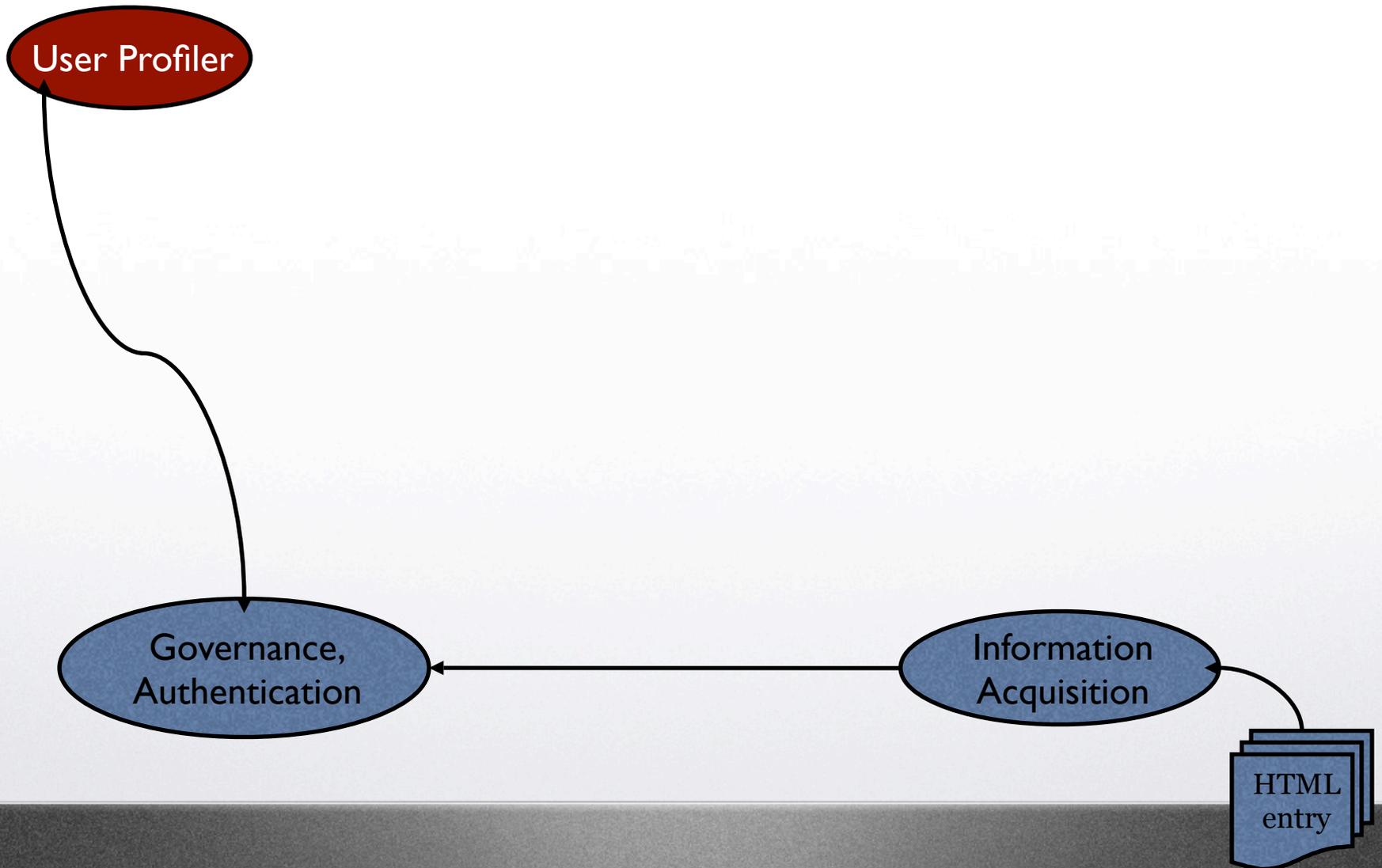
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