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Estonia´s Path to Nation-wide Electronic Health Record System (EHR System)

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HCT Health Care Technology

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- Facts about Estonia
- Background and first steps of implementation of EHR System in Estonia
- Design of a solution
  - Findings and results
- Difficulties on the road of the implementation of EHR System

Facts about Estonia

Background & first steps of implementation of EHR System in Estonia

Solution design

Difficulties on the road of implementation of EHR System

Facts about Estonia

- **Basic facts**
  - **Population is 1,3 million**
  - **Every citizen has unique ID-code**
- **Health care system**
  - **Compulsory solidarity based health insurance paid by employers; 13% of payroll tax (95%)**
  - **Health care costs make up to 6% of GDP (9,5% in OECD)**
  - **Healthcare providers are private, municipal or governmental**
  - **Hospital system – publicly owned private hospitals**
  - **General practitioners are private entrepreneurs**

Facts about Estonia

- **Facts about e-services**
  - 88% of households have broadband connection (2017)
  - 82% of households using a mobile internet connection (2016)
  - 96% of income tax declarations are made via the E-Tax Board (2016)
  - 32% of votes were cast over the internet on (2017)
  - 99% financial transactions (bank transfers) carried out electronically

- **General**
  - NATO Cooperative Cyber Defense Centre is located in Estonia (2008)
  - Skype is made in Estonia

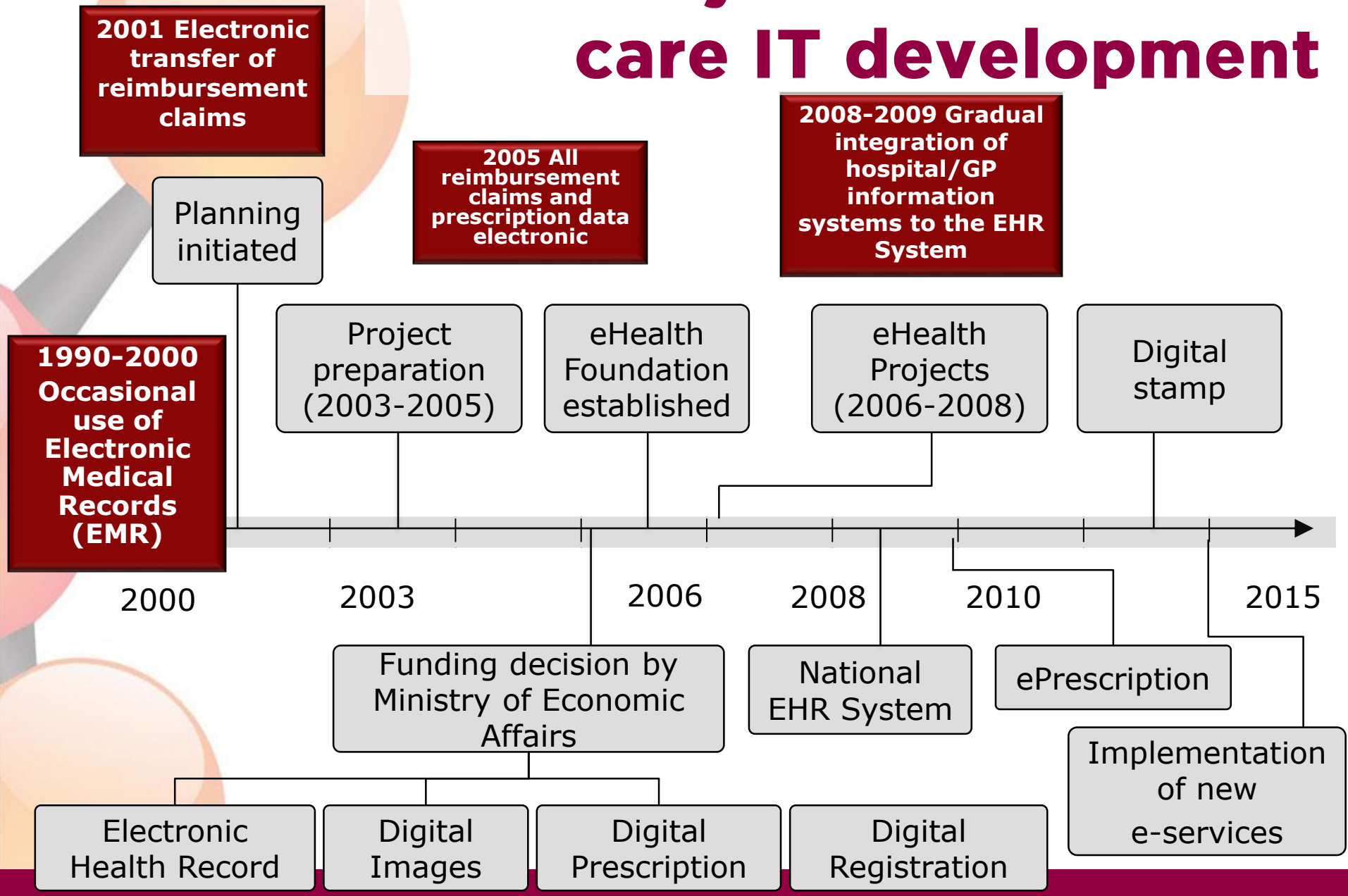
CCDCOE
NATO Cooperative Cyber Defence Centre of Excellence Tallinn, Estonia

