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 …*

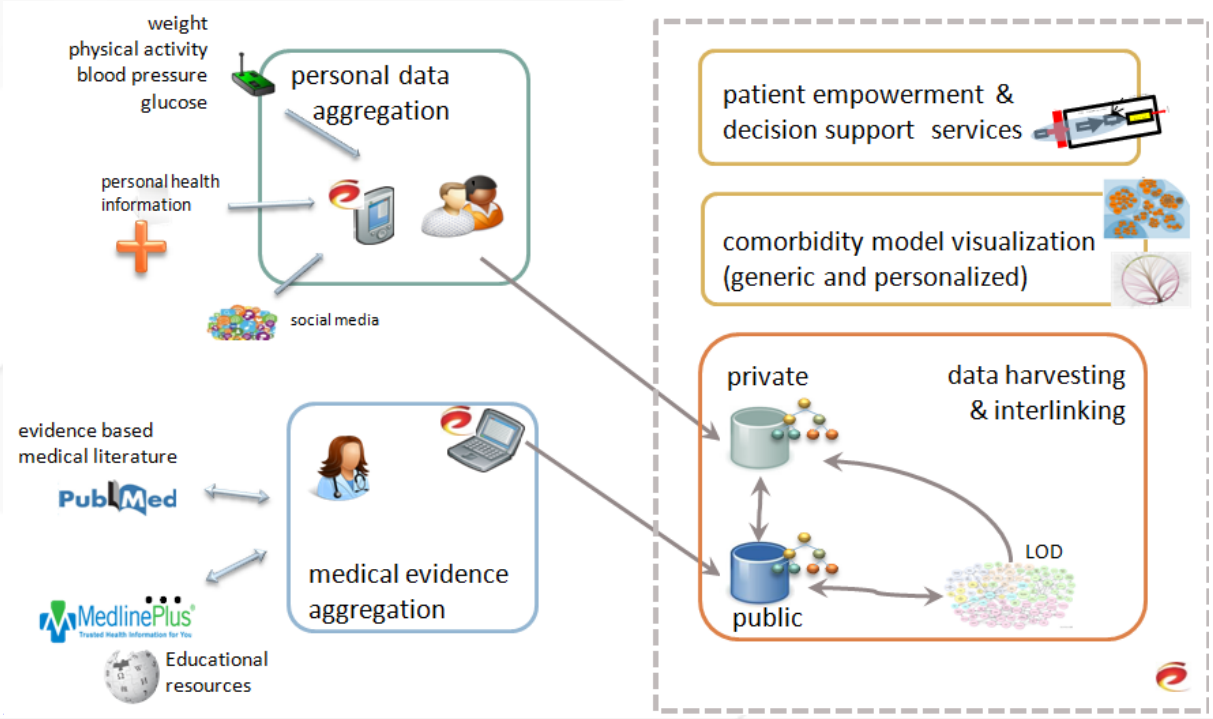
Next steps:

- 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 ≡ The right to informational self-determination

- *Individual consent*
- *Individual control*

Privacy concerns:

