

Practical considerations in implementing Big Data in Health Care practice

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UH of Liège, Belgium

UH of Liège is an Academic Hospital

1038 beds and about 5,500 staff members

Activities spread over 8 localizations including
4 hospitalization sites

Since 2004, the UHL has an Electronic Patient
Record (EPR) including medical, nursing and
paramedical information and a complete RIS-
PACS for its medical imaging

These computer tools allow both the exchange
of data inside the hospital and outside,

ensuring an optimal
continuity of hospital care
and extra-mural care



Level of computerization of EPR at CHU of Liège

Lot 1	Results server (clinical biology, medical imaging, nuclear medicine an pathology)	Fully implemented
Lot 2	Medical record and paperless	Fully implemented
Lot 3	Resources management	
→ Lot 3A	Management of multi-sites patient appointments	Fully implemented
→ Lot 3B	Management of beds (in real time and forward planning)	Fully implemented
Lot 4	Drug order and administration	Finalizing
Lot 5	Order of clinical biology and medico-technical examinations	Finalizing
Lot 6	Care management	
→ Lot 6A	Nursing electronic record	Fully implemented
→ Lot 6B	Paramedical electronic record	Fully implemented
→ Lot 6C	Food management	Currently

Electronic Medical Record Adoption Model (EMRAM)

Stage 7

- Complete EMR; external HIE (Health Information Exchange); data analytics; governance; disaster recovery; privacy and security

Stage 6

- Technology enabled medication; blood products and human milk administration; risk reporting; full CDS (clinical decision support)

Stage 5

- Physician documentation using structured templates; Intrusion/Device protection

Stage 4

- CPOE (computerized physician order entry) with CDS (clinical decision support); nursing and allied health documentation; basic business continuity

Stage 3

- Nursing and allied health documentation; EMAR (Electronic Medication Administration Records); role-based security

Stage 2

- CDR (Clinical Data Repository); internal Interoperability; basic security

Stage 1

- Ancillaries – laboratory: pharmacy and radiology/cardiology information systems; PACS (Picture Archiving and Communications System); digital Non-DICOM image management

