Special Topics in Security and Privacy of Medical Information

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Why is securing medical information important?

- What are some potential threats to medical information?

Potential Threats

- Compromise of identity
Potential Threats

- Compromise of Privacy
  - Britney Spears, George Clooney, Octomom (Nadya Suleman) are all victims of medical privacy breach

Potential Threats

- Compromise of integrity
  - A person's medical record was falsified with psychiatric history of depression

Potential Threats

- Compromise of Network
  - UNC-Chapel Hill radiology department records compromised
  - Over 160,000 women mammogram records may have been potentially compromised
This course

- Syllabus
  - Medical records and access control
  - Communication standards
  - Medical device security
  - Portable patient record systems
  - Privacy and anonymity techniques for medical data
  - Medical image security
  - Medical identity theft

- Prerequisites
  - Basic knowledge of computers and networking
  - Comfortable with programming
    - Java programming component
  - Have access to a computer for lectures and a microphone headset

- Website
  - http://www.cs.jhu.edu/~sdoshi/jhuisi650

- Office Hours
  - By appointment

- Text Book
  - Lectures based on research papers which will be put online
This course

Grading
- Assignments (2): 20%
- Project: 40%
- Participation: 40%
  - Discussion sessions 20%
  - Debates 10%
  - General participation 10%

Collaboration policy
- No collaboration on assignments unless stated otherwise
- May work in teams for project
  - Must let me know teams by end of the week
- Discussion session leads will be assigned by me

Email IDs
- Class mailing list
  - Will create a new mailing list today -- the ISIS mailing list only allows you to use your ISIS id for communication
  - Discussions/announcements would be held on this list
  - Type email id
Project (40%)

- **OpenMRS**
  - Open source electronic medical record system
  - Java based system with SQL backend and Web app as the front end
  - Customize the medical record system
  - Based on a concept dictionary which forms the core
  - Stores diagnosis, tests, procedures, drug information
  - Wiki: www.openmrs.org

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Project (40%)

- **Concept Dictionary**
  - What happens if you want to store glucose levels?

<table>
<thead>
<tr>
<th>Date</th>
<th>Patient</th>
<th>Sodium</th>
<th>Creatinine</th>
<th>Urine Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>Smith</td>
<td>142</td>
<td>0.7</td>
<td>Yellow</td>
</tr>
</tbody>
</table>

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Project (40%)

- **Concept Dictionary**
  - Easier to customize for new observations
  - One row per value rather than per patient
  - Observations referenced from central concept dictionary

<table>
<thead>
<tr>
<th>Date</th>
<th>Patient</th>
<th>Observation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>Smith</td>
<td>Creatinine</td>
<td>1.5</td>
</tr>
<tr>
<td>Monday</td>
<td>Smith</td>
<td>Urine Color</td>
<td>Yellow</td>
</tr>
<tr>
<td>Wednesday</td>
<td>Jones</td>
<td>Sodium</td>
<td>142</td>
</tr>
<tr>
<td>Wednesday</td>
<td>Jones</td>
<td>Creatinine</td>
<td>0.7</td>
</tr>
</tbody>
</table>
Project OpenMRS requirements

- Java
- Ant
- Eclipse
- MySQL
- Tomcat
- SVN client: version uploaded is 10938
- Preferably work in a unix environment

Project: Part I

- Understanding OpenMRS
  - Explore documentation and presentations and the codebase
  - Configure and setup system
  - Configure roles for hospital setting
  - Configure privileges
  - Configure alerts
  - Source demo data and test the alerts
  - Writeup

Project: Part II

- Designing extensions to OpenMRS
  - Two security features
  - Two functionality features
  - Substantial in nature
  - Motivate need in healthcare setting
  - Detail design of how you plan to accomplish this
  - Task breakdown
  - Extra credit
  - Writeup and Presentation
Project: Part III

- Implementation
  - Well documented code
  - Correct use of security primitives
  - Easy to configure system
  - Test runs
  - Write up
  - Presentation

Project

- Look up project document for grading rubrik
- Installation instructions and source code on website
- Can work in teams of 2-3 students
  - Let me know teams by end of week
- Can use existing modules in OpenMRS SVN

Discussion Sessions (20%)

- Students will lead
- Sessions will be assigned topic and paper for session
- Students should identify papers associated with topic
  - Send them to me a week in advance of your session
- Idea is for students to cultivate a discussion on set topic
  - May introduce activities such as debates etc
  - Should present slides in part of lecture,
    - Email slides to me and I will upload them into AdobeConnect
- Discussion notes should be maintained by lead and should be sent to me afterwards
Assignments (20%)

- Two assignments
  - Should be done individually
  - All resources used must be cited
  - Should be submitted on due date

Medical Records Systems

- Medical Record
  - Longitudinal history
- Started with paper based systems
  - Kept in folders which are typically divided into sections

Medical Record Systems

- Issues with paper based systems
  - Patients chart may be unavailable when a healthcare professional needs them
  - Poor organization may lead to waste of time in searching for the right data
  - Data may be illegible
  - Records may be misplaced easily
  - In a 500-bed hospital, a 7-inch stack of laboratory reports must be filed each day!
Medical Record Systems

- Most paper based systems are now being replaced by electronic health record systems
  - Also called computer based patient records
  - All information maintained digitally

Advantages of EHR

- Remote access to patient data
- Legible
- Logging of accesses possible
- Flexible layout of data
- Continuous data processing
  - Helpful in checking for errors
  - Easier to search through

PHR systems

- Personal health record systems
  - Maintained by individual
  - Can be shared with doctors, family members
  - Information usually either imported from labs or entered by the individual
  - E.g. Google Health, Microsoft Health Vault
**EPR/EHR systems**

- Electronic Patient Record systems
  - Maintained by the provider
  - Usually the doctor enters the information
  - Patients do not have easy access to their own health records

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**EPR vs PHR**

- Synergistic outcomes.
  - PHR data can augment physician collected data
  - Patients motivated to participate in their own healthcare management
  - Patients could receive feedback on the PHR

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**EPR vs PHR**

- Conflicting outcome
  - Patient role may frustrate provider
  - Provider may not trust the PHR data
  - Data may not be up to date in the PHR system
Integrating EPR and PHRs

- Efforts are moving towards this goal
  - Numerous challenges exist
    - Patient control and authentication
    - Synchronization
    - Data formats
    - Data entry
    - Usage of PHR data for diagnostic analysis

Content of records

- Personally identifying information
  - SSN
  - DOB
  - Age
  - Gender
  - Address

- Health related information
  - Allergies
  - Blood Type
  - Lab tests results
  - Medical reports
  - Medications
  - Billing information
Security Requirements
- Authentication of user that accesses a record
  - Typically achieved with login credentials into the medical record system
  - Should every authenticated doctor be allowed to access every patient's record?

Security Requirements
- Access Control permissions must be in place
  - Provide flexibility over which records may be accessed
  - What is a better principle to follow?
    - Open to everyone in system
    - Control based on role
    - Allow only as needed

Security Requirements
- Confidentiality and integrity of data
  - Records must be kept and transferred confidentially
    - How can confidentiality be achieved?
  - The integrity of records must be maintained
Security Requirements

- Non-repudiation to ensure traceability
  - A change made by authorized personnel to a record cannot be denied at a later time

This lecture

- Course overview
- OpenMRS
- Medical Records
- Start exploring OpenMRS documentation and configuring it