Towards Privacy by Design in Personal e-Health Systems

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First step towards privacy by design

- Analyze the personal e-Health systems
  - *Modeling their functionalities*

- Identify the arising privacy issues
  - *Based on modeled system’s functionality*

- Present some possible privacy-enhancing techniques
  - *e.g. encryption, anonymization, pseudonyms …*

Next steps:
- Develop a methodology for engineering privacy
- Organize practical guidelines
CARRE Project

https://www.carre-project.eu

- It is a EU co-funded project in the area of cardiorenal with focus to provide personalized health
- Personal data: Sensor data (e.g. activity and blood pressure), PHR and patient’s intentions (travel, diet, diseases, etc)
Privacy principles and concerns

Privacy principles:

- Data minimization
- Data protection by design
- Data protection by default

Privacy concerns:

- User identification
- Personal data leakage

Privacy ≡ The right to informational self-determination

Individual consent

Individual control

2. Green Paper on Mobile Health (“mHealth”) (SWD(2014) 135 Final)
Data requirements for a personal e-Health system

- Medical
  - Personal health records
- Cognitive
  - Intentions, plans, etc.
- Environmental
  - Environmental sensors
  - Geolocation data
- Financial
  - Health insurance
- Personal data in personal systems
- Personal data in institutional systems
- Educational resources
  - For patients
  - Medical evidence
- Public data on the web
Basic personal e-Health systems functionalities

1. **basic e-health system**
   - **user interface**
   - **personal data storage**
   - **personal data processing**

2. **personal data from**
   - personal systems
   - institutional systems

3. **public data from**
   - public online databases

4. **personal data to**
   - external services and data bases (e.g. registries or statistical pooling)

5. **‘bulletin’ board**
   - private announcements to third parties
   - private responses to anonymous individual

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**G. Drosatos, Privacy by Design in Personal e-Health: 6**
(1) Personal data storage and processing

Privacy issues arise when these operations happen on remote service

- Countermeasures of data storage:
  - Cryptographic techniques

- Countermeasures of processing:
  - There is not general solution
  - Processing in encrypted data require a lot of assumptions
    - Pre-processing before encryption
    - Computational cost
    - Not possible to be applied to all cases
Personal data exchange with 3rd party systems

- Privacy issues:
  - Linkability among the different user’s accounts
  - Linkability with the physical person (in case of interaction with institutional systems)
  - Increase privacy concerns when combine partial personal data together

- Countermeasures:
  - There is not direct measures to this problem
  - An obvious solution involves building dedicated middleware in the user-side that will act as a proxy for all personal systems
(3) Integration of personalized public data

- **Privacy issues:**
  - Linking particular public data to specific user
  - Revealing the user’s needs to public service

- **Countermeasures:**
  - Altering (expanding or generalizing) the initial request
  - Cooperation of a group of users in the system to conceal one another’s requests
  - Using anonymous network technologies (such as TOR)
(4) Exporting personal data for public use

- Privacy issues:
  - Medical registries: User identification of ‘critical mass’ of pooled anonymized personal data
  - Statistical data pooling: User identification if number of participants is small

- Countermeasures:
  - Medical registries: Minimizing and stripping all the identifiable parts
  - Statistical data pooling:
    - Privacy preserving cryptographic techniques
    - The appropriate technique depends on the location of storage and the form of statistical processing
(5) Exchange of private personal data messages

- **Privacy issues:**
  - Conceal the user’s identity from the system and (selectively) from the receiver of the message
  - Conceal the actual message from the system

- **Countermeasures:**
  - Anonymous credential techniques
  - Cryptographic techniques
  - Unlinkably exchanging messages
Conclusions & Next steps

- **Analyze** the personal e-Health systems, **identify** the arising privacy issues and **present** some possible privacy-enhancing techniques

- Based on the arising privacy issues and propose possible countermeasures
  - **Create** a methodology for engineering privacy and present practical guidelines
  - **Apply** the developed methodology to CARRE
Any questions?

THANK YOU
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CARRE Project: Personalized patient empowerment and shared decision support for cardiorenal disease and comorbidities.