Stage 0

- All three ancillaries not installed

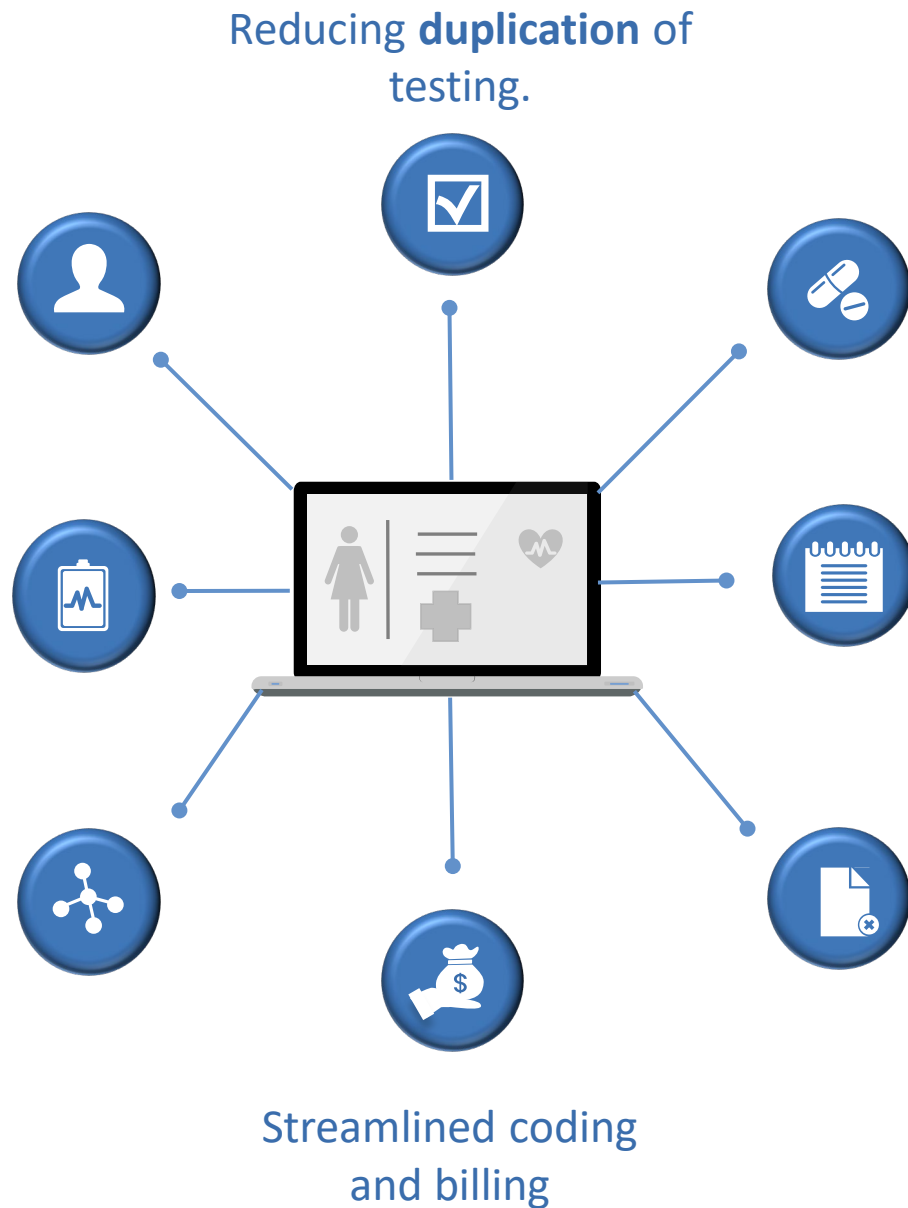
← UH of Liège

For what benefits?

A **quick** access to patients' records.
Gathering all relevant information
(lab results, etc.) **in one place**.
Making it easier to consider all aspects
of a patient's condition.

Always available, complete
and **up-to-date** patient
related information.

The possibility of
securely sharing
information with
patients and care
providers.



Helping physicians to reach the correct diagnosis and to prescribe more accurately.

Providing built-in safeguards against prescribing treatments that would result in adverse events.

Possibility of online appointment scheduling, online bill payments, prescription refill requests, and sometimes even data update capabilities

Decreasing **paperwork**.
Improving aggregation, analysis, and communication of patient information.

CDSS – EPR

Clinical Decision Support System Electronic Patient Record

Clinical decision support systems link health observations to clinician knowledge

Pneumonia Severity Index (PSI) of Fine score : estimates mortality for adult patients with community-acquired pneumonia

Cardio	Embolie pulmonaire	Pneumonie	Neuro 1	Neuro 2	Gériatrie	Pied diabétique	Phlébite
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1ère étape

> 50 ans ? Non → Comorbidité ? Non → Anomalies cliniques ? Non → **Classe 1**

Néoplasie		Altération conscience	
Hépathopathie		FR > 30/min.	
Décomp. cardiaque		SBP < 90 mmHg	
Atteinte cérébrovasc.		T < 35 ou > 40 °C	
Atteinte rénale		FC > 125/min.	

Oui → **Etape 2** Oui → **Etape 2** Oui → **Classe 2 à 5 selon étape 2**

2ème étape

Age ? (en année (hôte), en année -10 (fê))

Pathologies sous-jacentes	Examen clinique	Bio / Radio
Néoplasie <input type="text" value="0"/>	Altération conscience <input type="text" value="20"/>	PHa < ou = 7.35 <input type="text" value="30"/>
Hépathopathies <input type="text" value="0"/>	FR > 30/min. <input type="text" value="20"/>	Urée > 0.642 g/l <input type="text" value="0"/>
Décomp. cardiaque <input type="text" value="10"/>	SBP < 90 mmHg <input type="text" value="20"/>	Na < 130 mEq/l <input type="text" value="0"/>
Atteinte cérébrovasc. <input type="text" value="10"/>	T < 35 ou > 40 °C <input type="text" value="15"/>	Glucose > 2.5 g/l <input type="text" value="0"/>
Atteinte rénale <input type="text" value="10"/>	FC > 125/min. <input type="text" value="10"/>	Htc < 30% <input type="text" value="10"/>