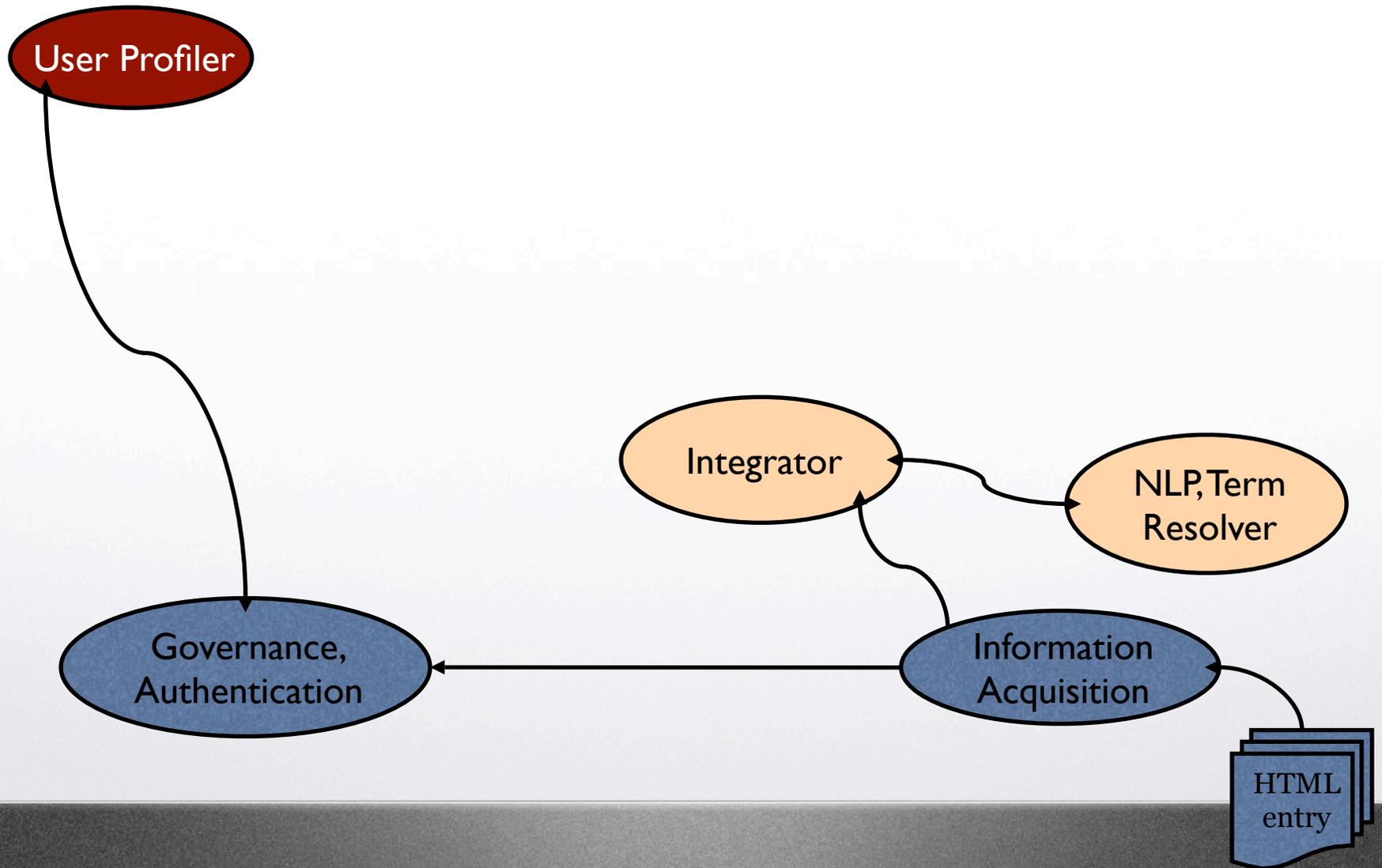
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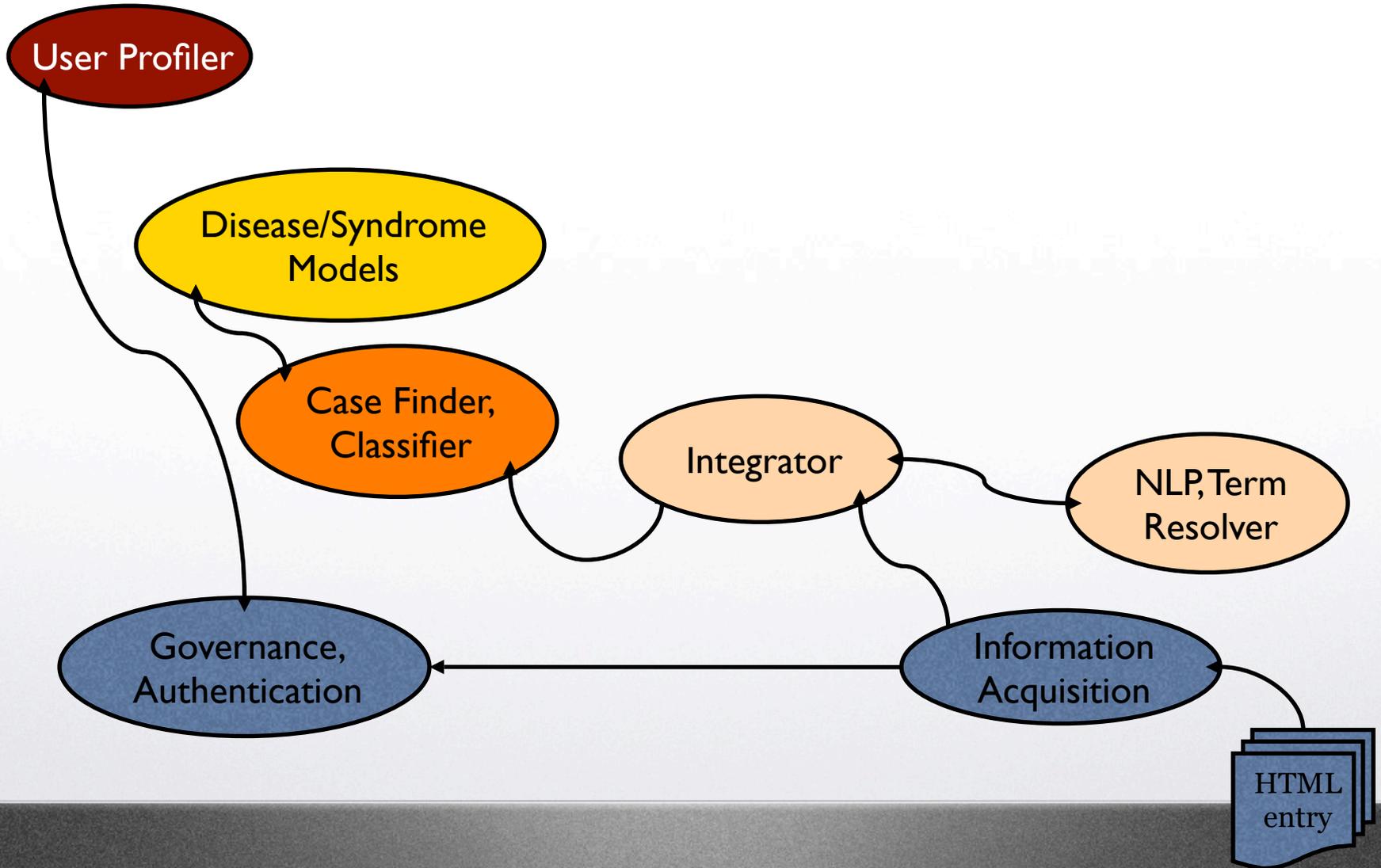