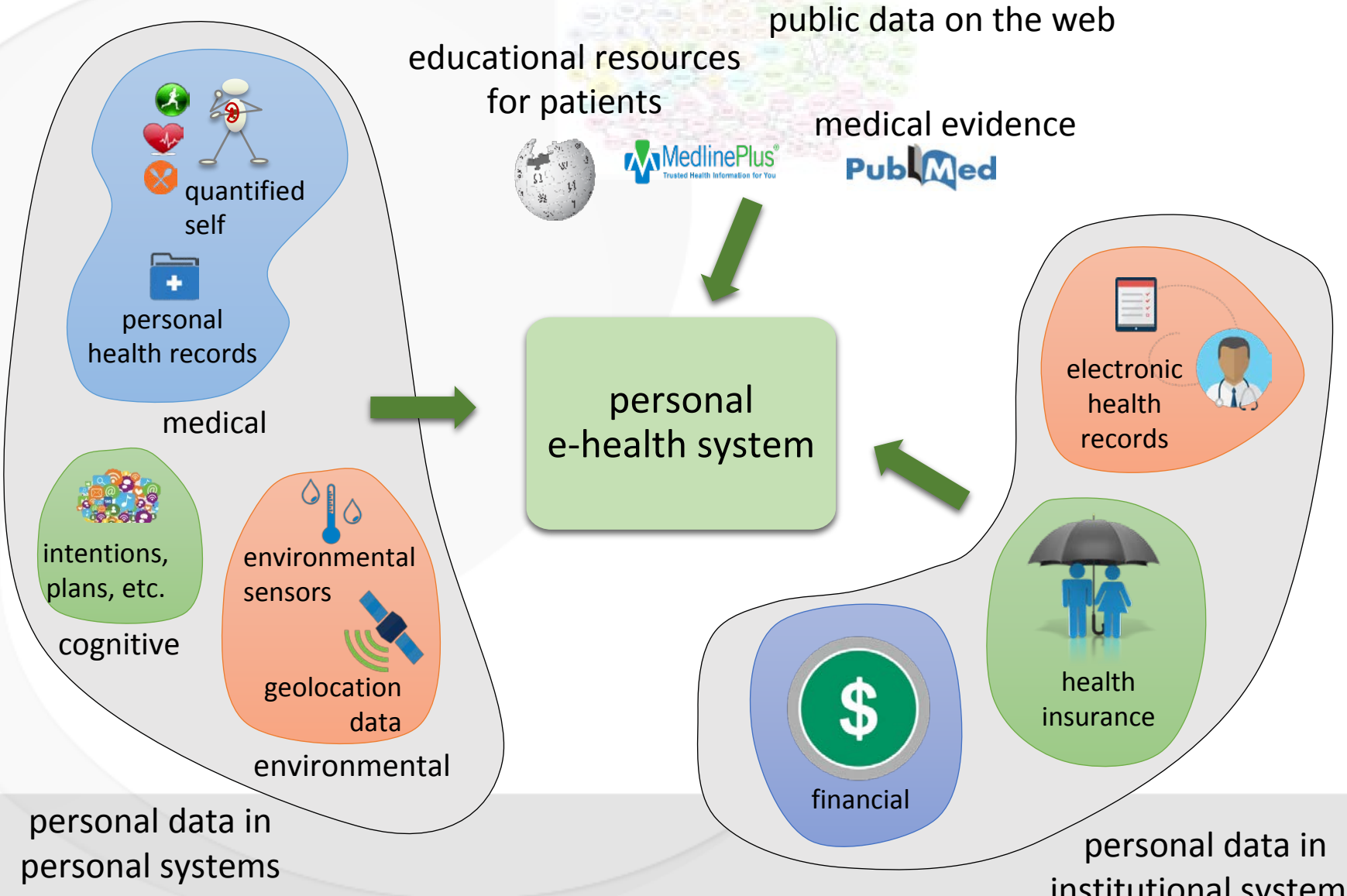
- *User identification*
- *Personal data leakage*

Privacy principles:

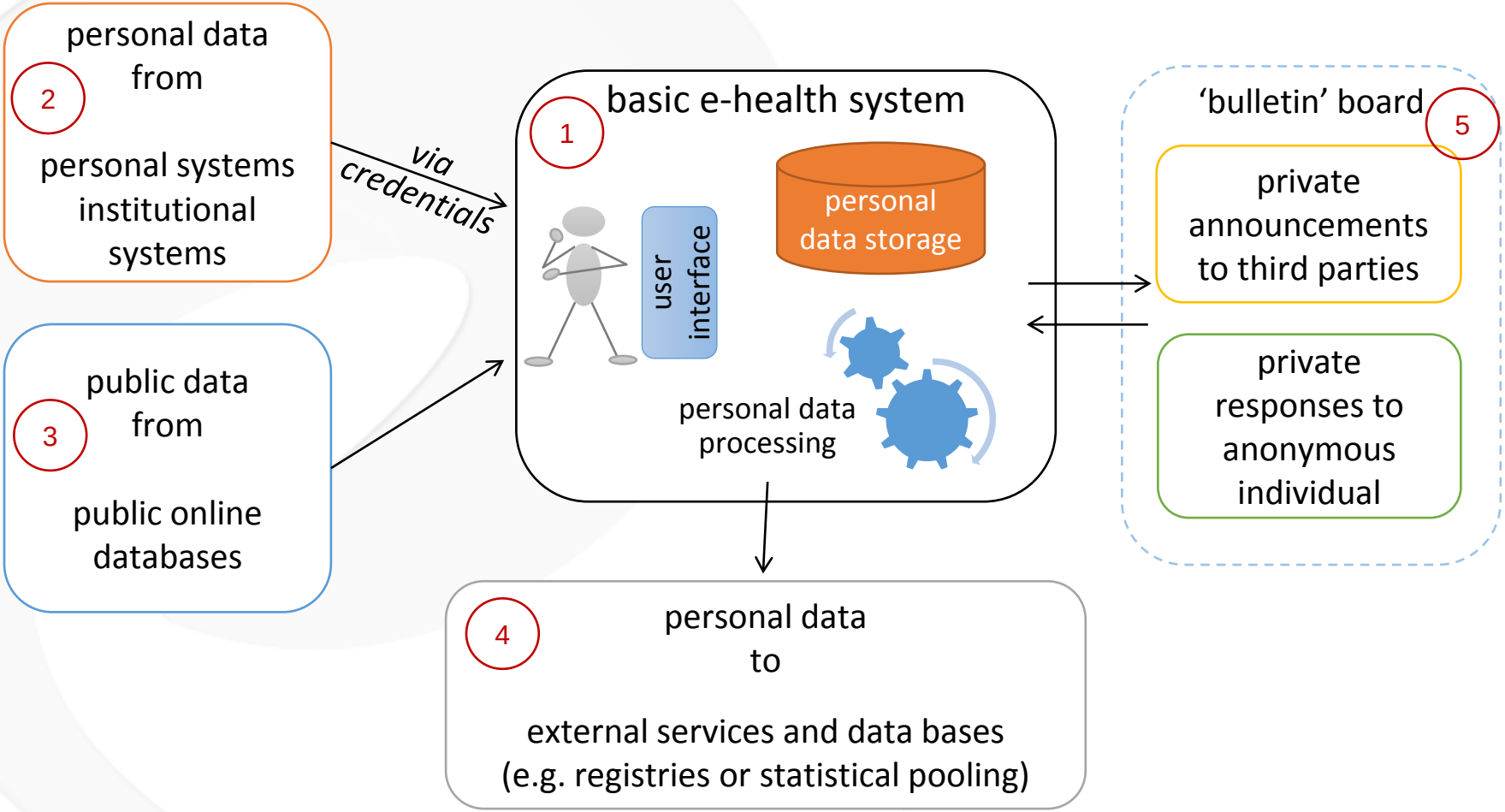
- *Data minimization*
- *Data protection by design*
- *Data protection by default*

1. Directive 95/46/EC. In Official Journal L 281, 0031-0050 (1995)
2. Green Paper on Mobile Health ("mHealth") (SWD(2014) 135 Final)

Data requirements for a personal e-Health system



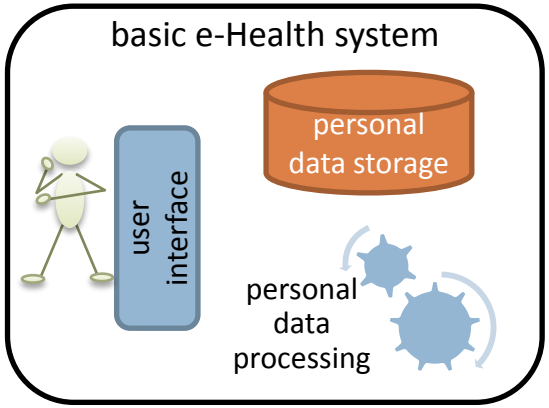
Basic personal e-Health systems functionalities



(1) Personal data storage and processing

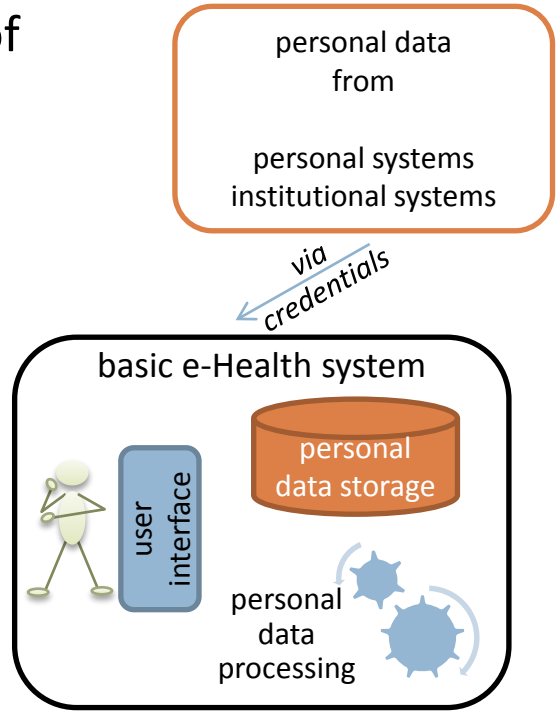
Privacy issues arise when these operations happens on remote service

