

# Estonian e-health

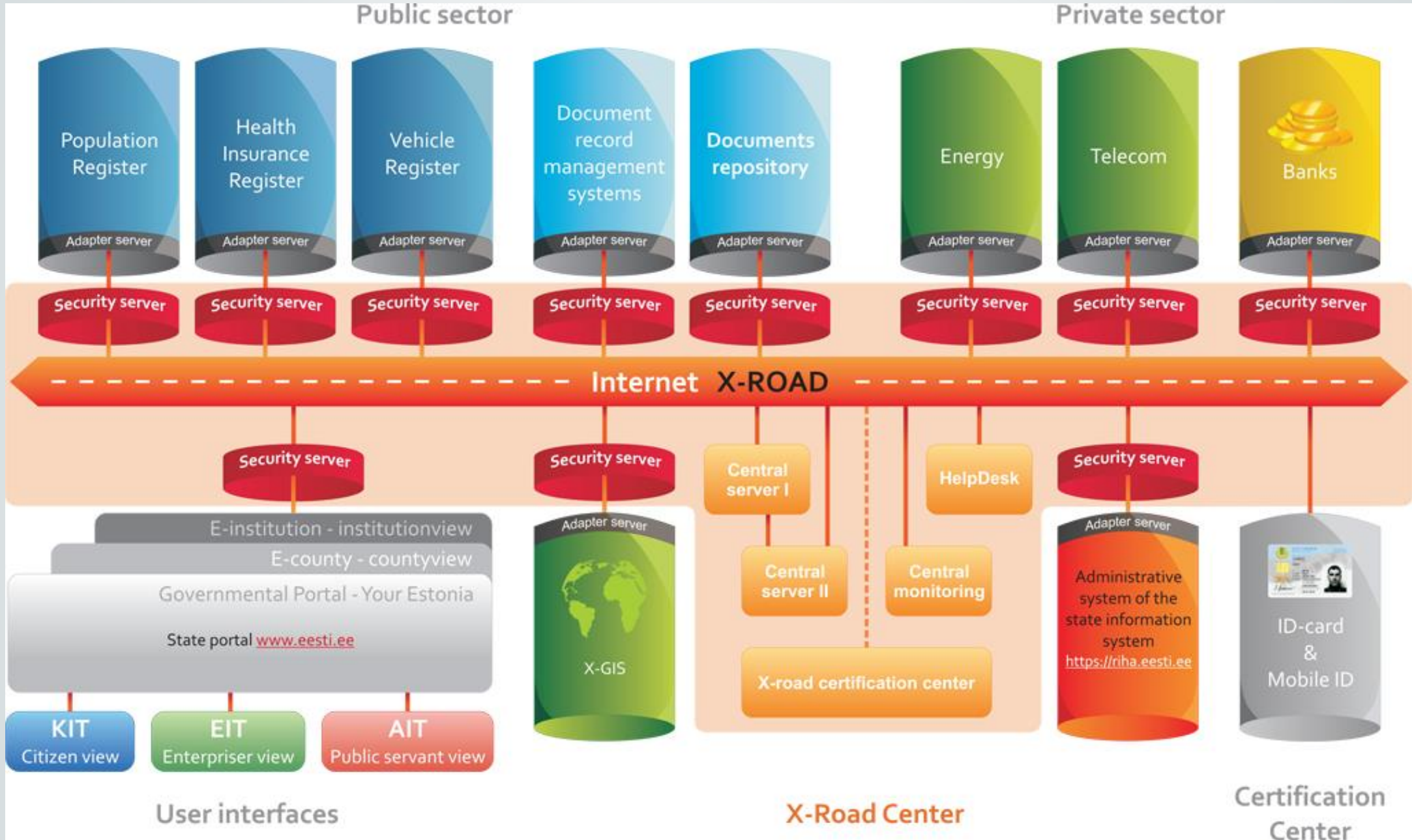
Artur Novek  
Estonian eHealth Foundation  
Implementation manager / Architect



# Estonia



# E-STATE ARCHITECTURE





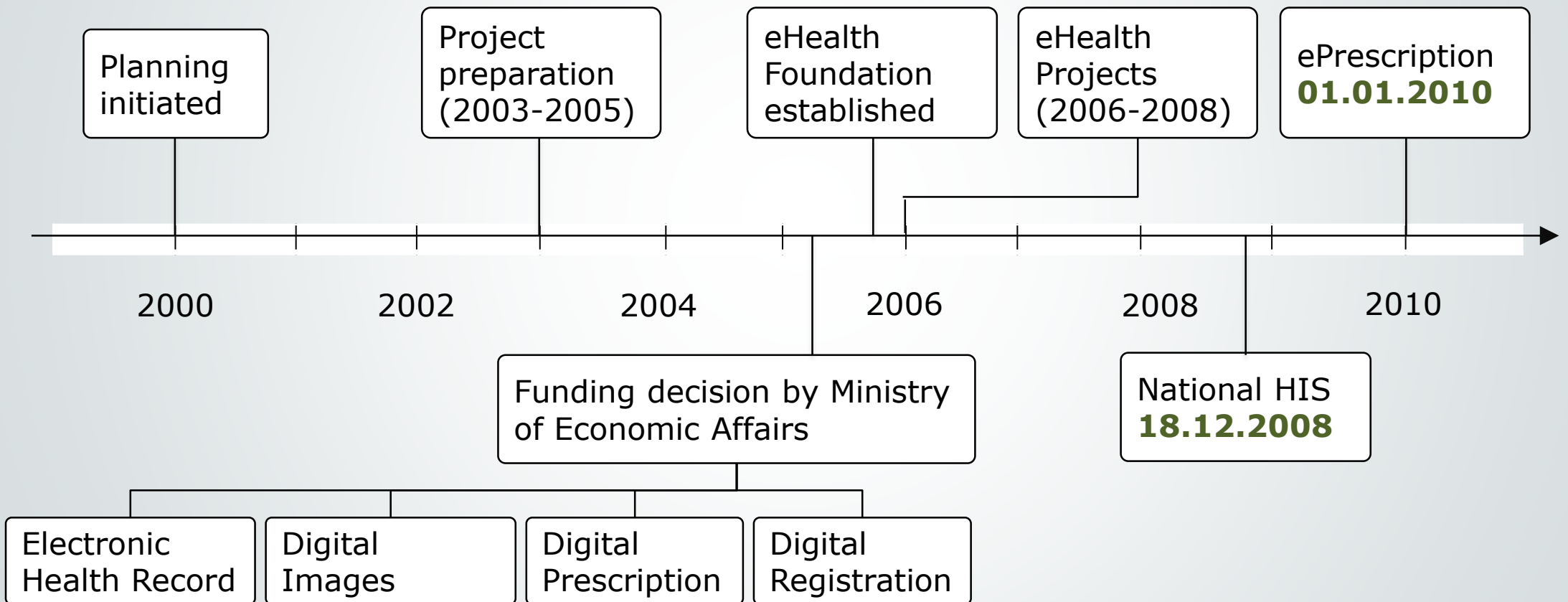
# HEALTHCARE IN ESTONIA

30 hospitals  
512 family doctors (juridical persons)

