Case Study for Cloud Computing Solutions in Public Health

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Agenda

- Cloud Computing Defined
- Cloud vs Traditional Computing
- Example: Clinical Decision Support
- Resources
- Wrap-up

Cloud Computing Defined

NIST Definition:

"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."

http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf

Cloud Computing Defined *(continued)*

- On-demand self-service to allow provisioning computing capabilities without human interaction
- Broad network access through standard mechanisms
- Resource pooling to serve multiple customers (*e.g.,* storage, processing, memory, and network bandwidth)
- Rapid elasticity commensurate with demand
- Measured service to control and optimize resource use

http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf

Cloud Computing Defined *(continued)*

- Software as a Service (SaaS). The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure using a thin client (*e.g.,* Office 365, remotely-accessed EHR).
- Platform as a Service (PaaS). The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider (*e.g.,* Salesforce.com, SAP).
- Infrastructure as a Service (IaaS). The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications (*e.g.,* what most people mean by "cloud").

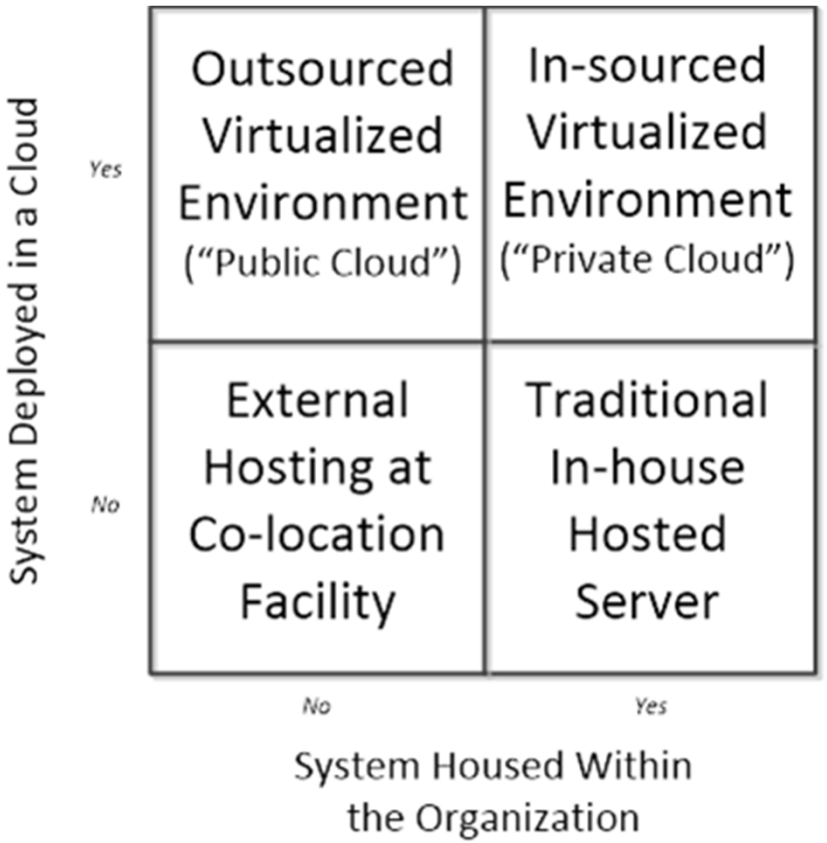
Cloud Computing Deployment Models

Type	Definition (NIST)	Public Health Examples
Private Cloud	Provisioned for exclusive use by a single organization comprising multiple consumers	Environment upon which an IIS deployed by a PH agency
Community Cloud	Provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns	Environment shared by multiple PH agencies for a specific purpose (*e.g.,* Biosense, APHL AIMS platform).
Public Cloud	Provisioned for open use by the general public	Environment maintained by PH for access by the general public for the purpose of providing community health assessments or access to aggregated data.
Hybrid Cloud	Composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability	An IIS running in a private cloud in an agency using a forecasting service running in a community or public cloud.

Cloud vs Traditional Computing

- Traditional: Computer software deployed on specific servers housed with the organization or a service provider
- Cloud: "Virtualized" environment that can be expanded or reduced based on changing needs without affecting the physical server infrastructure underneath
  - Enables service-oriented architecture
  - Allows more flexible, scalable, modular architectures
  - Less concern about physical location of apps, data, services

Cloud vs Traditional Computing



SWOT: Traditional In-house Hosted Server

Strengths: • Leverages existing infrastructure. • Services/applications can easily be isolated from one another for security or other considerations. • Costs are fixed and easier to predict/budget. • Servers are easy to control and secure.	**Weaknesses:** • Servers are fixed-capacity resources that require periodic capital investment to maintain and expand. • Highly-skilled staff required 24x7 to operate and secure platforms. • As needs change the computing environment is often slow to adjust. • Little opportunity to leverage across programs/systems. • Outwardly-focused applications put more and more pressure on limited Internet bandwidth.
Threats: • Industry is moving to cloud-based services more and more. • This alternative may get more and more expensive to maintain in terms of equipment and skilled labor.	**Opportunities:** • Hardware continues to be a commodity item whose price vs performance continues to decline.