Skype

Estonian nation-wide Electronic Health Record System (EHR System)

- The Estonian EHR System is unique as it
  - Encompasses the whole country
  - Registers virtually all residents' health history from birth to death, and
  - Is based on the comprehensive standard based IT infrastructure

EHR System and health care IT development



Main drivers


Clear governance of Estonian eHealth services


Legal clarity


Mature ecosystem for e-services in Estonia


Established on-line identification methods

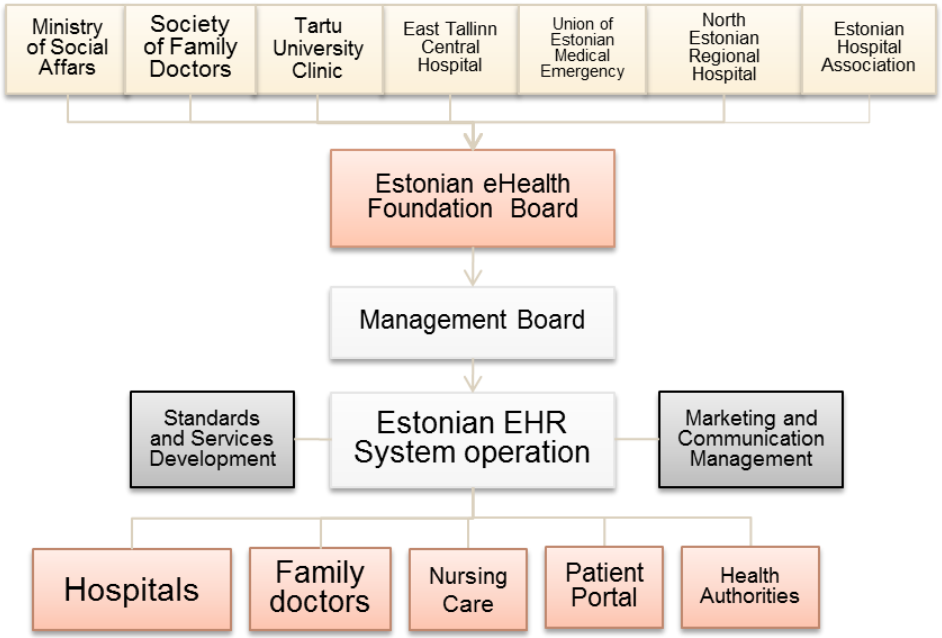

Agreement about access rights


Standardization

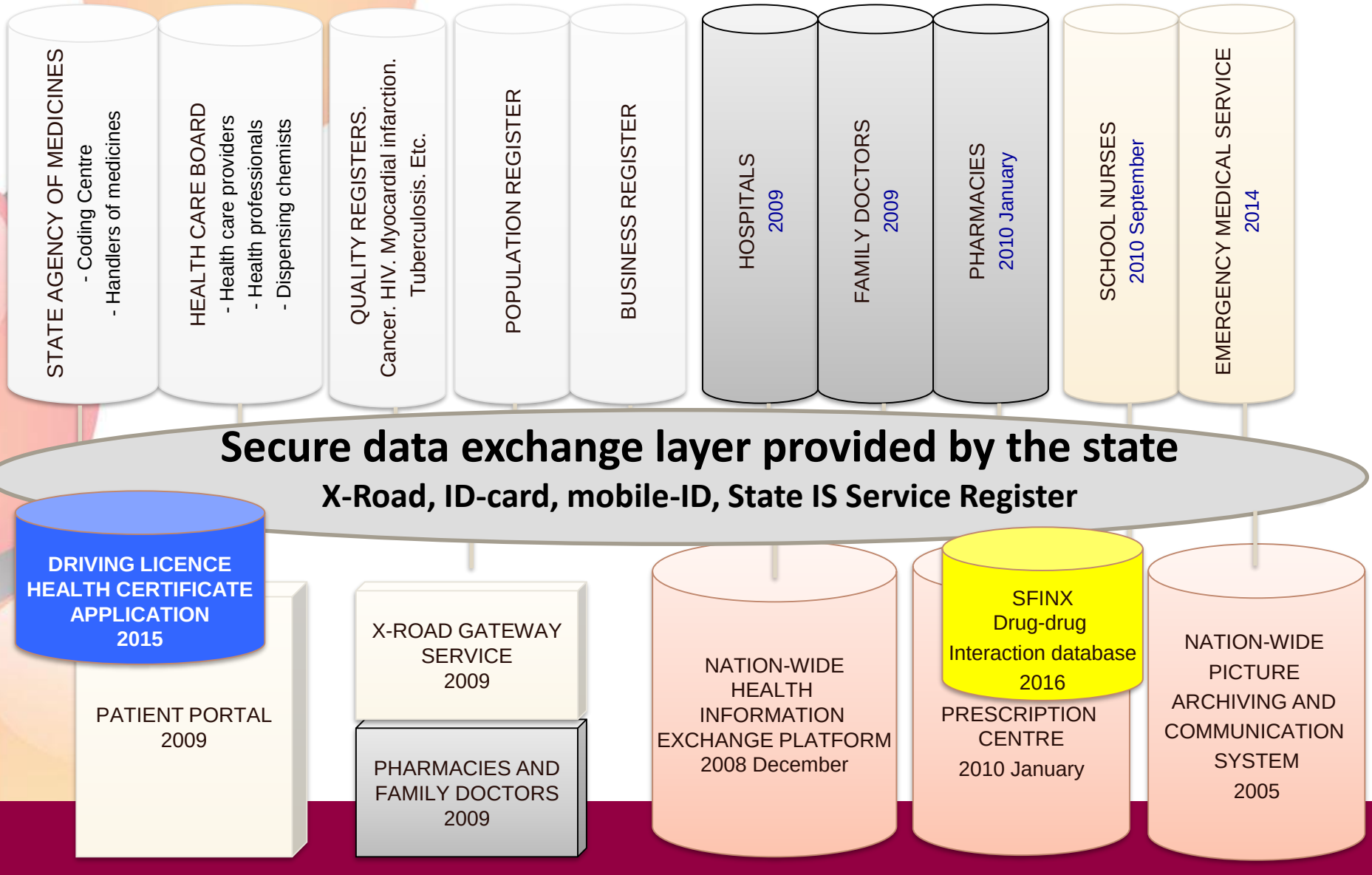
- Clear governance of Estonian eHealth services
  - Estonian E-Health Foundation
  - Estonian Health and Welfare Information Centre
- Legal clarity
- Mature ecosystem for e-services in Estonia
  - Secure data exchange platform provided by the state
- Established on-line identification methods
    - ID-card
    - Mobile-ID
- Agreement about access rights
- Standardization
  - Medical data
  - Data exchange