Healthcare expenditures 2011

- 5.9% from GDP
- 944.6 mlj. EUR

# Estonian eHealth history



# EU funded projects

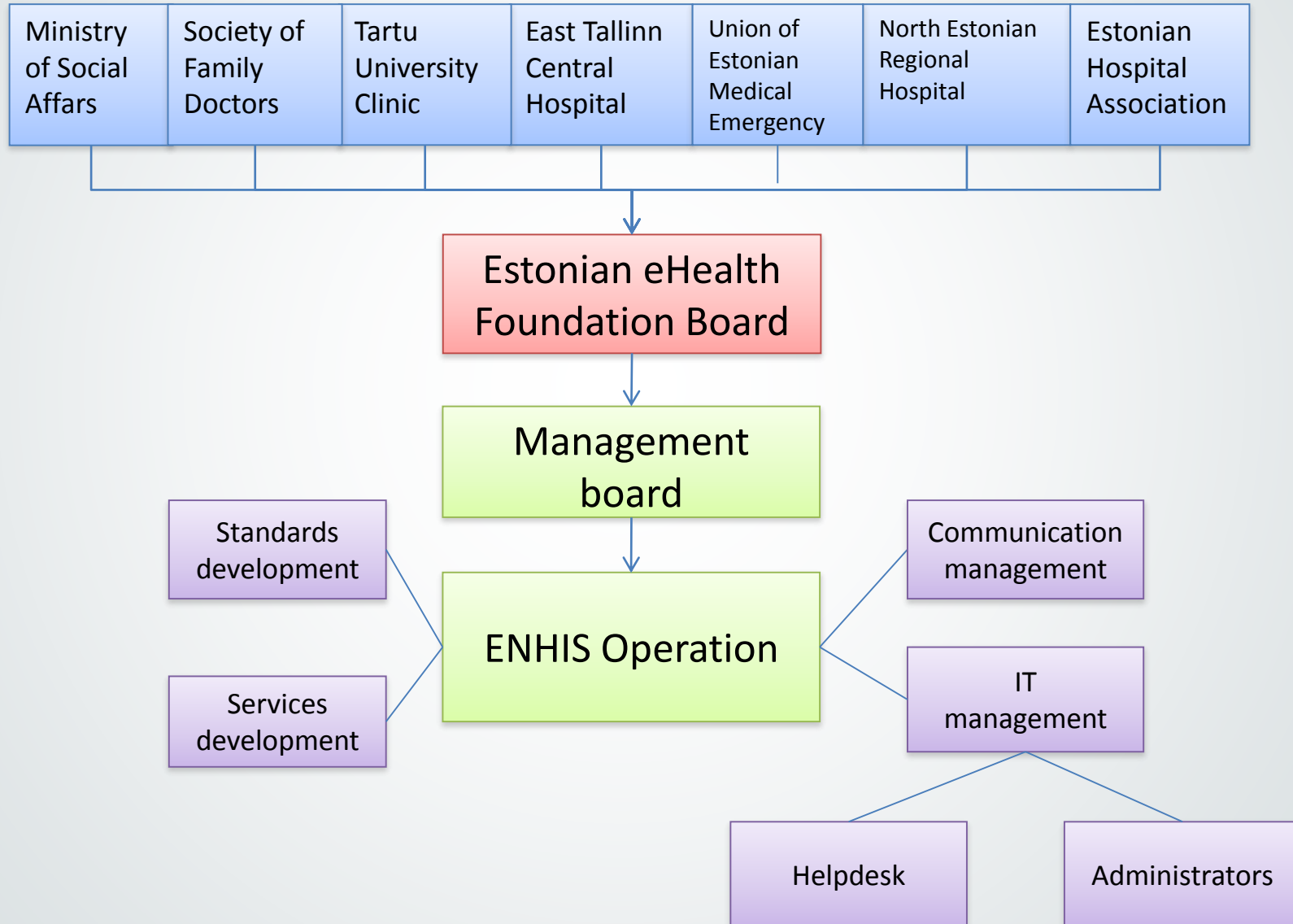
## Estonian eHealth Foundation

- Electronic Health Record (1.6 mln €)
- Digital Registration (0.2 mln €)
- Digital Images (0.2 mln €)

## Health Insurance Fund

- Digital Prescription (0.24 mln €)

# eHealth Foundation organization



# Development levels of Estonian Health Information System

**Institutional and user  
level cooperation**

- Partnerships
- User needs
- Training programs
- Process Descriptions
- Notifications

**Data Exchange level  
different e-services**

- User Interface
- User software
- Data input
- Data Visualisation
- Data filters (within user software)
- Web-interfaces
- Data transmission standards (HL7)

**Central System – Database  
and related services**

- Data set
- Data Standards
- Data filters relating to the central system
- Legal Framework



