Prospects for Cloud Computing in a Public University Hospital

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Wien, Austria November 23rd 2016
Agenda

1. Context
   • Hospital
   • Innovation Unit
2. Health IT Security & Cloud
3. Our case
   • Hospital status
   • Regional status
4. Prospects: ongoing projects
5. Challenges
6. Benefits
7. Conclusions
Hospital Clínico San Carlos (HCSC)

• Located in Madrid city center
• Belongs to SERMAS (+30 hospitals)
• 964 beds
• Potentially providing care to 365,000 patients from 14 primary care facilities
• 40,000 admissions, 650,000 outpatient consultations
• 125,000 emergency consultations (350/day)
• More than 5,000 professionals.
  • 807 staff physicians, 453 residents
Innovation Unit HCSC

• Main mantra is to produce VALUE

• Channeling innovation requests from
  • Hospital professionals
  • External partners
  • Or... proactive proposals by ourselves

• Two main areas:
  - Develop prototypes of innovative IT, together with external partners
  - Support the innovation process to move clinical research to market
HealthIT security problems: governance

• Head Directors of IT Department in “Castilla y León” Regional Healthcare System forced to resign this month due to the lost of thousands of medical images during migration of an old IT system

• External company had the governance of data and the contract expired...
HealthIT security problems: Virus vs HA

Data Error, Improper PHI Disposal  
Cause Security Concerns  
HIPAA Minimum Necessary Standard  
Discussed in Hearing

UK hospital system reports computer virus, cancels procedures

The National Health Service’s Lincolnshire and Goole trust reported on November 2, 2016 that a computer virus had infiltrated their system, forcing it to cancel “all planned operations, outpatient appointments and diagnostic procedures.”

The hospital system said in a statement on its website homepage that the virus infected the computer system on October 30, according to a report on KrebsOnSecurity.

We have taken the decision, following expert advise, to shut down the majority of our systems so we can isolate and destroy it,” NHS said. “All planned operations, outpatient appointments and diagnostic procedures have been cancelled for Wednesday, Nov. 2 with a small number of exceptions.”

The hospital system did not specify the kind of virus that was involved in the incident. Major trauma cases, and also high risk women in labor, were diverted to other hospitals.

As of November 3, the NHS website’s updated statement said that “the majority of our electronic systems are now back up and working.” Patients that were due to come in for an appointment, procedure, operation, or scan were encouraged to come in.
NOTICE OF DATA PRIVACY EVENT

SILVER CREEK FITNESS & PHYSICAL THERAPY PROVIDES NOTICE OF DATA SECURITY INCIDENT

San Jose, California – October 24, 2016 – Silver Creek Fitness & Physical Therapy, Silver Creek Physical Therapy Gilroy, Silver Creek Physical Therapy Sunnyvale, and Silver Creek Physical Therapy Los Gatos (collectively “Silver Creek”) today announced a data incident affecting the security of certain patient records. On September 11, 2016, Silver Creek was notified by its billing and software companies that their Amazon “S3” storage account was vulnerable because it was accessible to persons outside their organization, and that a security researcher who works for a software company accessed and downloaded information from the storage account. This storage account contained, among other things, protected health information of certain Silver Creek patients. The billing and software companies immediately took steps to secure the storage account and launched an investigation to determine to what extent sensitive information was accessed or acquired. They determined that the storage account was vulnerable from May, 2016 to September 11, 2016 and that information was accessed and downloaded by the security researcher on or around September 10, 2016. However, there are no indications that any fraud has resulted from this incident.

“We take any threat to the security of information entrusted to us very seriously,” said Mr. Jones, Co-founder of Silver Creek Fitness & Physical Therapy. “Once the error was discovered, we worked with the billing and software companies to ensure that access to the storage account was restricted and that proper access credentials are in place.” Mr. Jones added, “We apologize for any inconvenience or concern this incident may cause our patients.”

Information Compromised

While Silver Creek Fitness & Physical Therapy, Silver Creek Physical Therapy Gilroy, Silver Creek Physical Therapy Sunnyvale, Silver Creek Physical Therapy Los Gatos has no indications that any fraud has resulted from this incident, it has confirmed that the data affected by this incident possibly includes patient names, Medicare numbers, prescriptions, dates of birth, treatment locations, ...
• Patients should have freedom of access to their healthcare data.

• Researchers need easy access to patient data.

• Society demands security in this regard

• Security vs Usability? They are usually enemies

who wins?
Review of security in EHRs

- 26/49 used standards or regulations
- 27/49 studies use role-based access control (RBAC)
- 16/49 says emergency justify permission override
- 25/49 audit-log is produced
- 4/49 mention that users, health staff should be trained in security and privacy (!?)
Data Protection Regulation

Security measures are regulated in sections 89 to 104 of Spanish “Ley Orgánica de Protección de Datos” (Real Decreto 1720/2007):