SWOT: External Hosting at a Co-lo Facility

Strengths: • Burden of low-level operations passed on to a vendor better equipped and resourced to support the server environment. • Services/applications can easily be isolated from one another for security or other considerations. • Costs are fixed and easier to predict/budget. • Servers are easy to control and secure. • More and more affordable Internet bandwidth available especially for outwardly-facing applications.	**Weaknesses:** • Servers are fixed-capacity resources that require periodic capital investment to maintain and expand. • As needs change the computing environment is often slow to adjust. • Little opportunity to leverage across programs/systems. • May require virtual private network (VPN) to provide secure access back to the organization.
Threats: • Industry is moving to cloud-based services more and more. • This alternative may get more and more expensive to maintain in equipment costs.	**Opportunities:** • Hardware continues to be a commodity item whose price vs performance continues to decline. • An alternative scenario is the use of vendor-owned servers which lowers the capital cost for organizations while providing variable amounts of computing power.

SWOT: Outsourced, Virtualized Environment

Strengths:	**Weaknesses:**
• Burden of low-level operations passed on to a vendor better equipped and resourced to support the server environment. • Services/applications can easily be isolated from one another for security or other considerations. • Capacity, and therefore cost, can vary more flexibly based on the "needs of the moment." • More and more affordable Internet bandwidth available especially for outwardly-facing applications. • Enables location-independent access to systems and services. • Allows for more flexible and robust disaster recovery/business continuity implementations.	• Servers are outside of the organization's physical control. • Additional security issues may be exposed by the shared virtual environment. • Cloud providers are big targets for Internet-based attacks including denial-of-service attacks that might limit system availability. • May require virtual private network (VPN) to provide secure access back to organization. • Initial setup expense may be larger than a single project or organization can bear.
Threats:	**Opportunities:**
• The cloud service provider market is consolidating so there still can be a negative impact if the organization chooses the wrong vendor." • While most HIPAA breaches occur from lost, stolen, or compromised mobile devices, a conspicuous breach on a cloud service could adversely impact the market in a big way. • Some jurisdictions simply disallow public cloud deployment by law or policy, largely on security/privacy grounds.	• HIPAA-compliant environments are available. • Cloud-based computing becoming more accepted in the public and healthcare sectors. • Significant potential for cost sharing among projects, agencies, and organizations through the use of shared platforms. • Promotes "greener" environment by reducing the need for commuting and central physical presence by staff.

SWOT: In-sourced, Virtualized Environment

Strengths: • Organization retains physical control over servers. • Services/applications can easily be isolated from one another for security or other considerations. • Individual application/system capacity, and therefore cost, can vary more flexibly based on the "needs of the moment." • Enables location-independent access to systems and services. • Allows for more flexible and robust disaster recovery/business continuity implementations.	**Weaknesses:** • Highly-skilled staff required 24x7 to operate and secure platforms. • Outwardly-focused applications put more and more pressure on limited Internet bandwidth. • Cost of virtualization software may be more than an organization can bear. • There must be a sufficient quantity of servers procured to make the initial virtual environment setup worth configuring. • Capacity adjustments constrained by overall size of virtual environment deployed by the organization.
Threats: • Industry is moving to cloud based services more and more. • This alternative may get more and more expensive to maintain in equipment costs.	**Opportunities:** • Hardware continues to be a commodity item whose price vs performance continues to decline. • Cloud-based computing becoming more accepted in the public and healthcare sectors. • Significant potential for cost sharing among projects, agencies, and organizations through the use of shared platforms.

Clinical Decision Support (CDS)

"the use of information and communications technologies to bring relevant knowledge to bear on the health care and well-being of a patient."

Greenes RA. Definition, scope and challenges. In: Greenes RA, ed. Clinical Decision Support: The Road to Broad Adoption. 2nd ed. Waltham, MA: Elsevier; 2014.

Why Host CDS in the Cloud?

- Reduced barriers of entry for new users.
- Clinical knowledge is centrally maintained
- Hosting of core service and administrative tools are separable.
- Relatively lightweight products to deploy.
- Secure (even HIPAA-certified) cloud service providers readily available.
- Less responsibility over runtime environment if externally hosted.
- Avoids additional regulation.
- Avoids additional diligence and effort on security.
- Avoid distraction from other more crucial activities.