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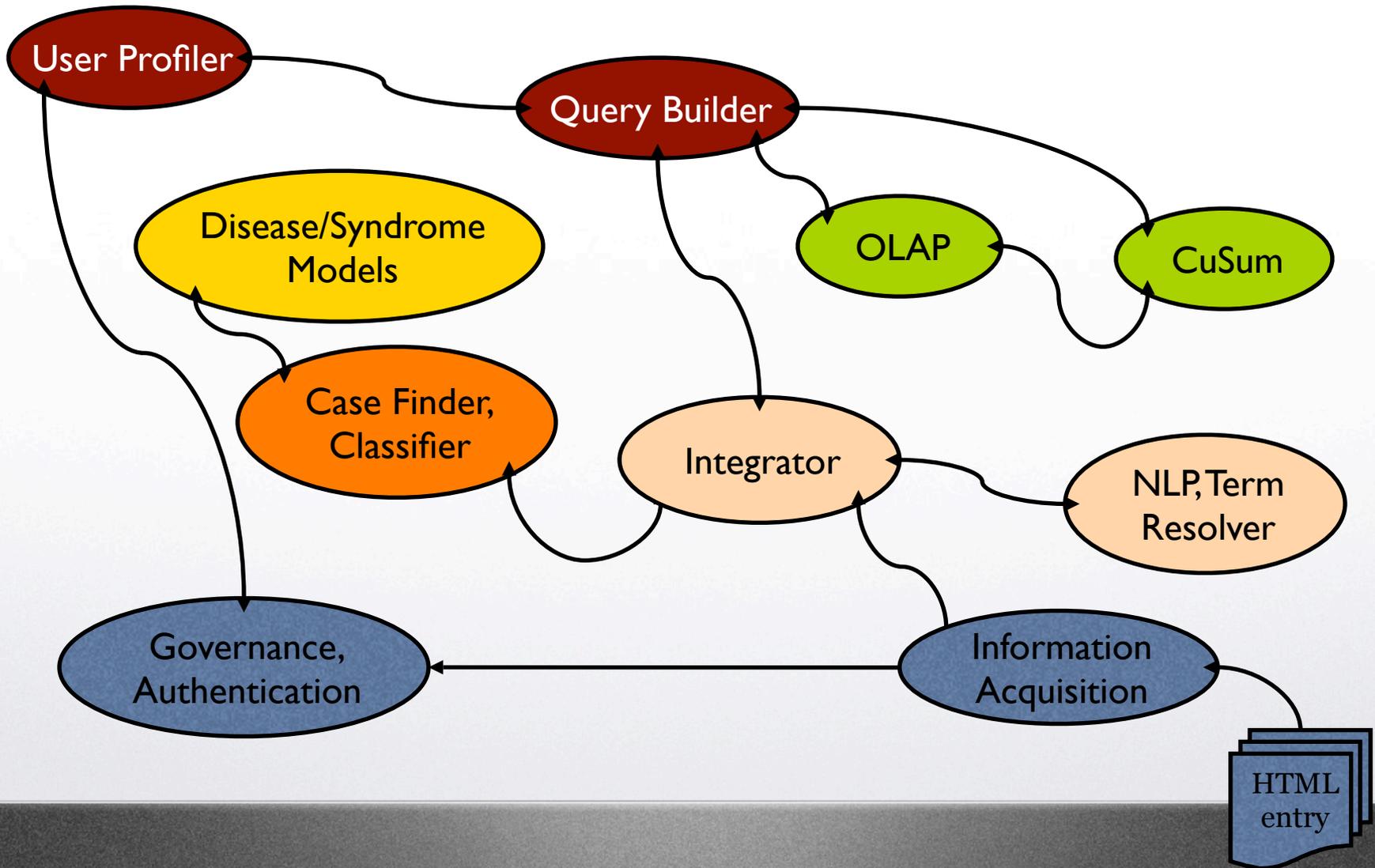
Java Update