Governance

- One responsible organization – eHealth Foundation
  - Founders were main stakeholders orchestrated by Ministry of Social Affairs
- We missed support of one major stakeholder
  - Estonian Medical Association – Professional association of medical doctors
- Parties not involved
  - Patients´ societies or associations



Architecture of Estonian nation-wide EHR System (since 2008)

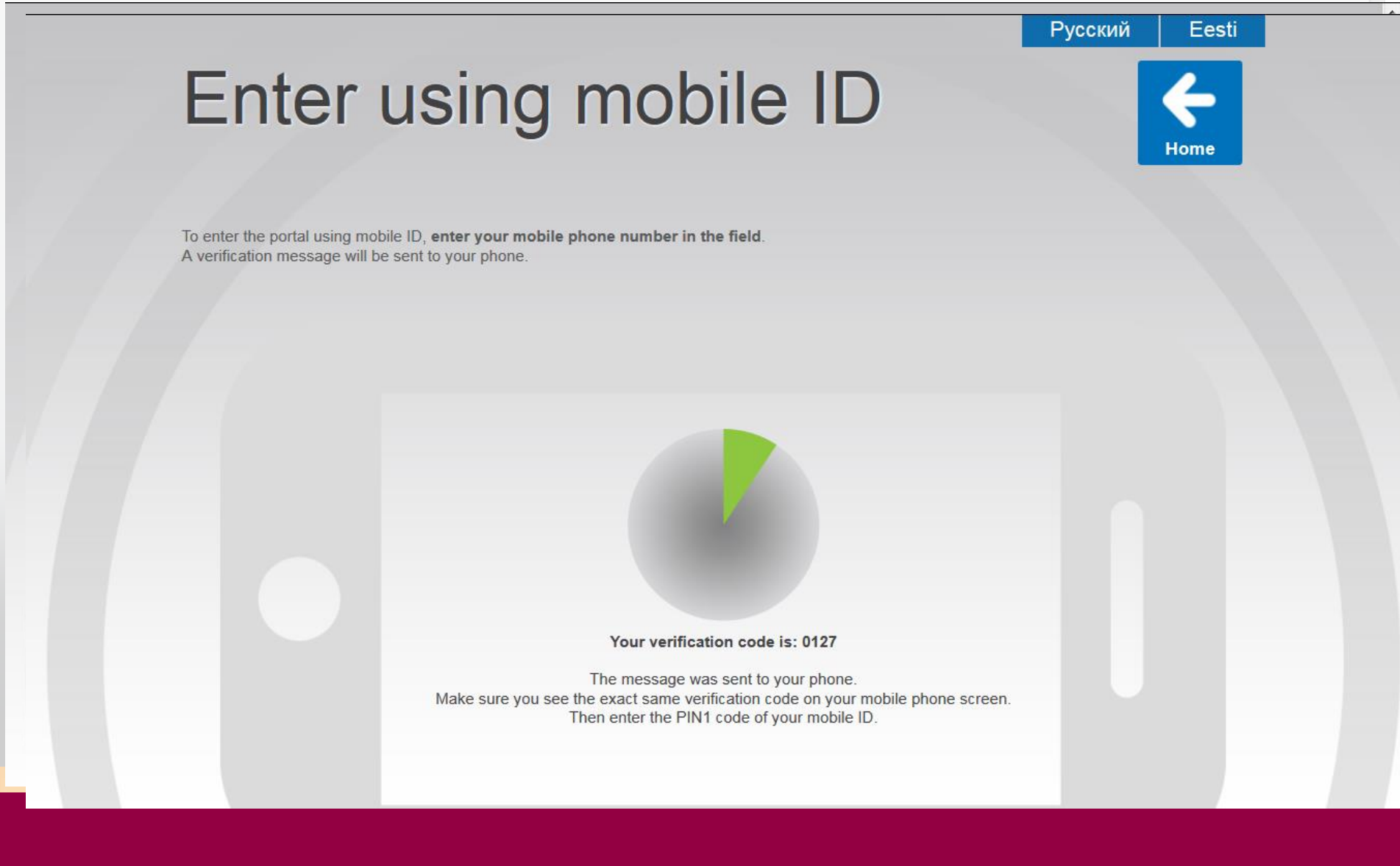


eHealth services in Estonia

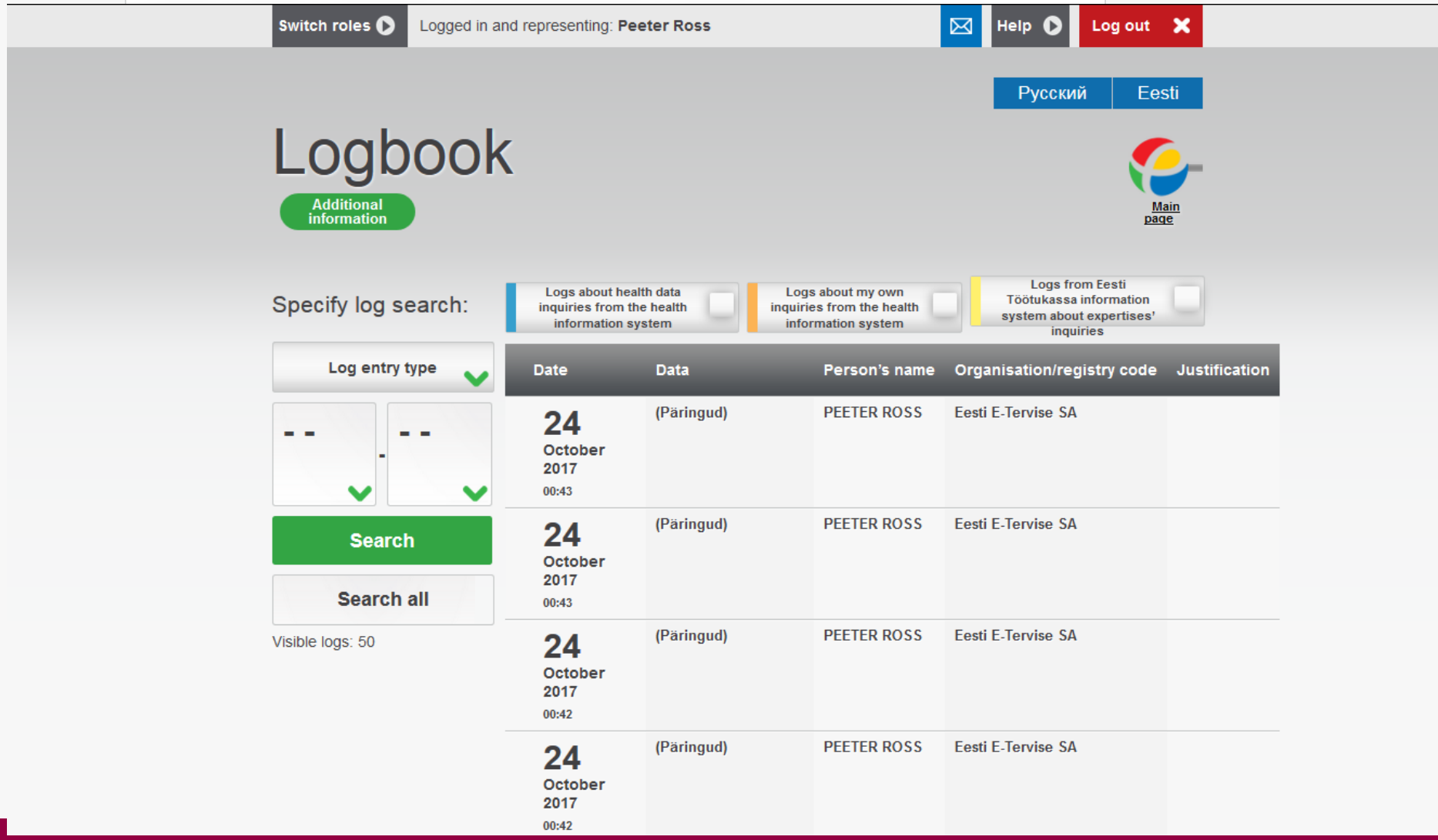
Exchanged data	• Available documents
	  • Time critical data (allergy, chronic diseases)
	  • General practitioners and hospital visits
	  • Summary of ambulatory and stationary case
	  • Link to medical images
	  • Referral letter