- 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



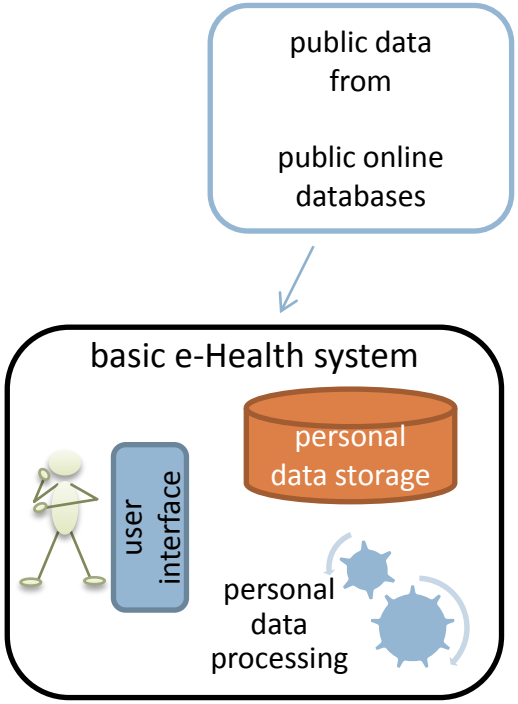
(2) Personal data exchange with 3rd party systems

- 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



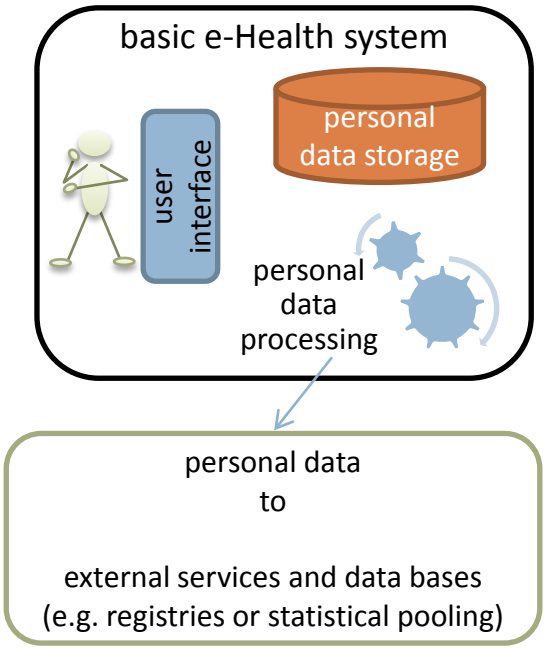
(3) Integration of personalized public data

- 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)



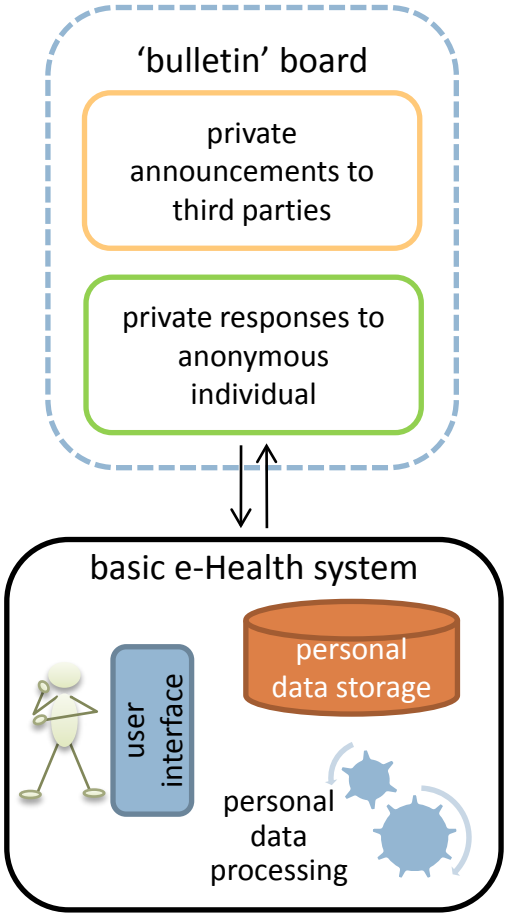
(4) Exporting personal data for public use

- 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
  - Develop a methodology for engineering privacy and present practical guidelines
  - Apply the developed methodology to CARRE

Any questions?

THANK YOU

Acknowledgement

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

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