A new version of Java is available.
Click here to continue.



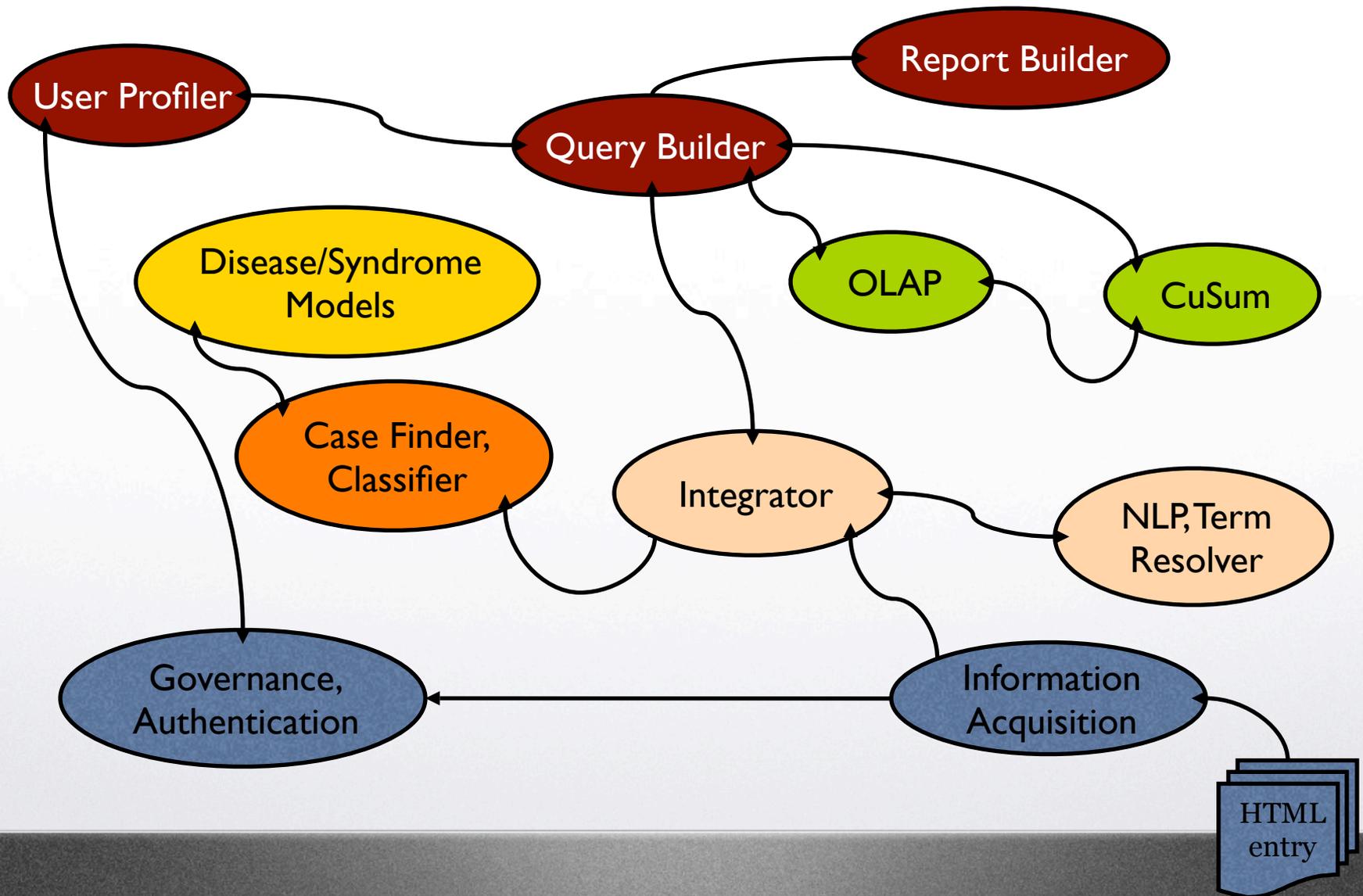






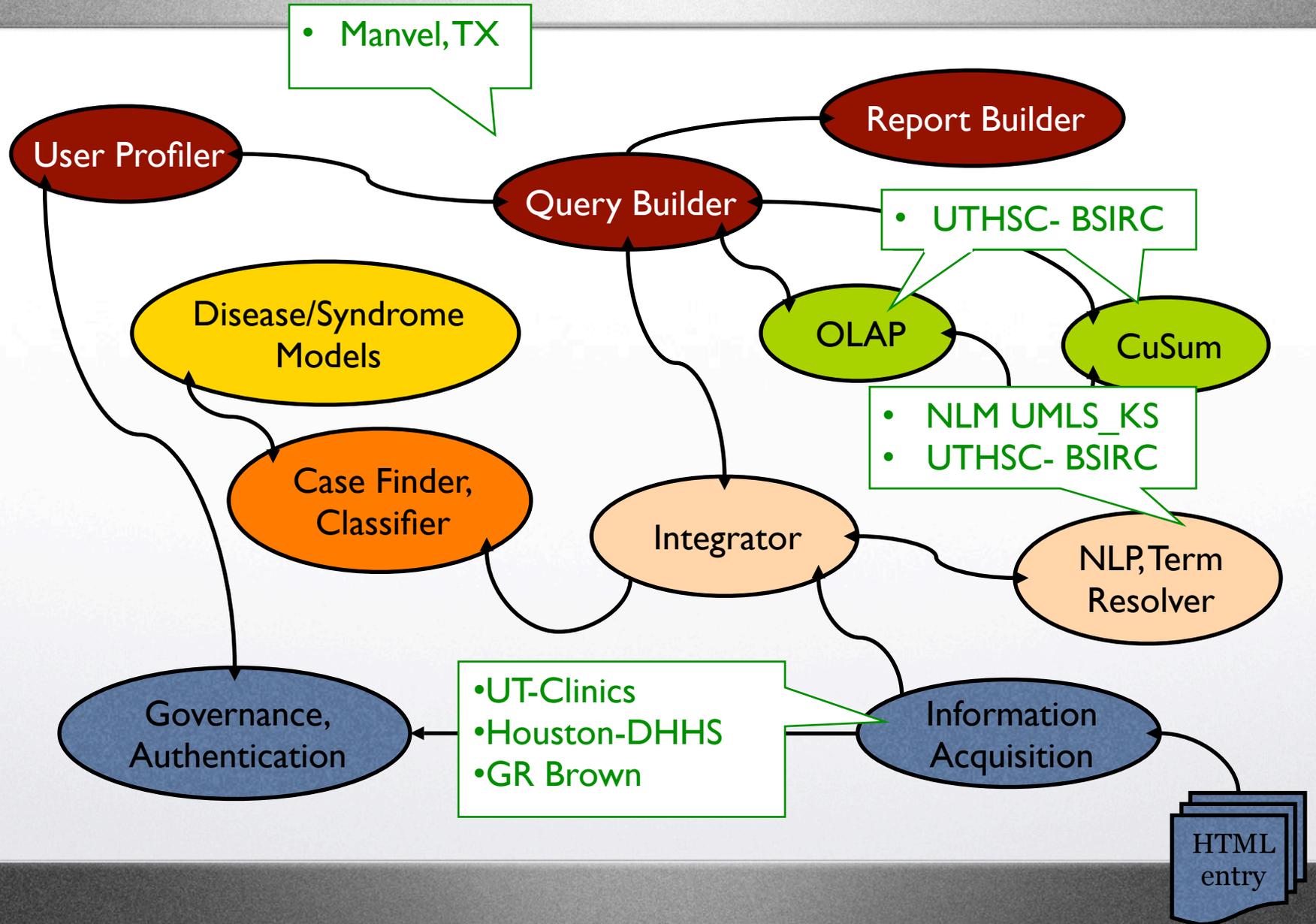


Shelter Surveillance at GR Brown Center





Shelter Surveillance at GR Brown Center





PDA Based Katrina Survey at Houston

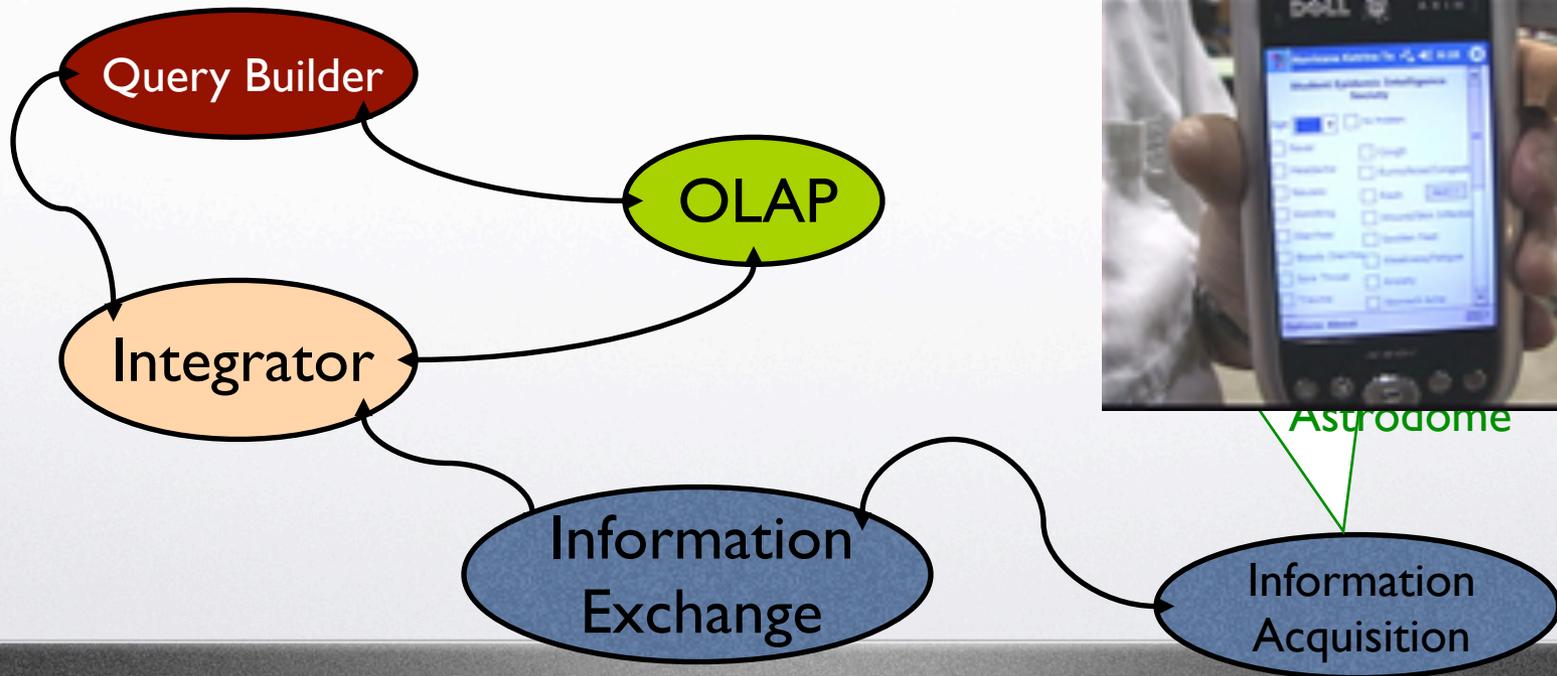


- A bed-by-bed needs assessment tool
- Wireless and offline sync with central DB
- Deployed in 3 shelter sites throughout the city and communicating through the Internet
- Faster than charging PDA batteries





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- Faster than charging PDA batteries





Outcomes



- Over 8800 patient encounters recorded between 9/1/05 and 9/19/05, when Houston shelters were evacuated due to the approach of the Hurricane Rita.
- Customized reports generated on demand and generic reports (frequency of events) every 12 hours:
 - Chronic disease such as HTN and diabetes in young and older adults
 - Respiratory (Asthma) and GI outbreak in children reported in the early days;
 - Succeeded by a sudden increase in respiratory illnesses and ophthalmologic problems in all ages in the last week.