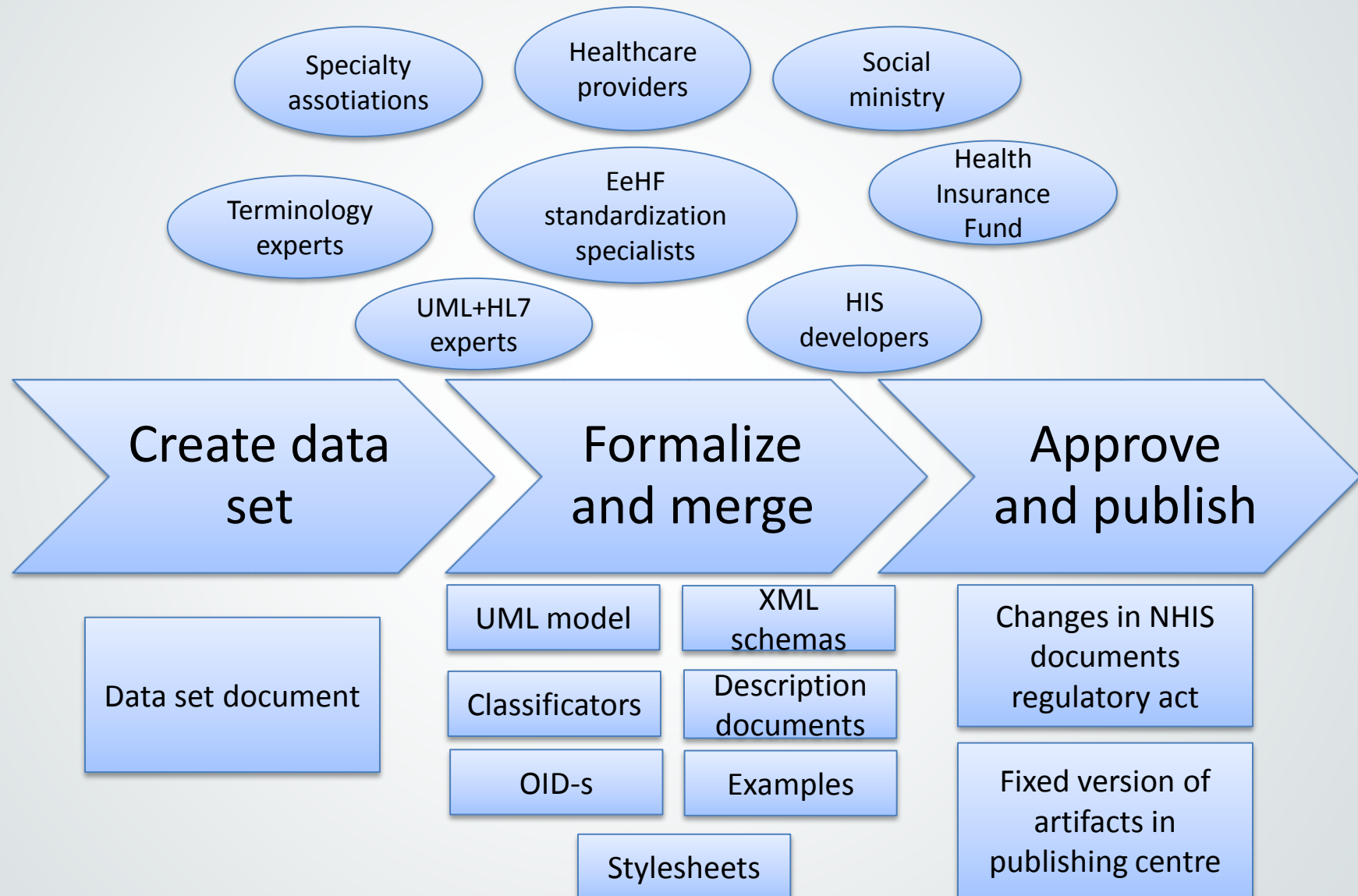
# STANDARDS



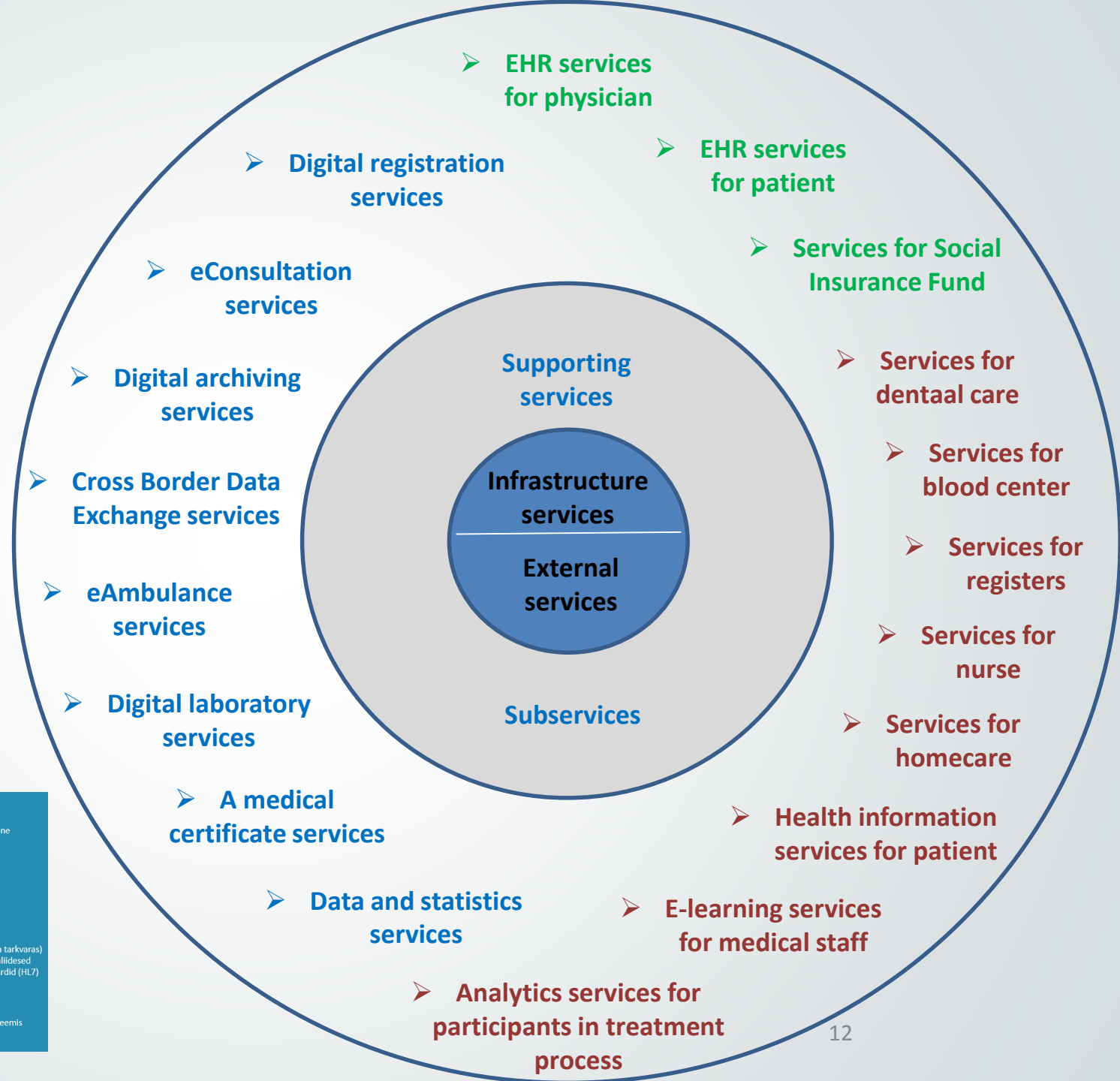
# Standards

- HL7 and DICOM (Picture Archive)
- International classification: ICD-10, LOINC, NCSP, ATC
- Estonian eHealth's OID registry
- Local eHealth classifiers
  - Published in publishing centre
  - Classifiers are regulated by government act <https://www.riigiteataja.ee/akt/12910889>

# Standardization process



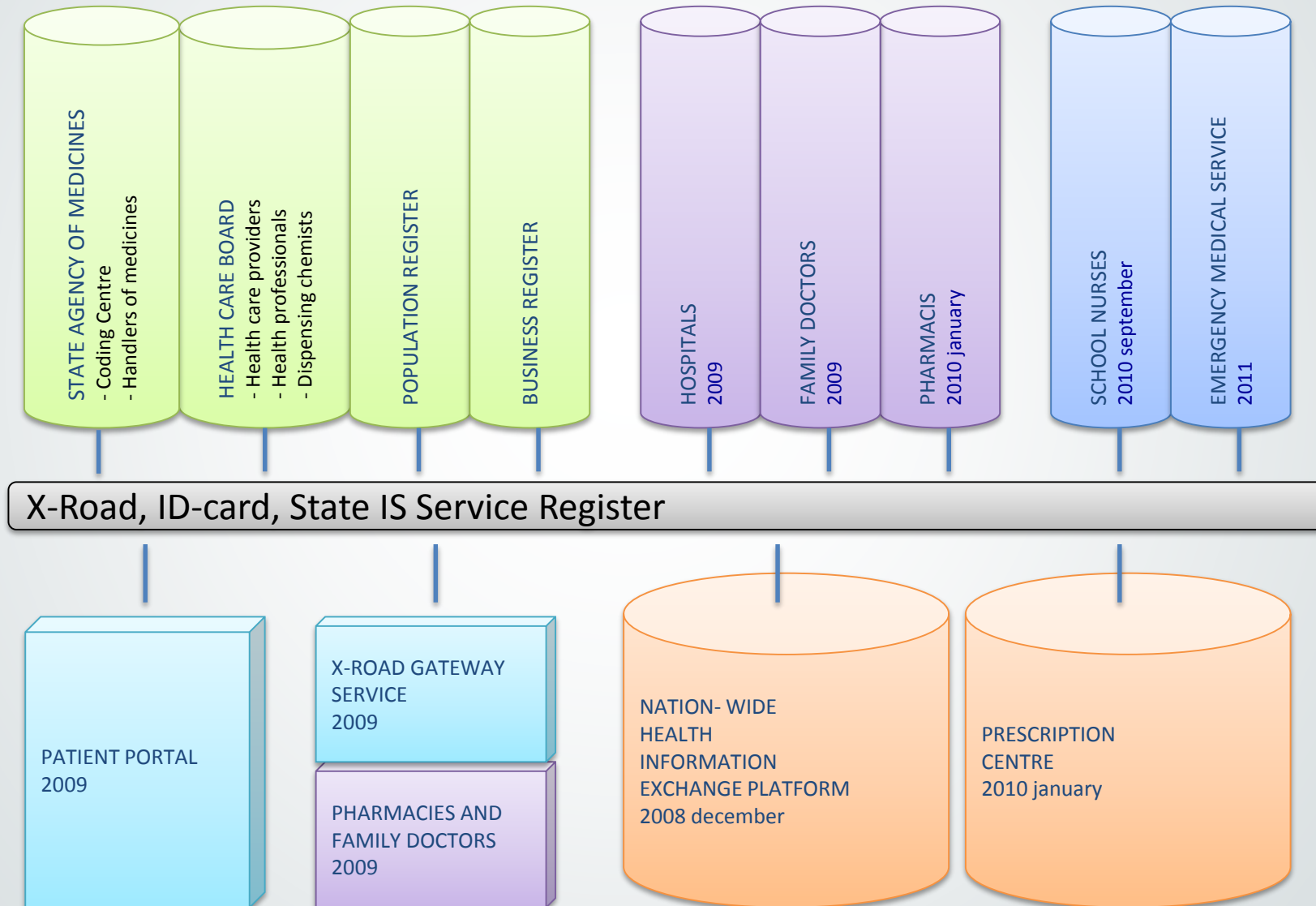
# Main services of the e-health in Estonia