<table>
<thead>
<tr>
<th>Security measures</th>
<th>Basic Level</th>
<th>Medium Level</th>
<th>High Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Staff Functions and obligations</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
</tr>
<tr>
<td>2. Incident Log</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
</tr>
<tr>
<td>3. Access control</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
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<tr>
<td>4. Handling of storage and documents</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
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<tr>
<td>5. Authentication and Authorization</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
</tr>
<tr>
<td>6. Back-up and restore</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
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<tr>
<td>7. Security responsible</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
</tr>
<tr>
<td>8. Audit</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
</tr>
<tr>
<td>9. Handling of storage and documents</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
</tr>
<tr>
<td>10. Authentication and Authorization</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
</tr>
<tr>
<td>11. Physical access control</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
</tr>
<tr>
<td>12. Incident Log</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
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<tr>
<td>13. Handling and distribution of storage</td>
<td></td>
<td></td>
<td>Si</td>
</tr>
<tr>
<td>14. Back-up and restore</td>
<td></td>
<td></td>
<td>Si</td>
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<tr>
<td>15. Access log</td>
<td></td>
<td></td>
<td>Si</td>
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<tr>
<td>16. Telecommunications</td>
<td></td>
<td></td>
<td>Si</td>
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</tbody>
</table>
SERMAS
Athene@ Plan: Cloud Center of Regional Health IT Systems (2013)

• Three-DataCenter topology (Active-Active / Contingency)
• Private Cloud for all Madrid health centers
• Consolidation: Virtualization + Standardization
  • Less cost
  • Higher Flexibility, Availability and Security
In our institution?

- Many “Data Islands” (lab, pharma, nursing emergency, radiology...)
- 40% of hospital software are self-developments
  - Very difficult to tackle migrations
- No structured EHR (yet)
- Intranet Web application “PACIENTE” (2005) to save discharge patient reports + integration with lab results
- Paper patient medical histories are stored in-hospital but also outside, through a company that keep, order and transport them
- No formal CISO (in process)
IaaS or SaaS

Example: Clinical Decision Support on Hyponatremia

• A web app to collect patient info and get evidence-based decisions
IaaS secure deployment
Example: MobiGuide

Credits to Daniele Segagni (FSM)
Big Data: HIKARI Project
MLaaS: Machine Learning as a Service

• IaaS, SaaS created for Data analytics for healthcare research

• R on Hadoop?

Data outside the Hospital?

<table>
<thead>
<tr>
<th>Label</th>
<th>Num. Patients</th>
<th>Intra-cluster contribution of variables (shown those &gt;15%; except when not reaching the threshold, where we show those &gt;9%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer</td>
<td>53</td>
<td>Cancer of bronchus; lung (81.13), Secondary malignancy of bone (45.28), Secondary malignancy of lymph nodes (43.4), Secondary malignancy of brain/spine (41.51), Secondary malignant neoplasm of liver (28.3), Secondary malignancy of respiratory organs (22.64), Cancer, suspected or other (18.87)</td>
</tr>
<tr>
<td>URTI</td>
<td>81</td>
<td>Urinary tract infection (95.06), E. coli (32.1), Bacterial infection NOS (29.63), Diaphragmatic hernia (23.46), Delirium due to conditions classified elsewhere (17.28)</td>
</tr>
<tr>
<td>NotSpec</td>
<td>351</td>
<td>Urinary tract infection (13.88), Other diseases of respiratory system, NEC (12.54), Encounter for long-term (current) use of aspirin (10.83), Hyperplasia of prostate (9.4)</td>
</tr>
</tbody>
</table>
Easy challenges

• Demonstrate capabilities of the cloud solution for **worst-case scenarios**
  • vulnerabilities in data transfer interfaces
  • breach of data confidentiality
  • breach of data integrity
  • accidental loss of data availability or confidentiality

• Demonstrate **features**
  • Increased protection of personal data
  • provenance and traceability
  • simplicity (e-certificates, vpn’s, etc... are not easy for users)
Hard challenges

• **Procurement** can take an age. Each spend must be fully justified, cause serious delays in innovation

• **Institutional and government support.** In our hierarchical structure, is needed.

• **Change & priority management:** You know what *could* be done! But physicians are caring for patients.

• **Patient Sensitive data:** in-house private cloud is costly, outside public cloud is insecure...

• **Cloud providers** cannot see patient data
Benefits

• **Security** is improved, if well implemented

• **Speed-up on backing up** from IT disasters

• **Testing new technologies** can be very fast and independent thanks to virtualization

• **On-demand scalability** for EHR use and research tasks
Conclusions

• **The need for training hospital staff at all levels** prevent doing fast innovations that have impact on their daily activity

• **Security** can be improved over traditional paper-based records. Need to define governance and define usable and hard security policies.

• **Actual benefit**: reduction of costs and backup. **Prospect**: MlaaS, CDSS,…

• **Using virtualization**, care professionals can explore new IT solutions

• To reach hospitals, success rely on iterative approach: **cheap** scenario-based prototypes that work can end up on **value-based investments**
Thank you

Cloud: a parallel dimension that allows the user to practice their magical abilities without the public's knowledge.

"You are now inside the mirror dimension, ever present but undetected. The real world isn't affected by what happens here. We use the mirror dimension to train, surveil and sometimes to contain threats."
About myself: arturogf@gmail.com

Designed the e-learning service. 30,000 students. HA with GFS2 + SAML2-Shibboleth federated Auth.

Leaderd the Data Integration Tasks within a 5M€ EU-funded FP7 project to develop a patient guidance system

supports the institution taking IT innovations that can provide some value for improvement