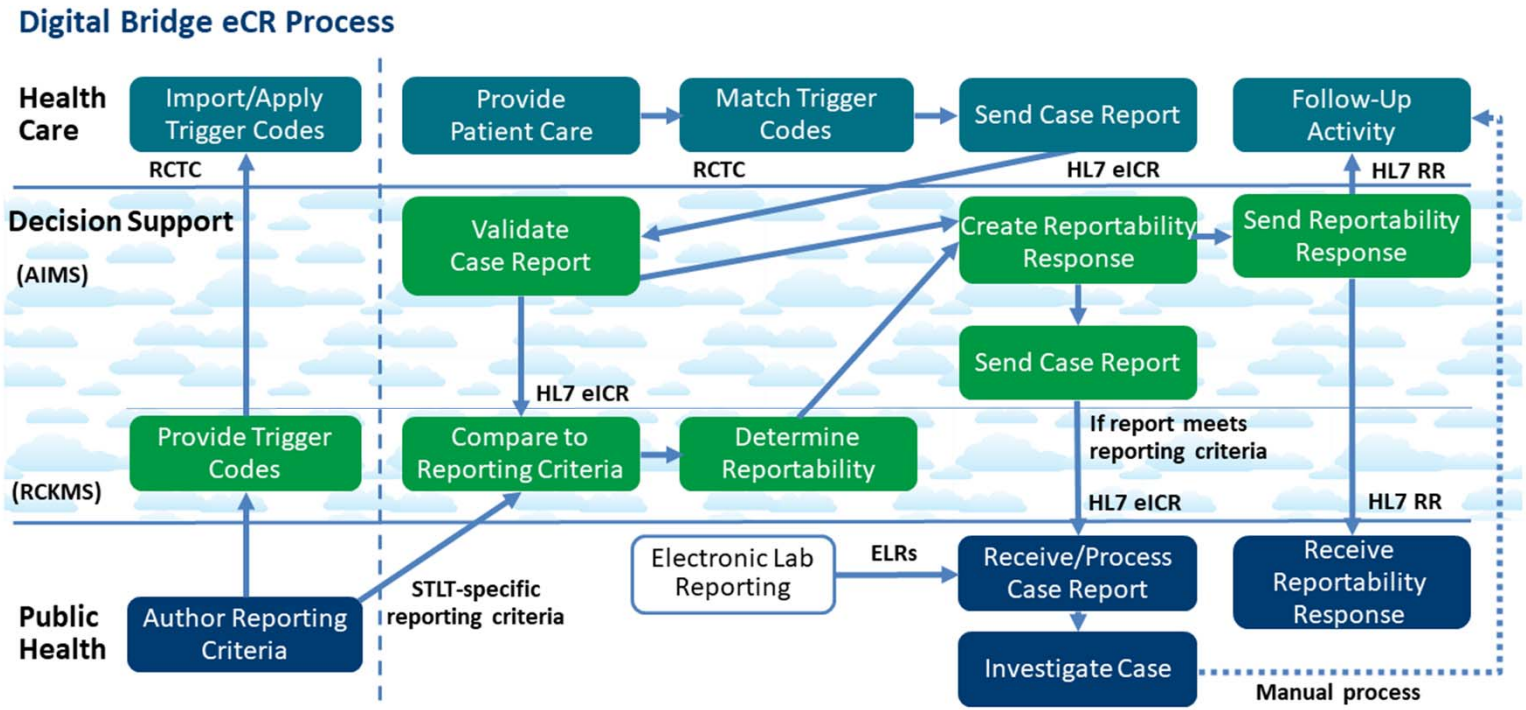
Electronic Case Reporting (eCR)

CDC Definition:

"the automated identification and transmission of reportable health events from the electronic health record (EHR) to state and local public health departments. Because eCR uses a consensus set of trigger events and a standardized format, EHR vendors can incorporate automated case reporting into the medical record systems consistently across the nation, minimizing development time and simplifying disease reporting for providers. Because the EHR is the data source for case reports, eCR will improve the completeness of patient contact, clinical, and epidemiologic information to jump start case investigations."