# Major architectural decisions of HIS

- Integration through Central system (Opt-out)
- XML based HL7 v3 (extended) messages
- Documents are kept in XML format (HL7 CDA R2)
- All structured data fields have OID-s
- Only final versions of clinical documents are sent into central system
- Reuse of national infrastructure
  - ID card for authentication and digital signature
  - Xroad for secure communication

# Architecture



# SECURITY & AUTHENTICATION



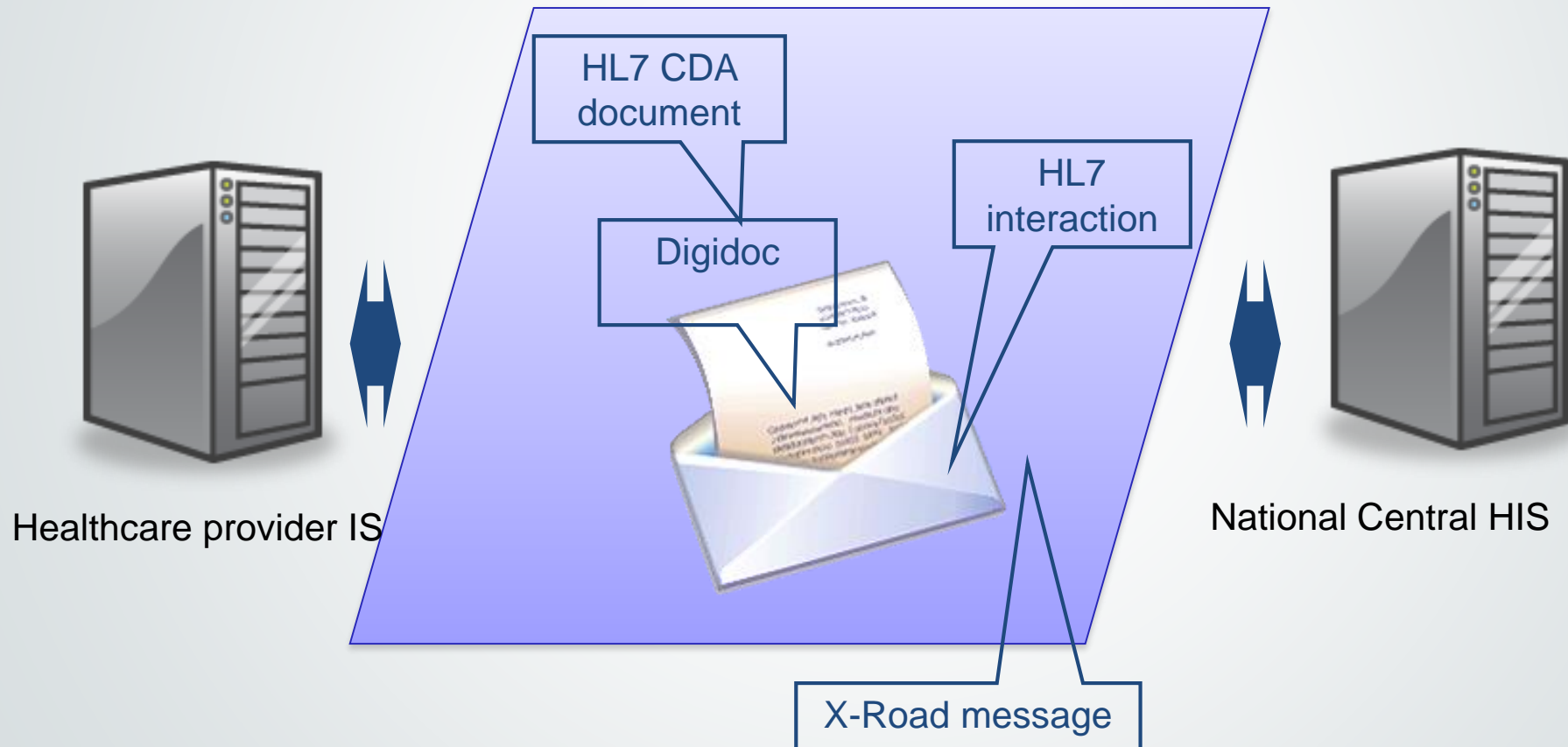
# The 6 main principles “6 whales” of security of Estonian eHealth system

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
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)

