Towards Privacy by Design in Personal e-Health Systems

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This work was supported by the FP7-ICT project CARRE (No. 611140), co-funded by the European Commission.
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

- Personal health records
- Medical
- Quantified self
- Personal data in personal systems
- Intentions, plans, etc.
- Cognitive
- Educational resources for patients
- Medical evidence
- Public data on the web
- Environmental sensors
- Geolocation data
- Environmental
- Electronic health records
- Health insurance
- Financial
- Personal data in institutional systems
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 via credentials

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
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 a 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
(2) Personal data exchange with 3\textsuperscript{rd} 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

‒ An **alyze** 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

   ✤ Develop a methodology for engineering privacy and present practical guidelines

   ✤ Apply the developed methodology to CARRE
Acknowledgement

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