Nation-wide EHR System services	• ePrescription • eReferral • eAmbulance • Drug-drug interaction service • Country-wide digital images
Cross-sectoral services	• Health declaration for driver licence exchange • Working incapacity assertion

Patient Portal



Patient Portal



Legal environment of eHealth

- **The Health Services Organization Act regulates the development and maintenance of the health information system**
  - **Lays down the necessary requirements to the patient, health service provider, document standards, etc.**
- **All healthcare providers must send certain health data to EHR System**
  - The set of documents is defined b**y the law**
- **Access only to licensed medical professionals**
  - **The attending doctor concept**
- **Patient has the right to close own data (*opt out*)**
- **The ethical committee was created to lead the discussions of patients´ rights and to select the proper system for the EHR System**
- **Citizen can**
  - **Access their own data**
  - **Declare intentions and preferences**
  - **Monitor logs**

Major architectural decisions of EHR System

Integration through Central system

- Only final versions of clinical documents sent to central system

Opt-out policy in form “patient can close data from doctors“

Use of standards

- XML based HL7 v3 (extended) messages
- Documents are kept in XML format (HL7 CDA R2)
- All identifiers have OID-s

Reuse of national infrastructure

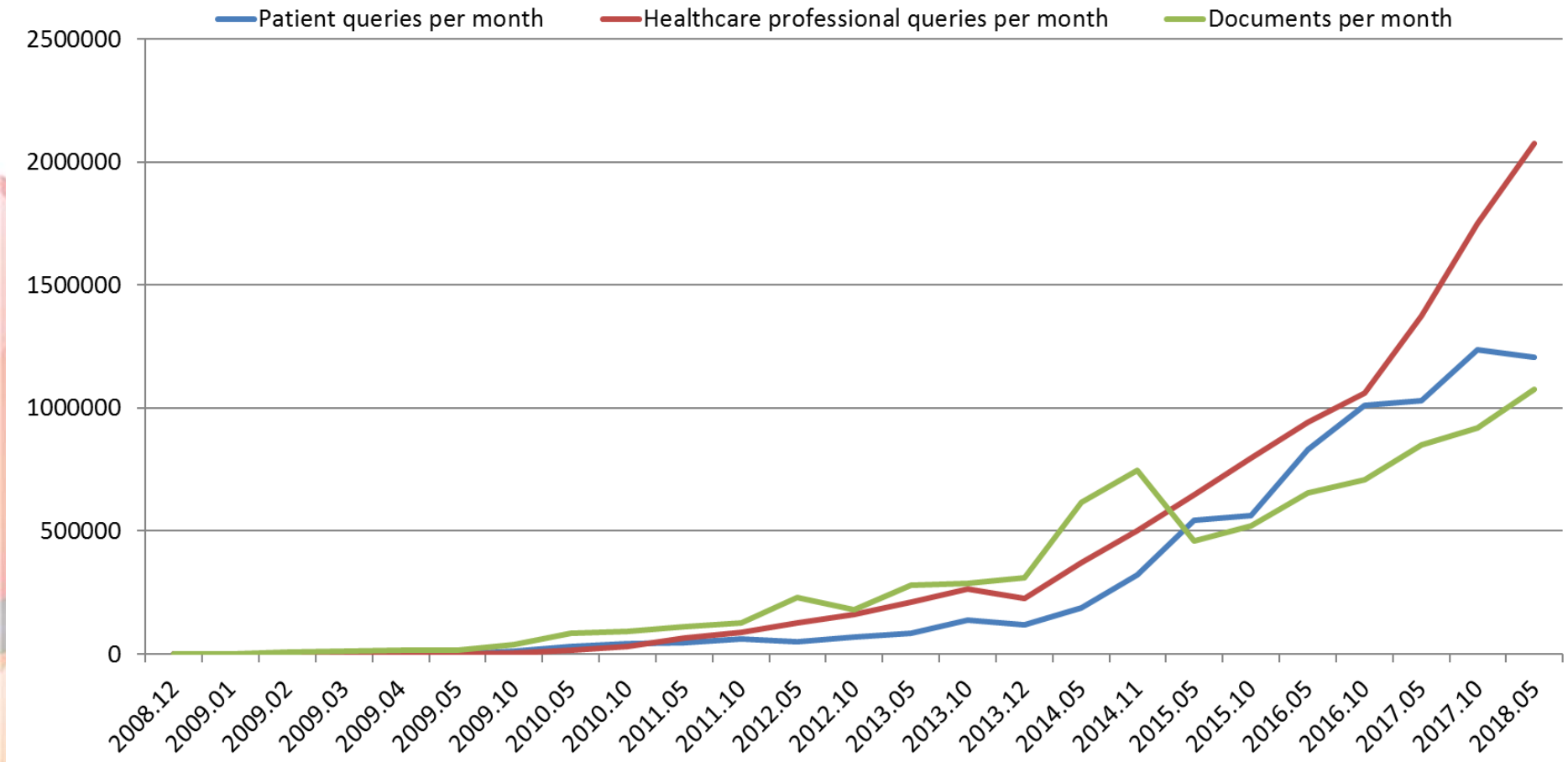
- ID-card or mobile-ID for authentication and digital signature
- X-road (state service bus) for secure communication
- Personal ID-number to identify a person and connect data in different systems