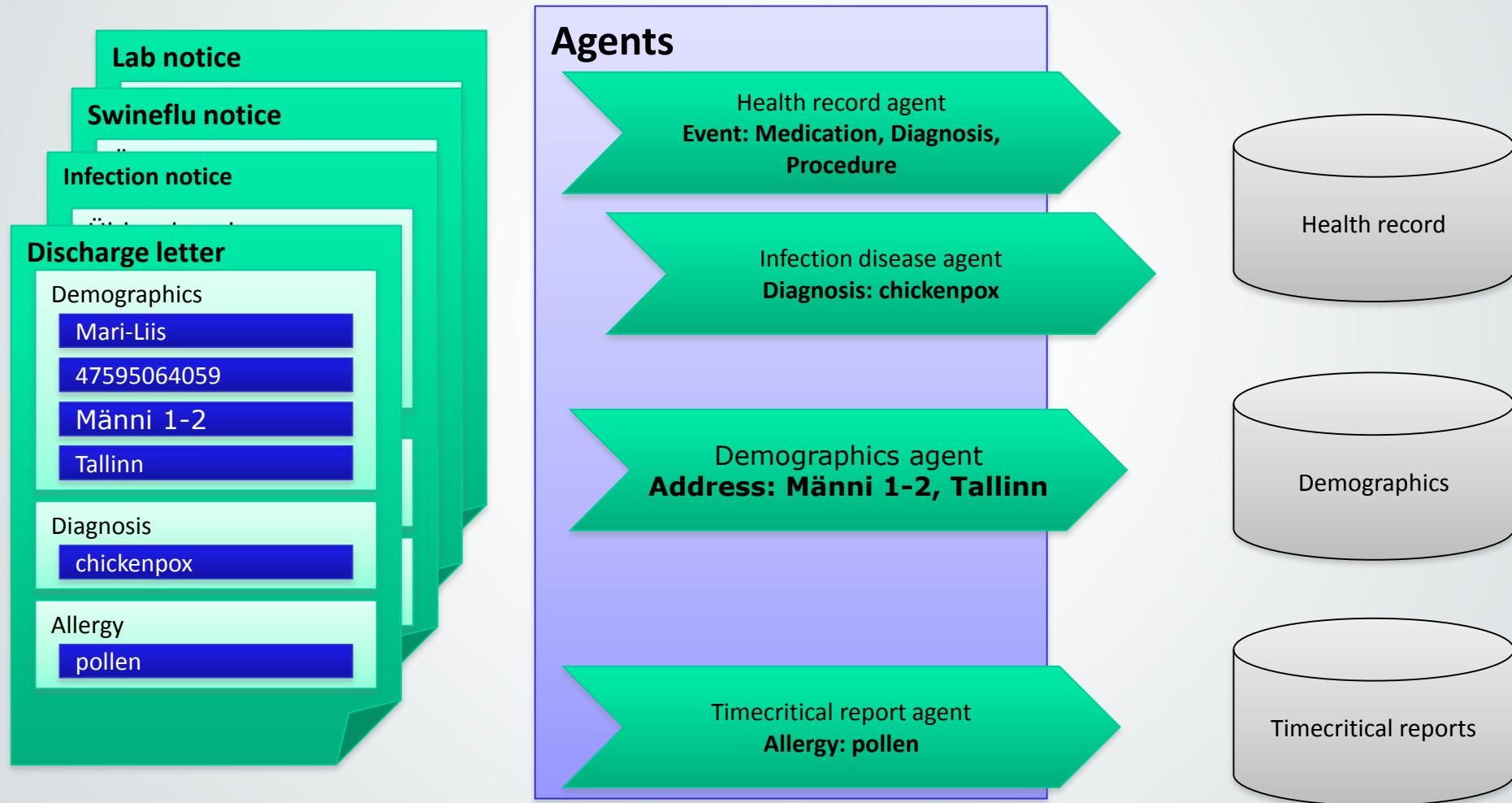




# HIS integration through X-Road



# Document processing



# Query processing

**Query**

Patient  
Mari-Liis  
47595064059

Record type  
Diagnosis

Patsient  
Mari-Liis  
47595064059

Diagnosis

Diagnosis

Diagnosis

Diagnosis: chickenpox

Document no: 103

Hospital: PERH

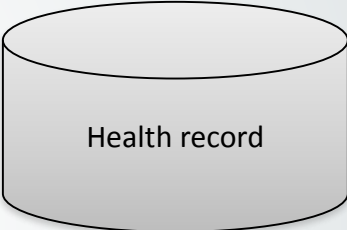
Warning, some documents are closed!

**Agents**

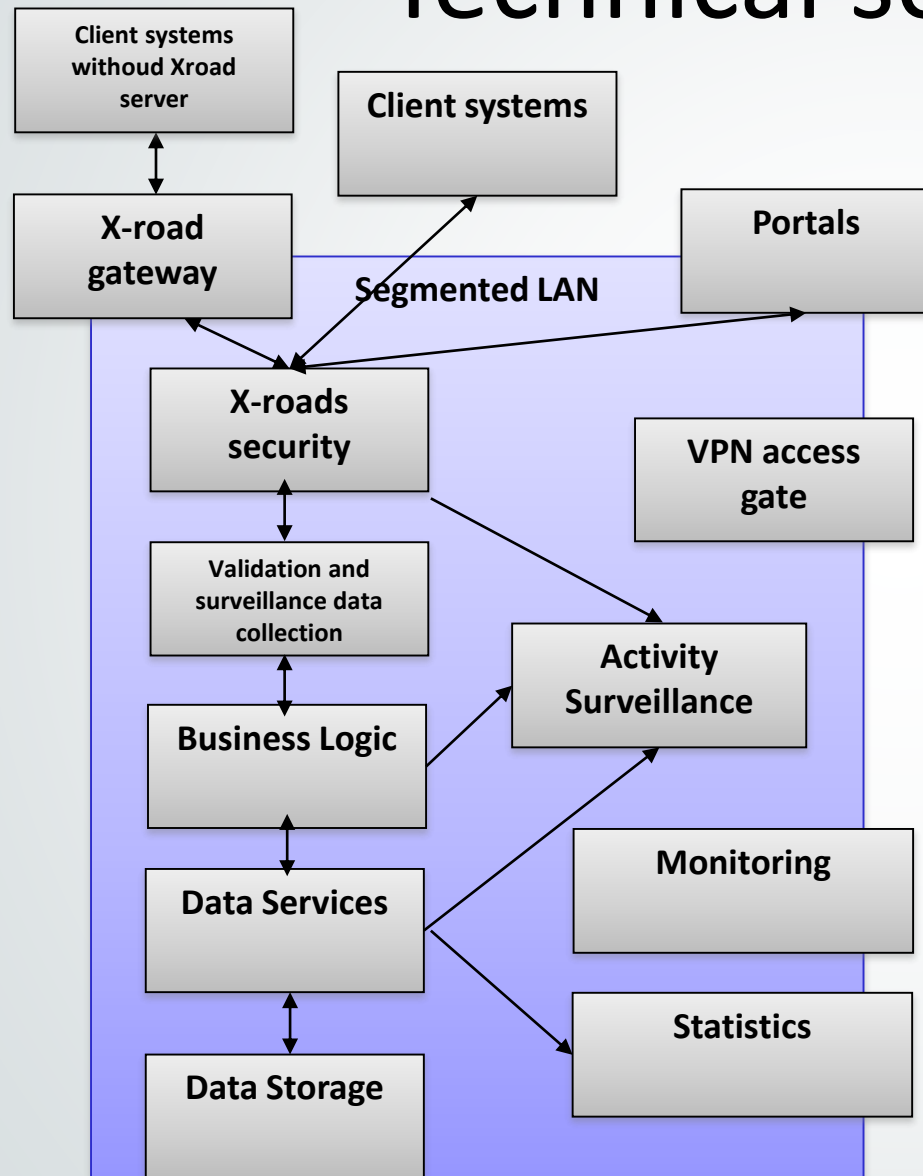
Health record agent  
**Find all diagnosis type records**

Security agent  
**Document open?**

Consolidate records



# Technical solution



- Client systems - HIS, GPIS
- Patient portal - Oracle Portal, 2013 change to Tomcat
- xRoad Gateway – MISP (Tomcat)
- Activity Surveillance - Tomcat, Sybase IQ, Webfocus
- Business Logic - Webmethods Integration Server and Broker
- Data Services - Oracle DBMS with Advanced Security and Database Vault
- Monitoring - Nagios, Cacti
- Statistics –Iway Service Manager, Sybase IQ, Webfocus