Reports

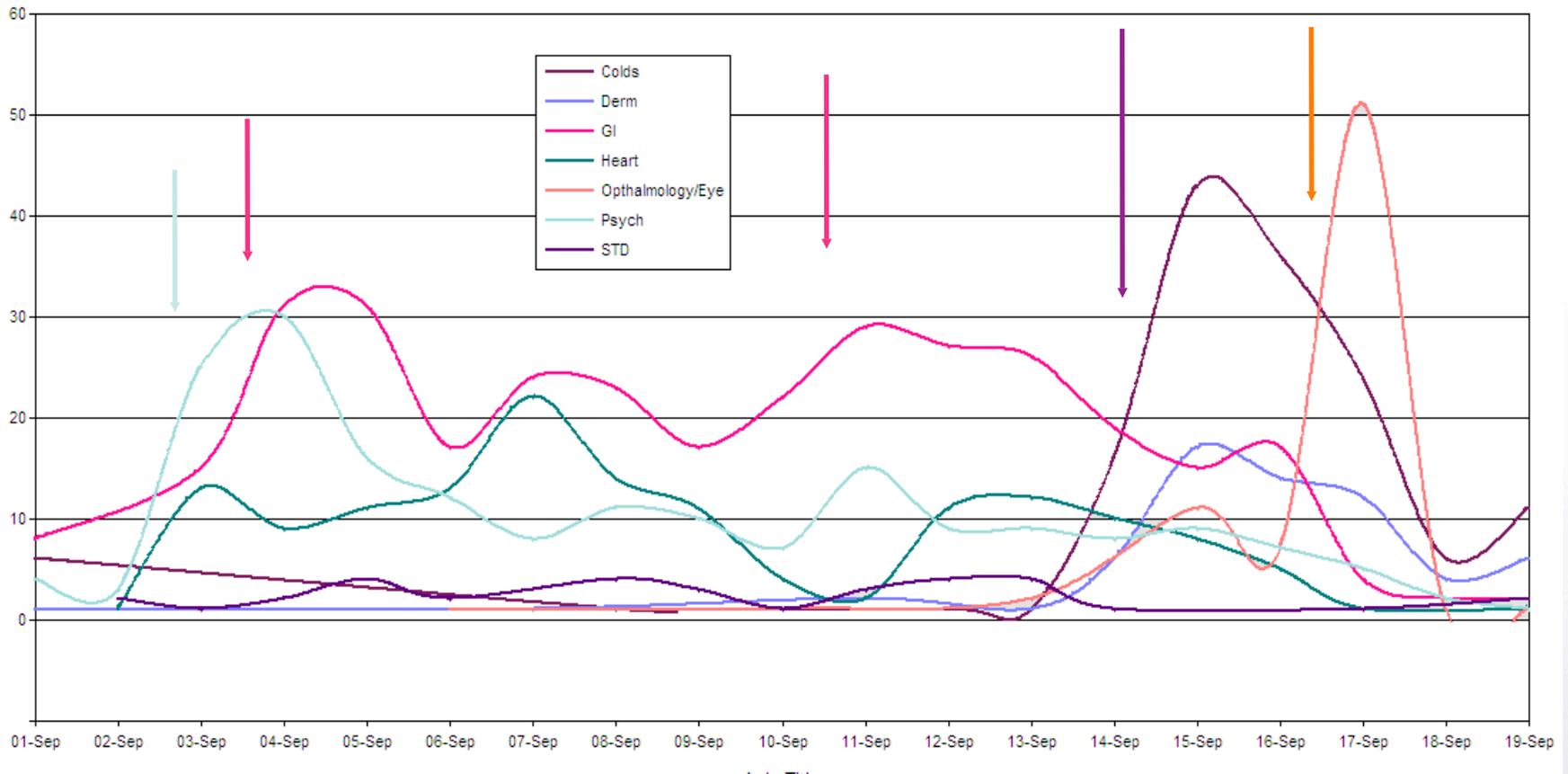
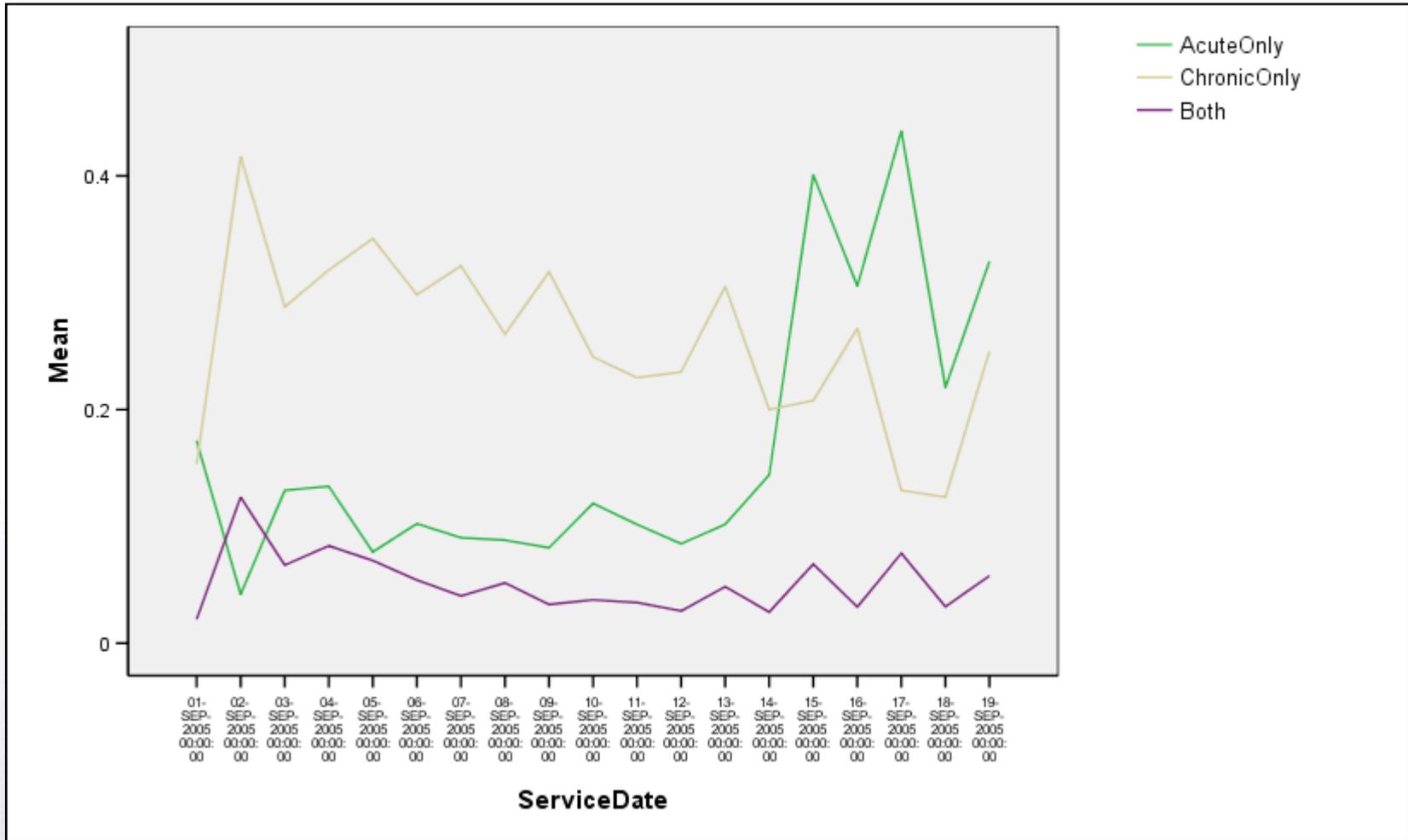