PaO2 < 60 mmHg

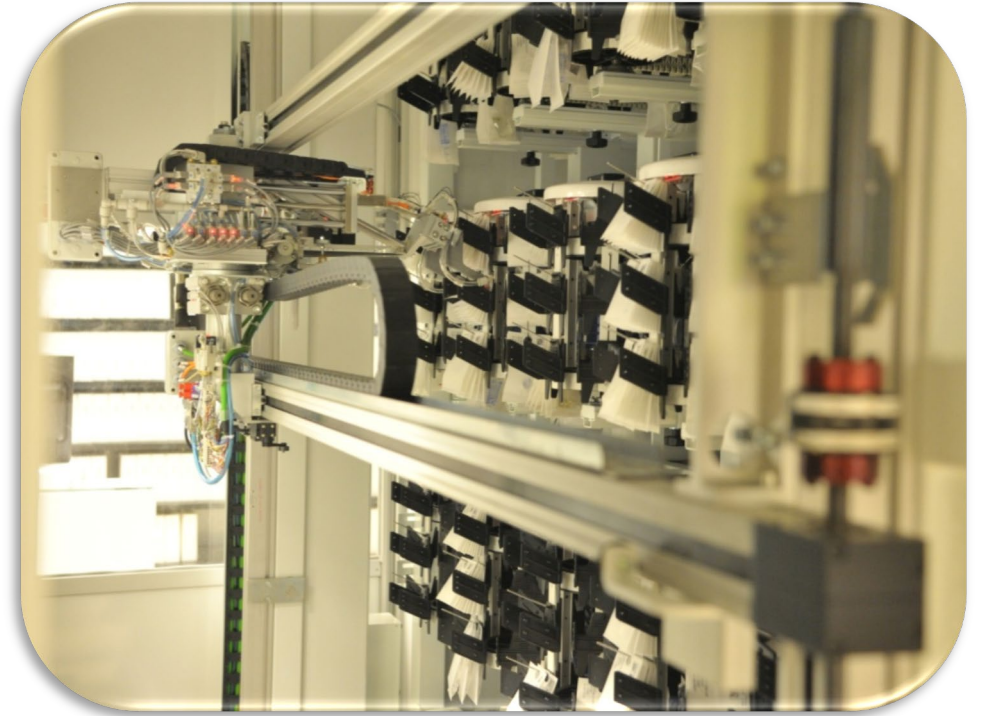
Epanch. pleural

Score de Fine

Interprétation

Classe 1 Pas de points
Classe 2 < 70
Classe 3 71 - 90
Classe 4 91 - 130
Classe 5 > 130

Order of clinical biology and drug administration plan



Pharmacy robots are driven by electronic prescription and drug inventory management system.