# PATIENT PORTAL (UPGRADE)

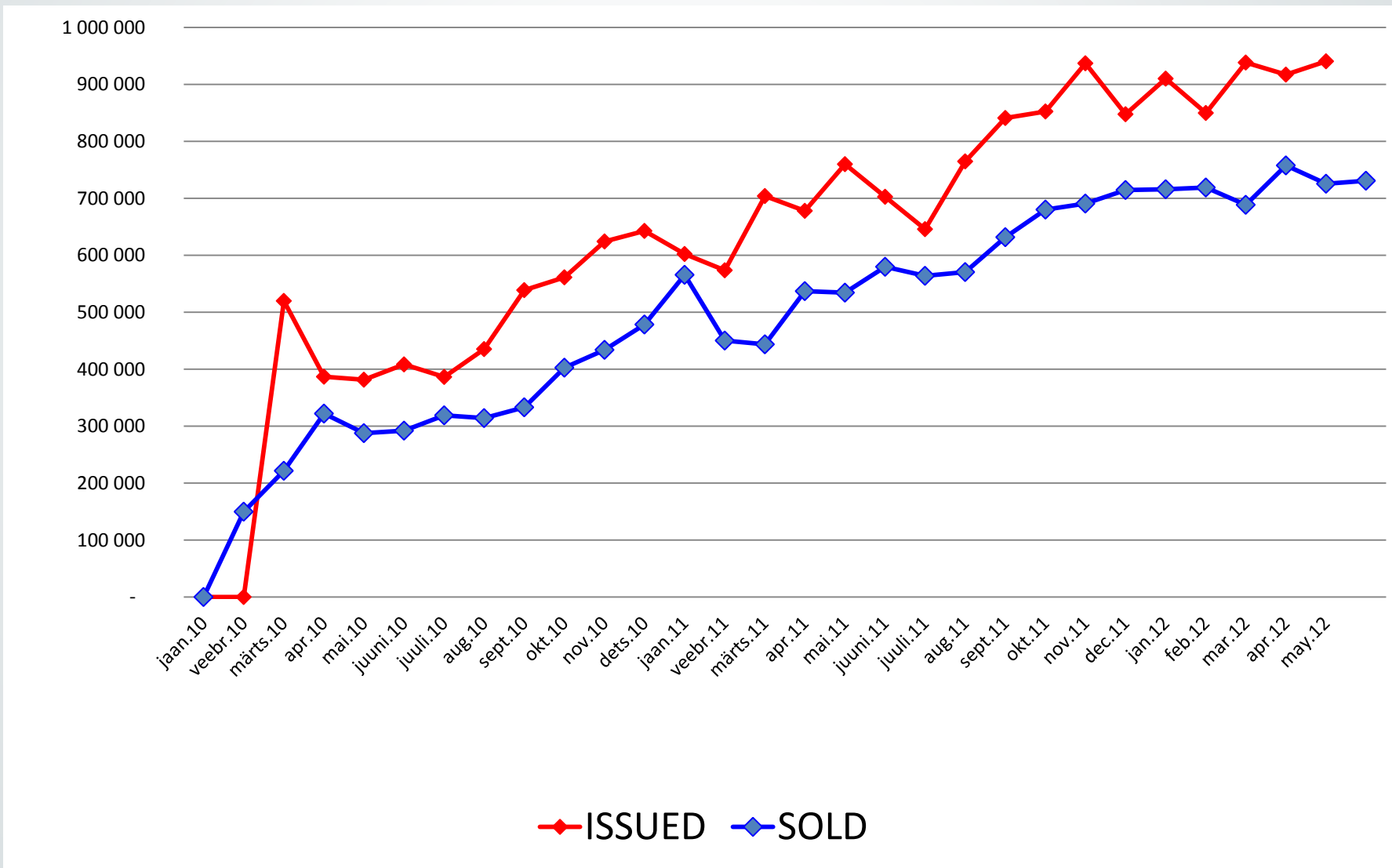
The screenshot displays a patient portal interface with several service tiles. Each tile contains text, a logo, and a refresh icon in the bottom right corner.

- Minu andmed**: 14212128025, **KINDLUSTATUD**, Perearst: Nimi ja perenimi. Refresh icon: green.
- Terviseandmed**: Saatekirjad, Uuringute vastused, Epikriisid, Diagnoosid, Terviseteatis, Vaktsineerimise pass, Raviarved. Refresh icon: blue.
- Tahteavaldused**: Refresh icon: blue.
- Esindatavad**: KATY CUUSK 45002280288, CARL KUUSK 34908027790, JANEK CUUSK 39107077773, JANEK CUUSK 39107077773. Refresh icon: green.
- Uuringud ja analüüsid**: Uuringute vastused, Analüüside vastused. Refresh icon: purple.
- Vaktsineerimine**: Refresh icon: teal.
- Esindajad**: KATY CUUSK. Refresh icon: green.
- Retseptid**: Refresh icon: green.
- Broneeri vastuvõtu aeg**: Refresh icon: green.

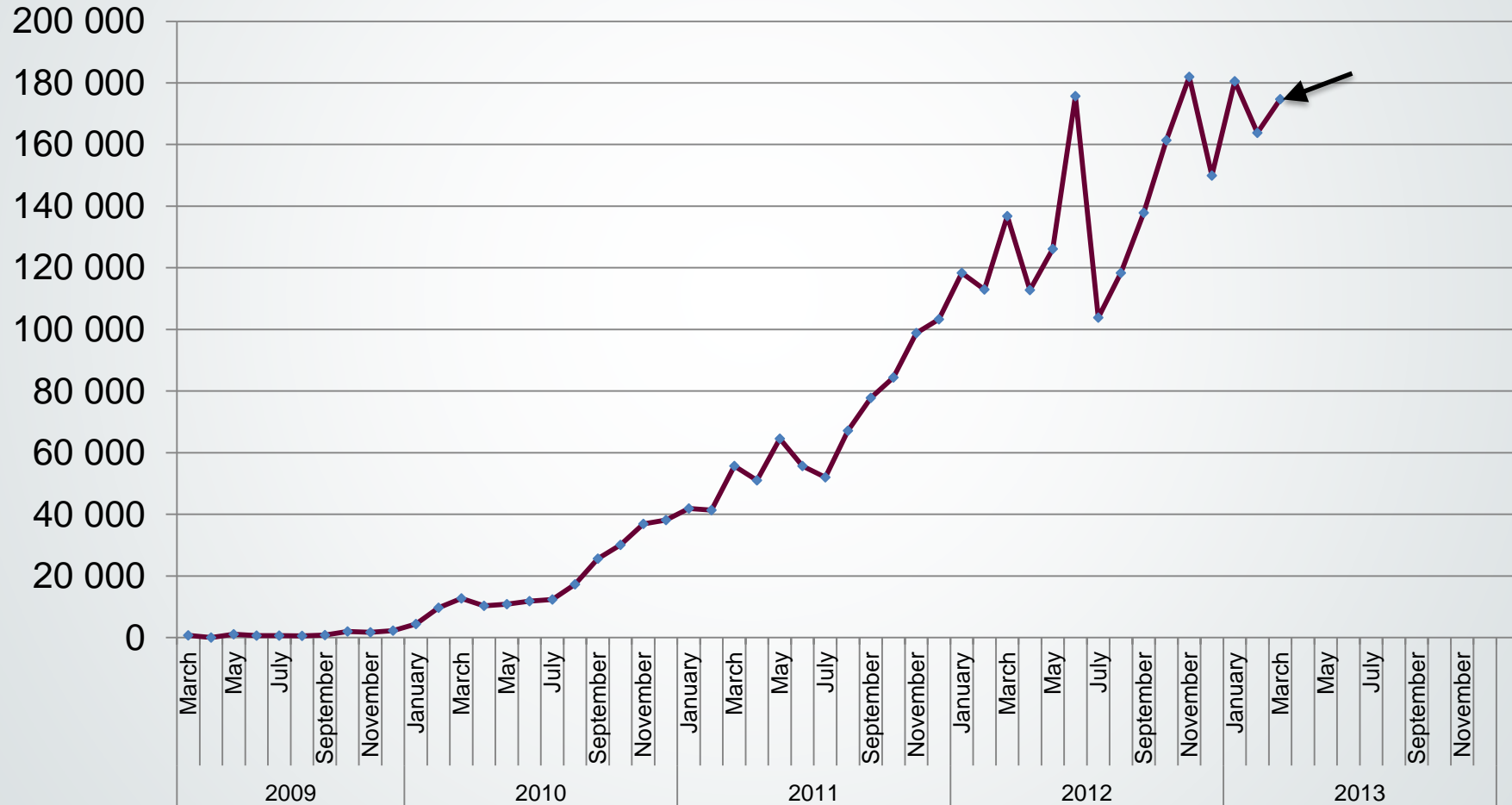
# Acceptance

- ePrescription covers 94% of issued prescriptions.
- Over 90% of Hospital discharge letters – digital
- Over 95% of stationary case summaries have sent to the central DB
- Ambulatory case summaries sending
  - No certain rules for sending ambulatory case summaries!
- 1 069 075 person have documents (82% of population)