Figure 3: Frequency analysis of illnesses by date

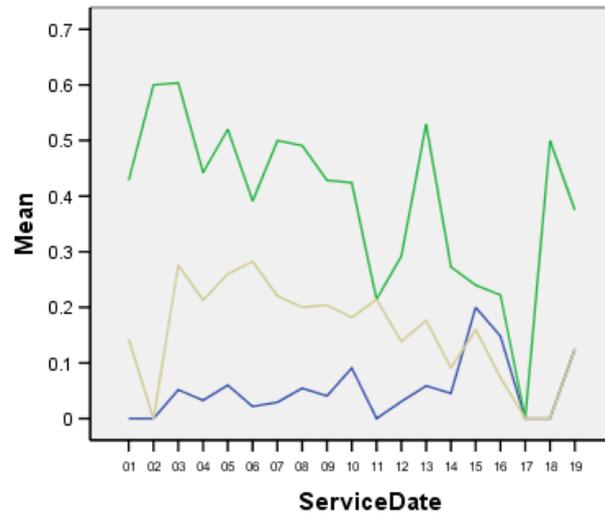
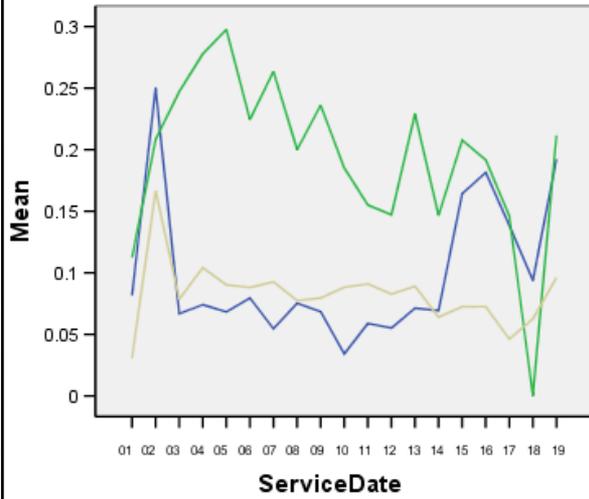
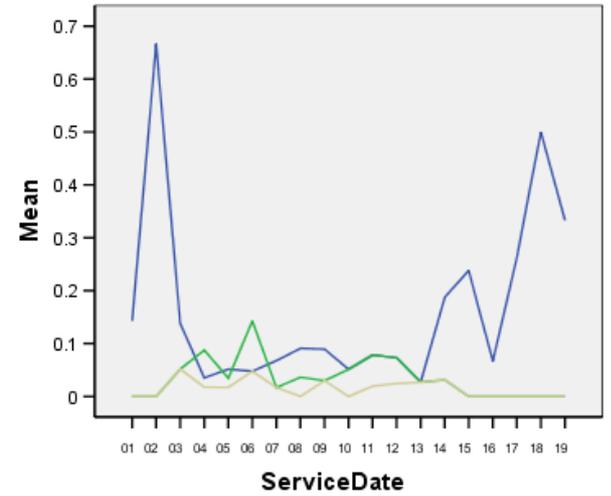
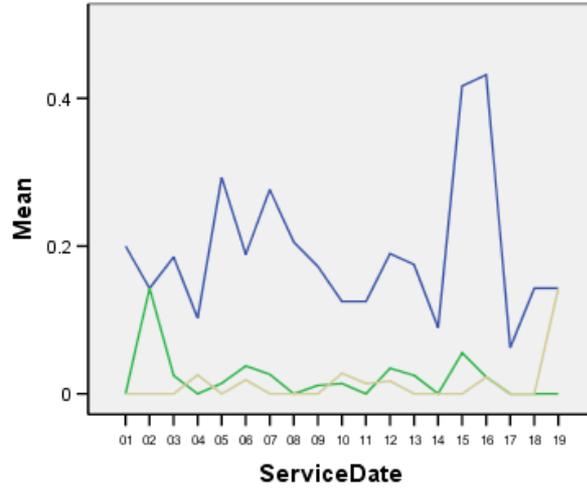
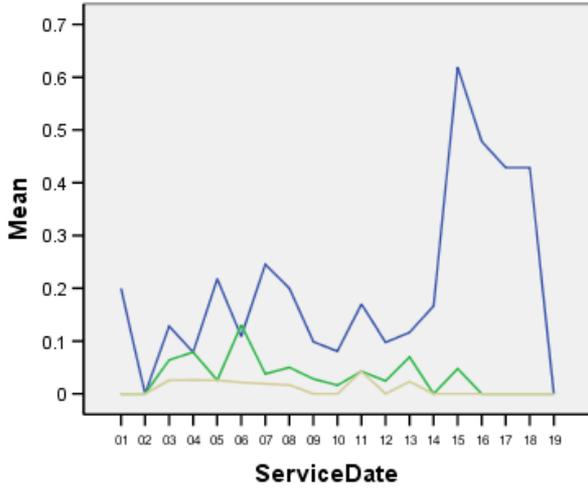