FINDINGS

Current situation (May, 2018)

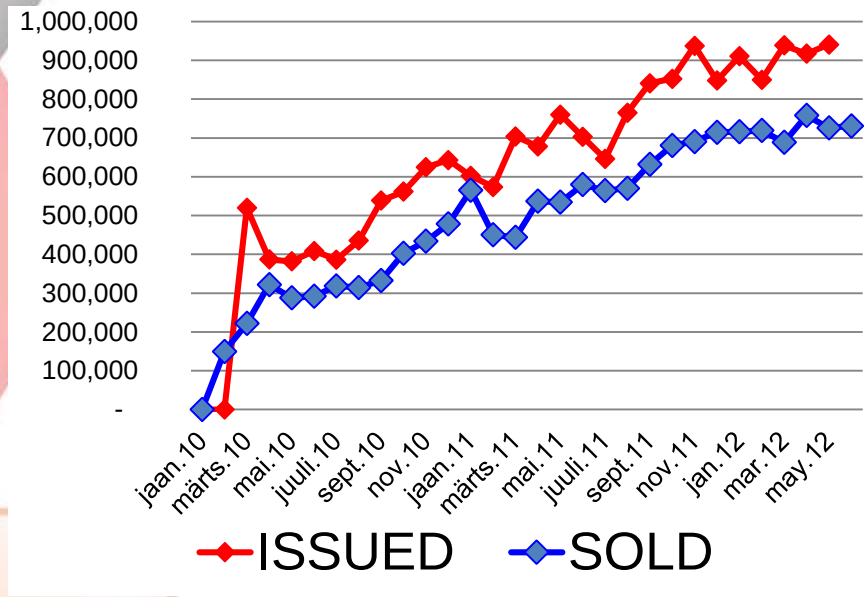
- 40 660 000 medical documents
  - 14 different documents
- Health information about 1.6 million inhabitants (Estonia has 1.32 million inhabitants)
- Out-patient case summaries – 21 million
- Exam reports – 10.5 million
- In-patient case summaries – 1.91 million

Use of digital data



ePrescription, Estonia

99% of prescriptions are issued in electronic form



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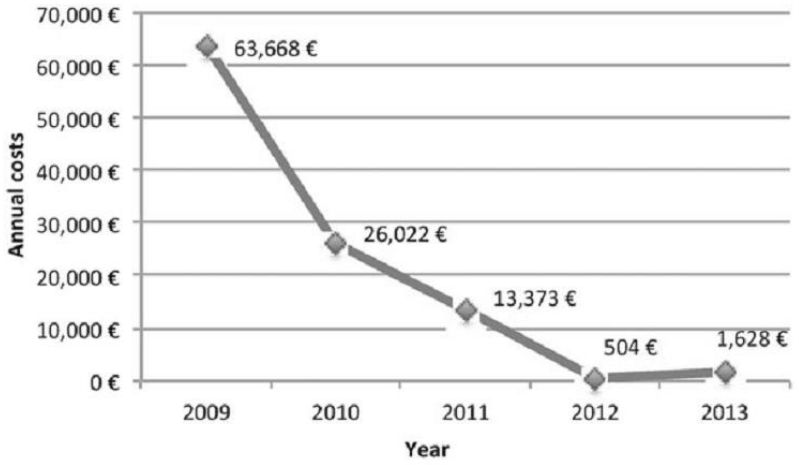
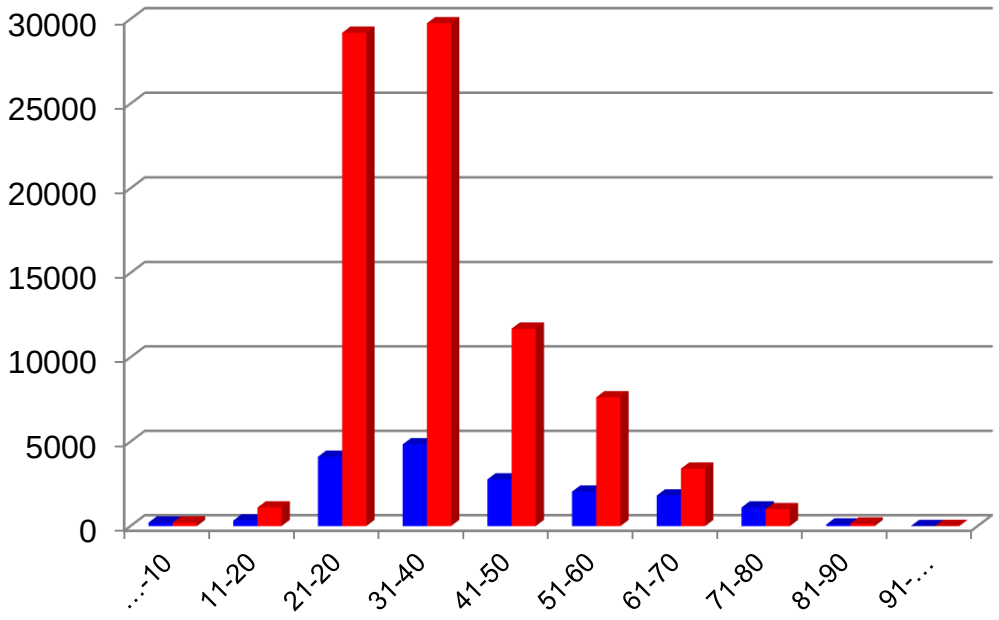