# ePrescription (94%)

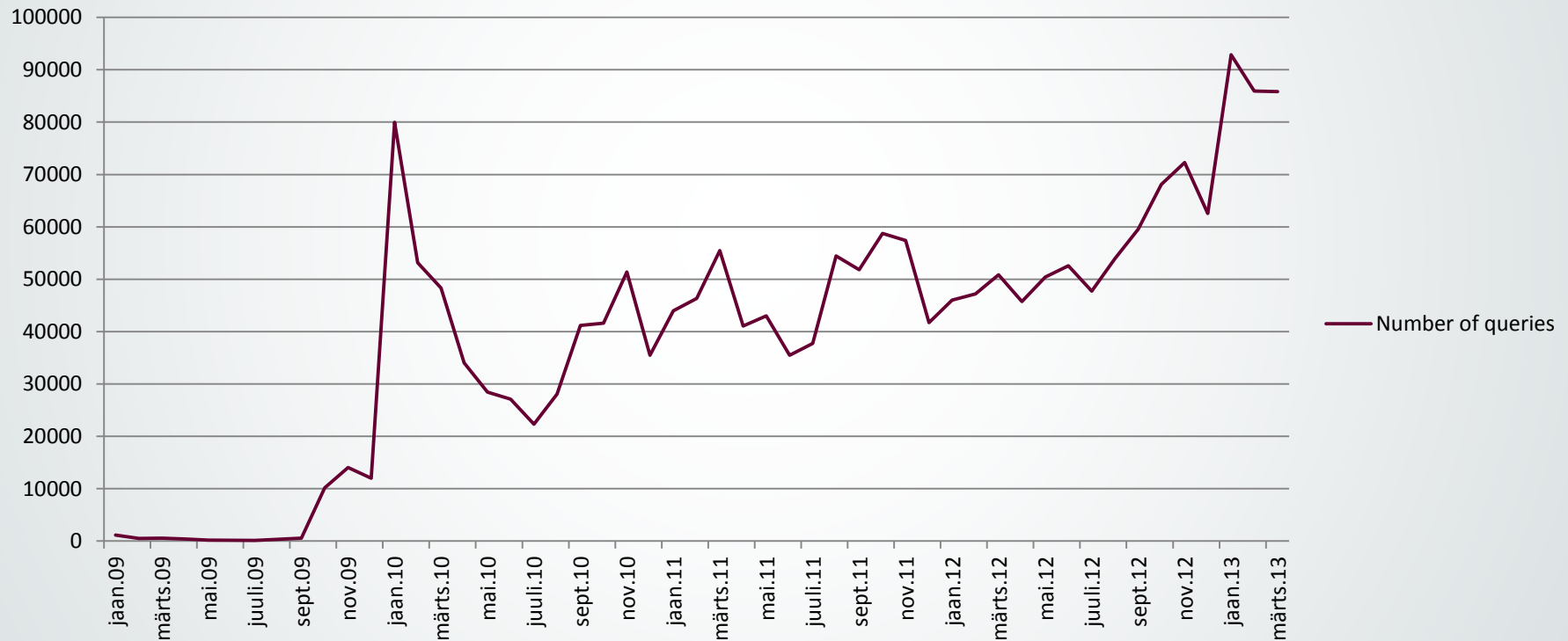


# Retrieval of Medical Documents by Healthcare Professionals

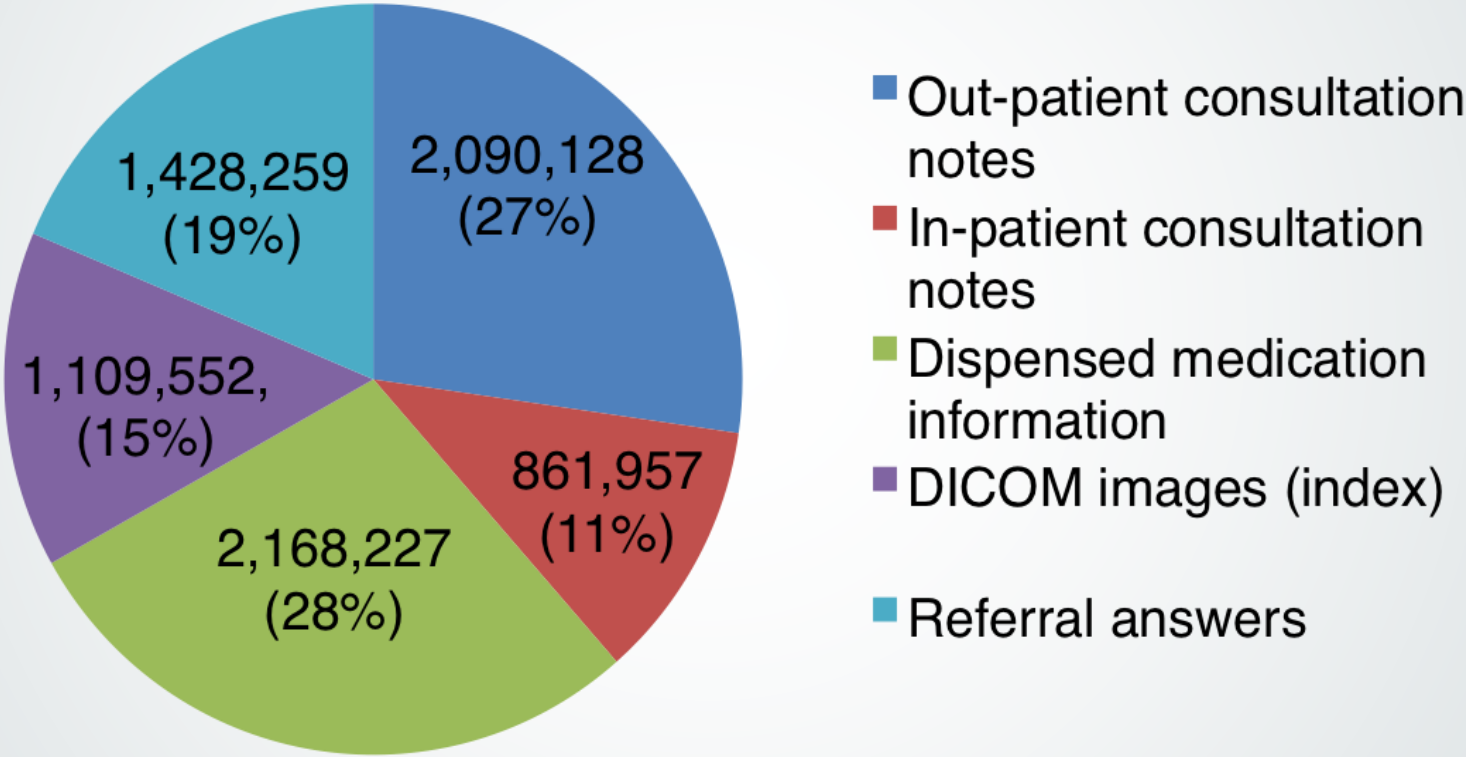




# Patient portal Number of queries



# Documents in eHealth Registry

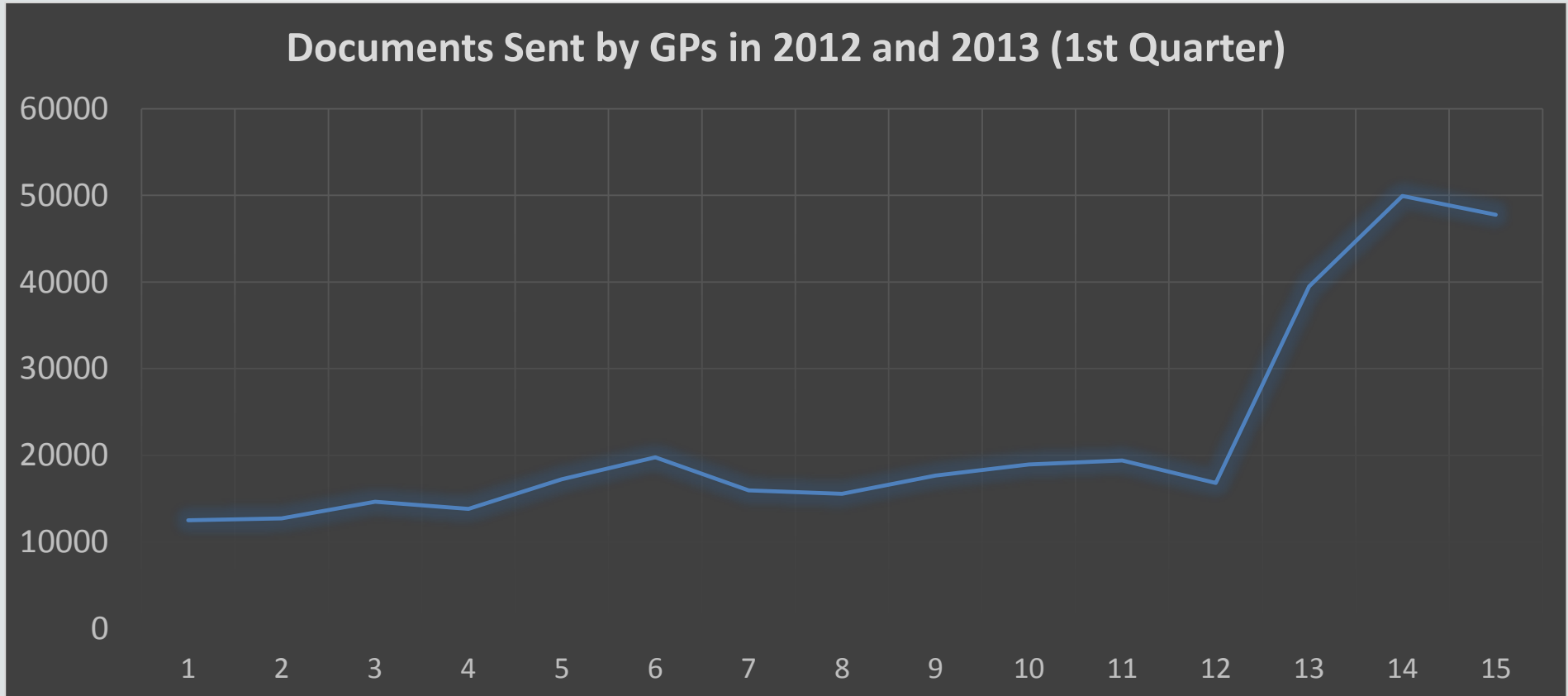


# LEARNING POINTS



- Resources were planned only for central development.
- Usability. Developing process has to include medical competence – users
- Data quality is important
  - Complete and quality data give value.
- Balance between security and usability