Reports



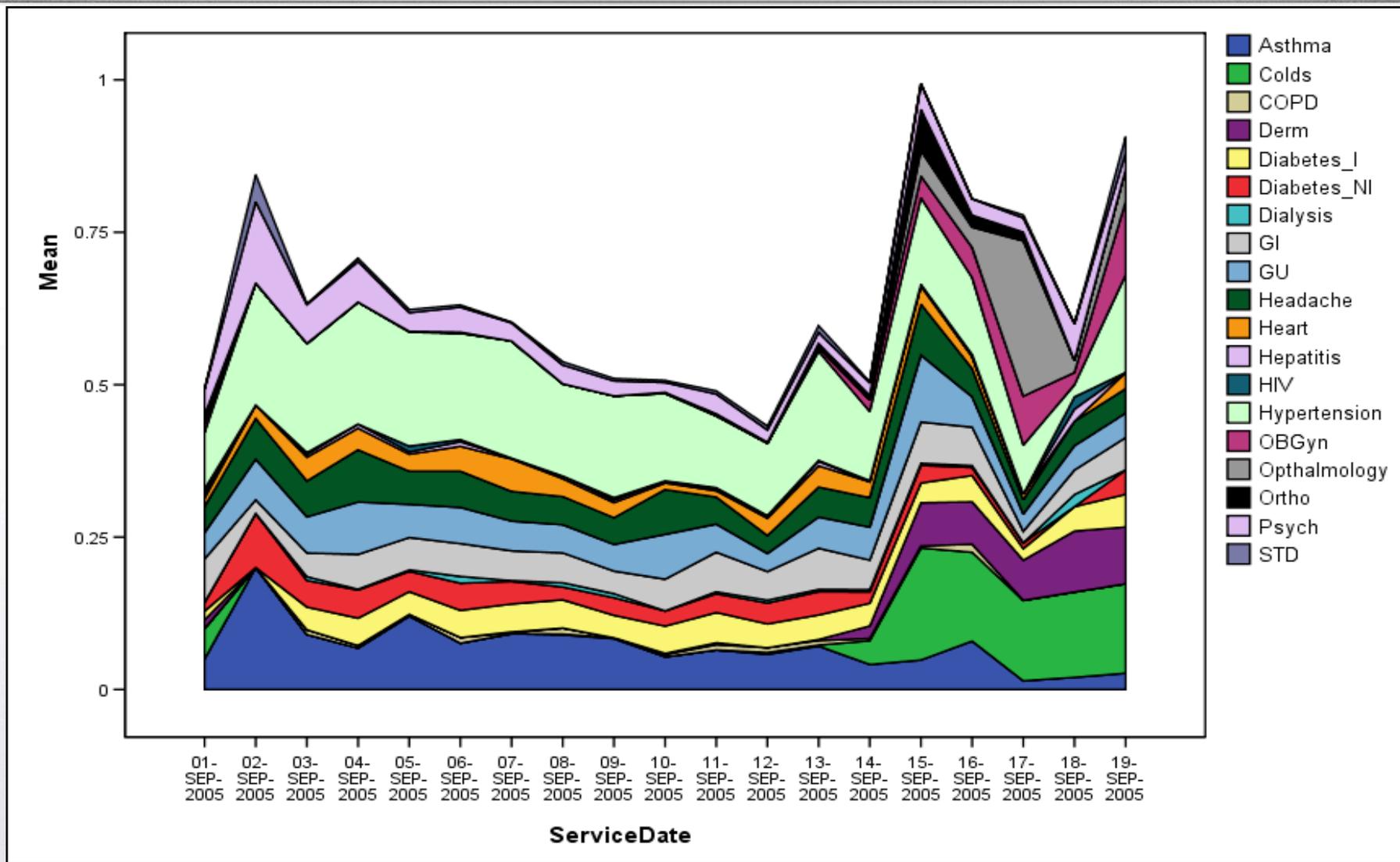


Reports



— Respiratory
— Cardiovascular
— Diabetic

Reports





Reports



9/11/2005 8:00:09 PM

<u>Syndrome</u>	<u>Count</u>
Botulinic	3
Hemorrhagic	15
Rash	69
Constitutional	71
Neurological	76
Gastrointestinal	132
Respiratory	240

G.R. Brown Convention Center Katrina Shelter
Houston Department of Health and Human Services

Syndromic Findings By Visit Date

9/11/2005 7:58:36 PM

<u>Visit Day</u>	<u>RODS Syndromic Class</u>	<u>Visit Date</u>	<u>Count</u>
Friday, September 02, 2005			
	<i>Gastrointestinal</i>	9/2/2005	1
	<i>Other</i>	9/2/2005	8
Saturday, September 03, 2005			
	<i>Gastrointestinal</i>	9/3/2005	7
	<i>Hemorrhagic</i>	9/3/2005	2
	<i>Neurological</i>	9/3/2005	6
	<i>Other</i>	9/3/2005	68
	<i>Rash</i>	9/3/2005	8
	<i>Respiratory</i>	9/3/2005	21
Sunday, September 04, 2005			
	<i>Botulinic</i>	9/4/2005	1
	<i>Constitutional</i>	9/4/2005	18
	<i>Gastrointestinal</i>	9/4/2005	25
	<i>Hemorrhagic</i>	9/4/2005	2
	<i>Neurological</i>	9/4/2005	13
	<i>Other</i>	9/4/2005	245
	<i>Rash</i>	9/4/2005	13
	<i>Respiratory</i>	9/4/2005	56
Monday, September 05, 2005			
	<i>Botulinic</i>	9/5/2005	1
	<i>Constitutional</i>	9/5/2005	19
	<i>Gastrointestinal</i>	9/5/2005	28
	<i>Hemorrhagic</i>	9/5/2005	3
	<i>Neurological</i>	9/5/2005	19
	<i>Other</i>	9/5/2005	322



Win Win Win



- UT-Clinics seamlessly participated in clinical assistance, public health surveillance, response planning and decision making activities (no reporting or operational overhead)
- Houston DPH could operationalize a full blown, tightly integrated situation awareness system for response planning in less than 8 hours
- UTHSC could get reimbursed by state disaster relief funds based on services documented and reported by the system



- Performance
- Reliability (Accessibility, Availability)
- Integrity (relies on a robust service description, discovery, negotiation and invocation system)
- Security and authorization in dynamic and distributed environments



- Software as (decoupled, encapsulated) services
- Information integration (avoiding information silos) is critical
- SOA enables:
 - Flexible, adaptive and customizable architecture
 - Agility and better preparedness by
 - Leveraging existing infrastructure
 - Collaboration in distributed environments
 - Sharing best practices
- Lower operational and development cost by capitalizing on reuse of existing resources



Acknowledgements



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- Houston Department of Health and Human Services (HDHHS)



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