Figure 4. Prescription forms bought by the EHIF in 2009–2013.

ePrescription, Estonia

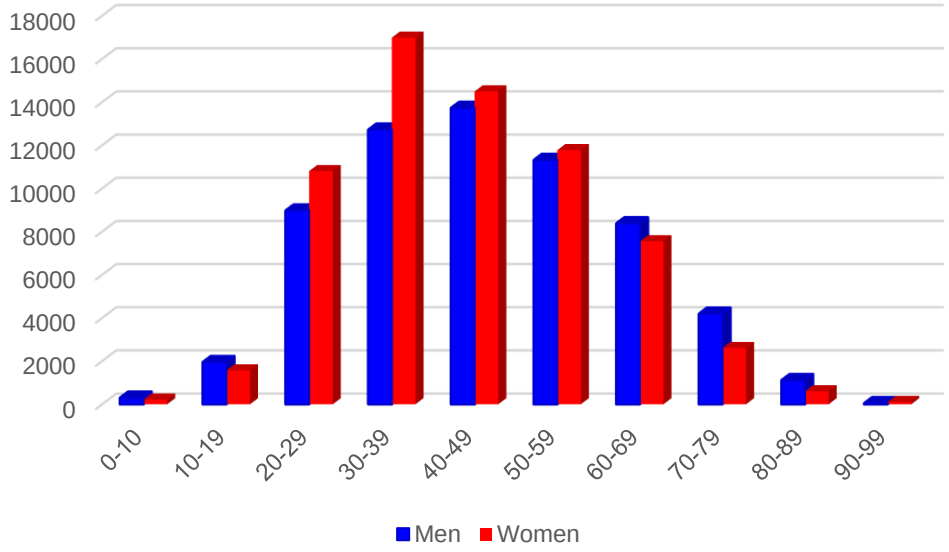
Sept. 30th,



iPatient Portal users 2012

Logins to iPatient Portal in 2012 and Patient Portal Users in 2015 by age and gender

Patient Portal users 2015



Observations and difficulties

PHYSICIAN AND OTHER PROFESSIONALS HAVE TO CHANGE THE WAY THEY FILL IN THE MEDICAL FILES →MORE UNIFORM LANGUAGE

SEMANTIC INTEROPERABILITY IS HARD TO ACHIEVE → DATA QUALITY

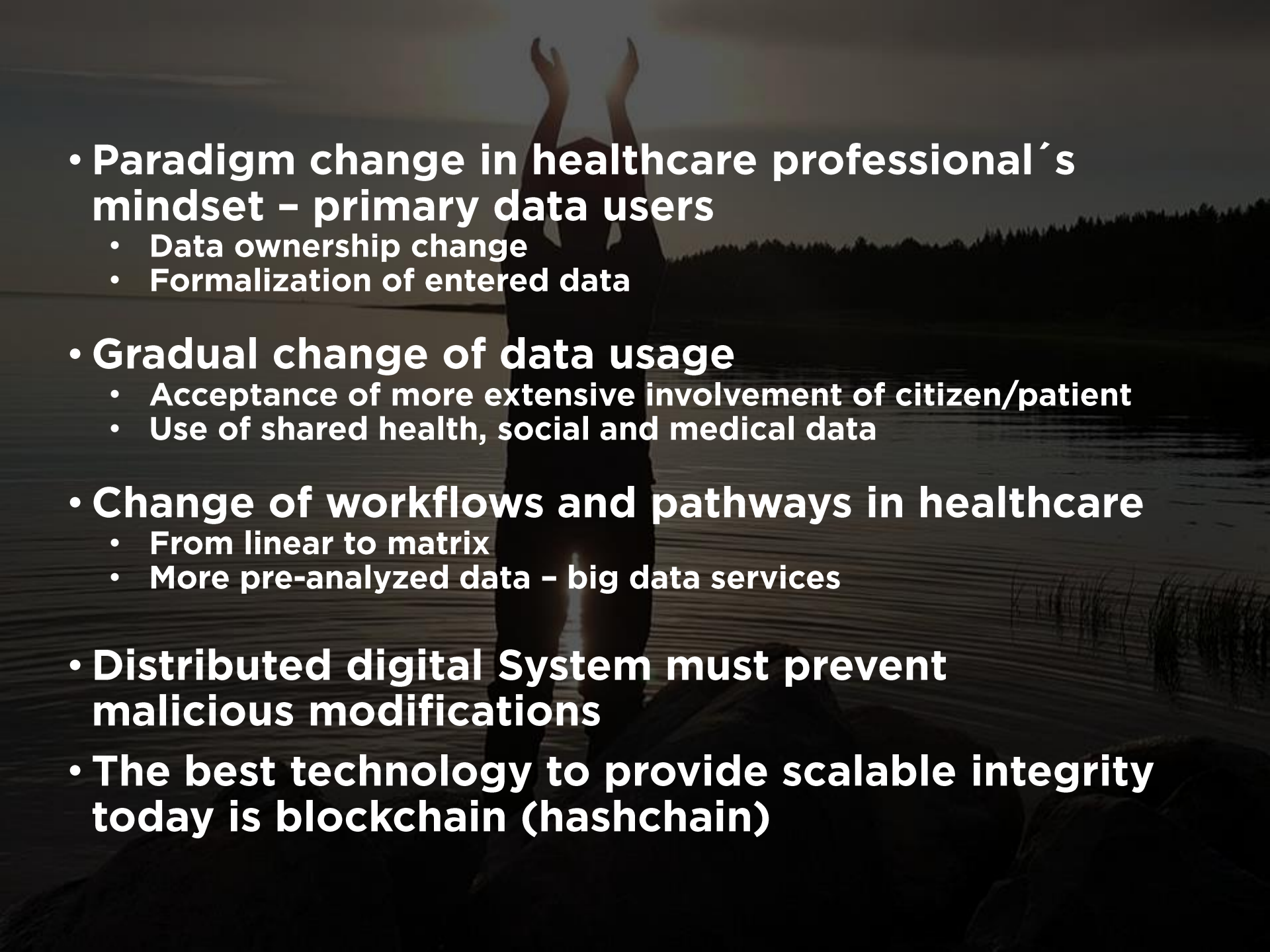
ACCEPTANCE OF HOSPITAL PERSONNEL TO SHARE MEDICAL DATA IN PATIENT PORTAL WITH PATIENT IS PROBLEMATIC