https://wwwn.cdc.gov/nndss/electronic-case-reporting.html

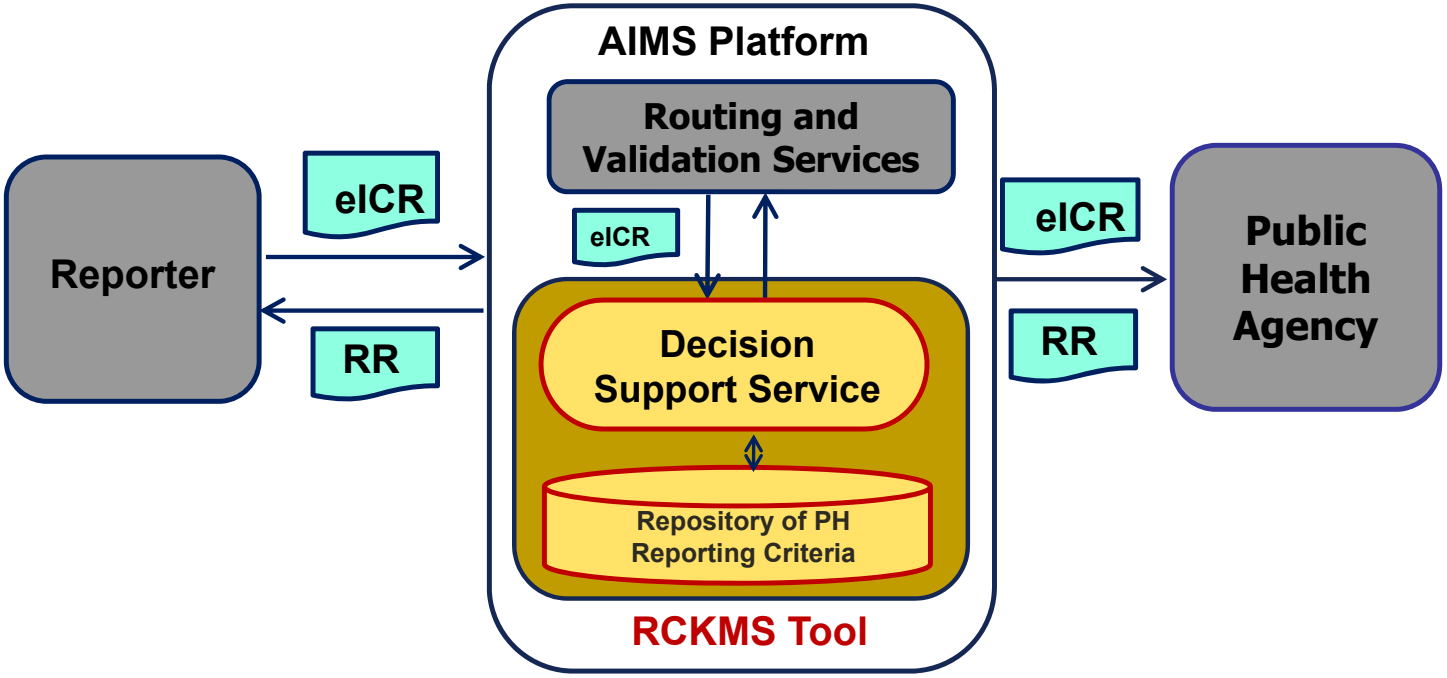
Electronic Case Reporting Workflow



RCTC = Reportable Conditions Trigger Codes
HL7 eICR = HL7 Electronic Initial Case Report
HL7 RR = HL7 Reportability Response

AIMS = APHL Informatics Messaging Services Platform
RCKMS = Reportable Conditions Knowledge Management System
STLT = State, Tribal, Local, Territorial
ELRs = Electronic Lab Reports

Example CDS Service for eCR: RCKMS



1. **Authoring Interface:** Jurisdiction enters Reporting Specifications into Tool
2. **Repository**: Reporting Specifications and Criteria stored in a Repository
3. **Decision Support Service (DSS)**: Reporting Specifications deployed to DSS (Rules Engine)

Implications for Public Health

- Cloud computing is simply an alternative way to provide server resources, one in which the resources are scalable on demand.
- Some jurisdictions simply disallow server deployment outside of the agency (cloud-configured or not) by law or policy, but programs would be well advised to *not* accept a 'No' based on policy without investigation.
- Cloud computing shifts the cost of providing server capacity from a capital expense to an operational expense.
- Independently-certified public cloud computing services can be acquired with reasonable guarantees of security for the server environment.
- Steep up-front set-up charges that are imposed by some cloud service providers could be mitigated by sharing an environment.
- Many PH product/product support vendors are all engaged in supporting cloud-based deployments and even prefer this type of implementation.

Resources

Resource Name/Description	URL
Cloud Standards Consumer Council	http://www.cloud-council.org/
EHNAC: Cloud-enabled Services Accreditation Program	http://www.ehnac.org/cloud-enabled-services/
HHS: *Guidance on HIPAA & Cloud Computing*	http://www.hhs.gov/hipaa/for-professionals/special-topics/cloud-computing/index.html
HLN: *Encrypting Data at Rest on Servers: What does it get you?*	https://www.hln.com/encrypting-data-at-rest-on-servers-what-does-it-get-you/
IEEE: Standards in Cloud Computing	http://cloudcomputing.ieee.org/standards
NASCIO: *Capital in the Clouds* (7 part series)	https://www.nascio.org/Publications/PID/485/evl/0/CategoryID/49/CategoryName/Capital-Cloud-Series
NIST Cloud Computing Program	https://www.nist.gov/programs-projects/nist-cloud-computing-program-nccp

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