  - PIN for every document ...

# Digital stamp for family doctors





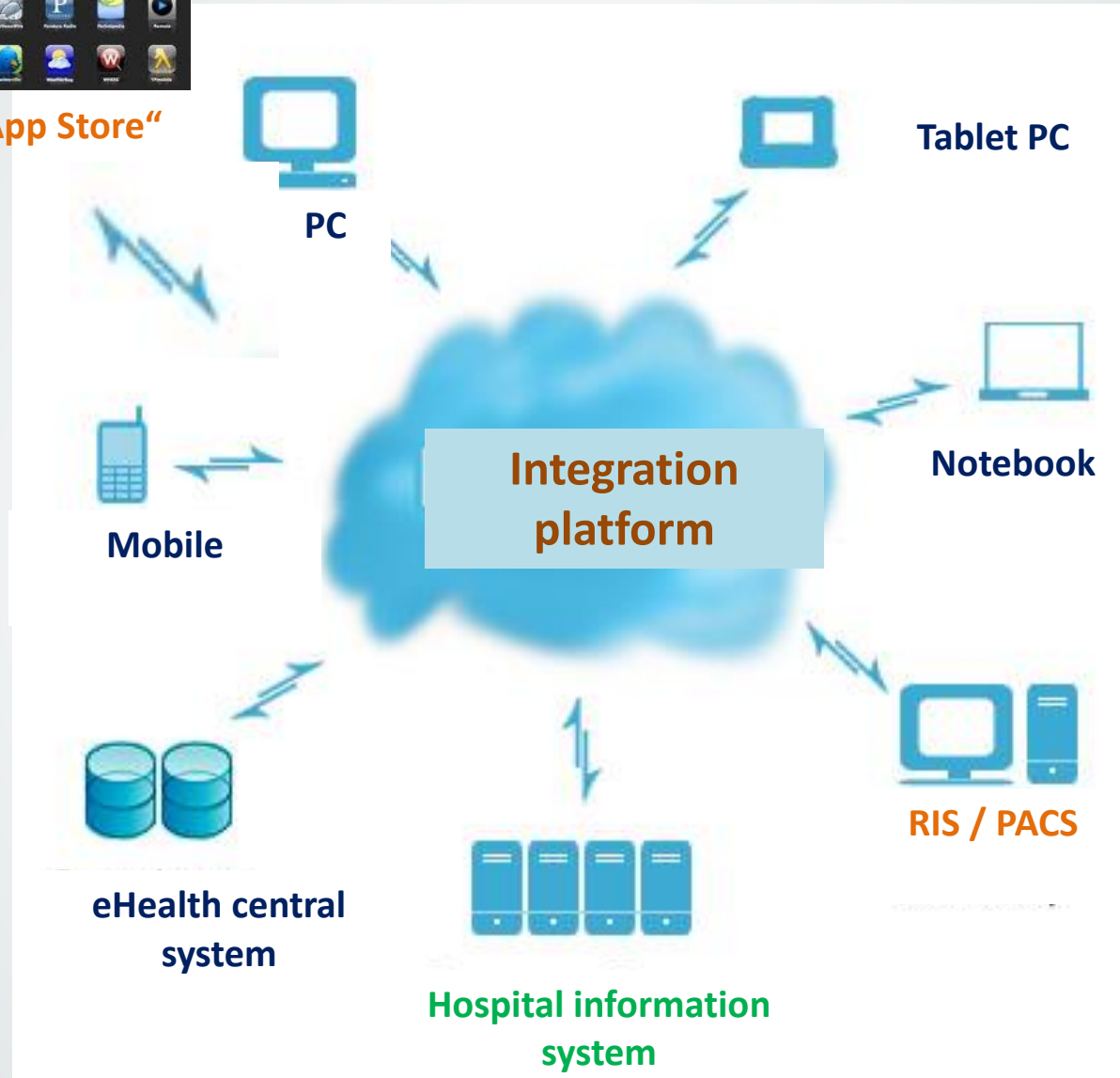
**Connecting health**

# Better services

- Faster data input
  - Voice recognition, statistics based text input assistant
- Faster and better output
  - Important information on “one screen”
  - Combining information from multiple sources
  - Graphical solutions
  - Precaching
- Single sign on



„App Store“





# „App Store“



*Speciality based applications*

# FUTURE OUTLOOK



Thank you!