MUCH ATTENTION TO SECURITY AND ELECTRONIC AUTHENTICATION OF THE USERS

USER INTERFACE DEVELOPMENT WAS UNDERESTIMATED

MEDICAL DATA IS NOT WHAT PEOPLE ARE LOOKING FOR – THEY ARE INTERESTED IN SERVICES

CHANGE MANAGEMENT IS ALWAYS A CHALLENGE



- Paradigm change in healthcare professional´s mindset – primary data users
  - Data ownership change
  - Formalization of entered data
- Gradual change of data usage
  - Acceptance of more extensive involvement of citizen/patient
  - Use of shared health, social and medical data
- Change of workflows and pathways in healthcare
  - From linear to matrix
  - More pre-analyzed data – big data services
- Distributed digital System must prevent malicious modifications
- The best technology to provide scalable integrity today is blockchain (hashchain)

Thank you!

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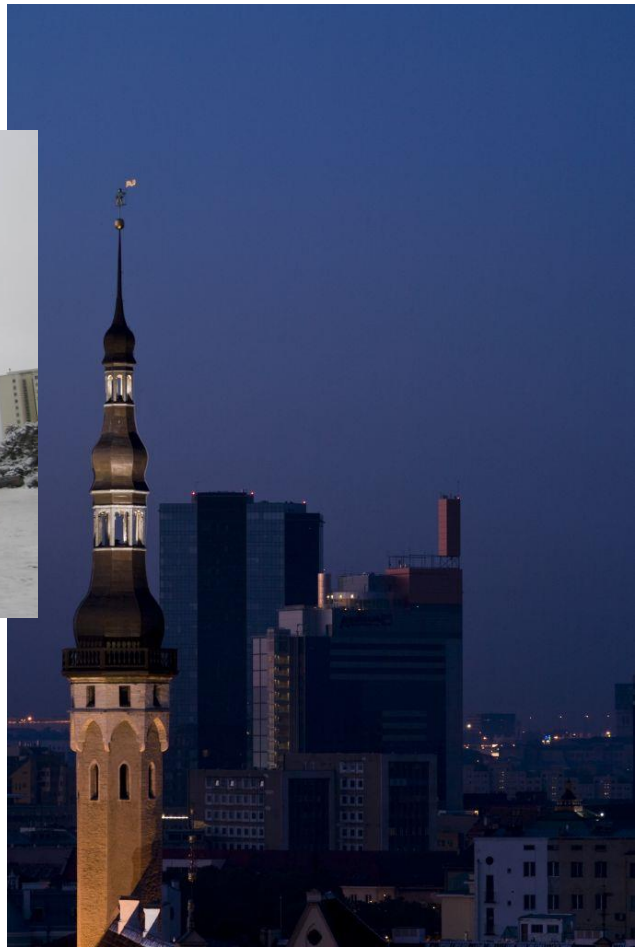

Six main principles „6 whales“ of security of EHR System

1. **A secure authentication** of all users with ID-card or Mobile ID
2. **Digital signing or stamping** of all medical documents
3. **A maximum accountability (transparency)**: all actions will leave an unchangeable (and unremovable) secure trail, protected by blockchain (hashchain)
4. **Coding of personal data**: separating of personal data from medical data
5. **Encrypted database** that allows to remove the confidentiality risk from the technical administrators
6. **Monitoring** of all actions together with the corresponding counter-measures (both organizational and technical)