CLMA

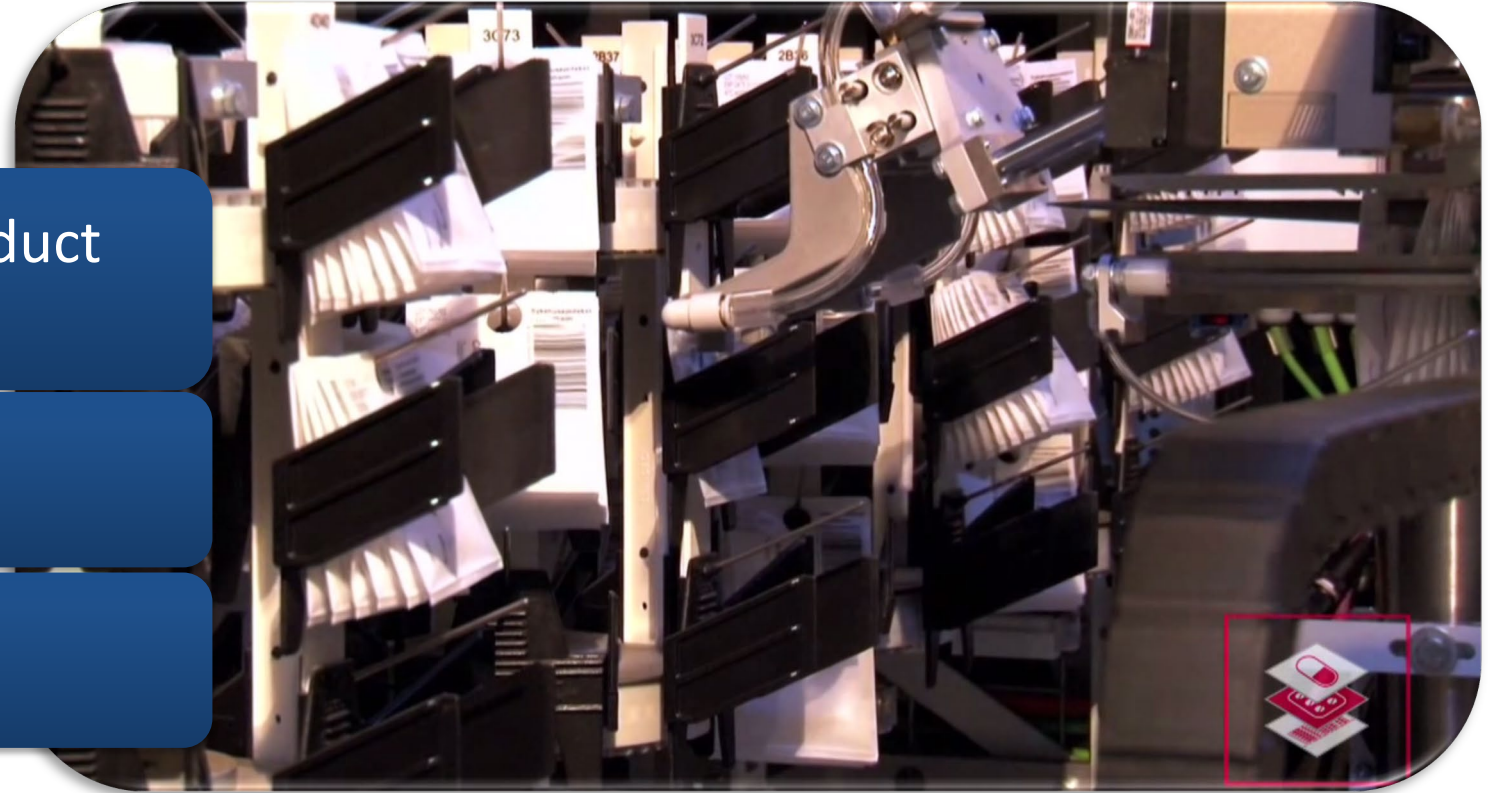
Closed Loop Medication Administration

Identification of each medicinal product individually

Link to computerized prescription

Association of each identifier to:

- A patient
- A drug dosage
- A drug-administration route
- A time



CLMA

Closed Loop Medication Administration

Automated medicine cabinets are also linked to the computerized prescription of drugs and only issue prescribed drugs.



CDSS – CPOE

Clinical Decision Support System
Computerized Physician Order Entry



Data sharing with external care providers

Access to the online appointment booking portal (for patients and external physicians).

www.chuliege.be

The screenshot displays the CHU de Liège online appointment booking portal. At the top, the CHU de Liège logo is visible on the left, and the user's appointment number '04/242 52 00' is shown on the right. Below the logo, there is a navigation menu with options: 'Vous êtes', 'Les soins aux patients', 'La recherche', 'L'enseignement', and 'Le rôle sociétal'. A search bar with the text 'Que cherchez-vous?' is also present. The main heading of the page is 'Mes rendez-vous en ligne'. Below this, there is a 'Tableau de bord' section. The 'Vos rendez-vous' section is divided into 'Dans le futur' and 'Dans le passé'. The 'Dans le futur' section shows a single appointment for 'Lundi 6 Janvier 2020 - 16:45' in Dermatology. The 'Dans le passé' section shows three past appointments from December 2019 and November 2019. On the right side, there is a 'Réservez un nouveau rendez-vous' section with a list of specialties for booking, including Anesthésie, Cardiologie, Centre de la mémoire, Centre de référence SIDA, Chirurgie abdominale, Chirurgie cardio-vasculaire, Chirurgie de la main, Chirurgie orthopédique, Chirurgie plastique et maxillo-faciale, Clinique de la douleur, Dentisterie, Dermatologie, Diabétologie, and Endocrinologie.

Data sharing with external care providers

Access to the CHU medical imaging portal via a strong authentication system (for patients and external physicians).

www.chuliege.be

The screenshot displays the CHU de Liège medical imaging portal. At the top, there are navigation tabs: "Vous êtes", "Les soins aux patients", "La recherche", "L'enseignement", "Le rôle sociétal", and "myCHU". Below these are sub-tabs: "Accueil", "Les soins aux patients", "Mes services en ligne", "Mes examens radiologiques", and "Partager". The main heading is "Portail d'imagerie".

The patient information section shows "Féminin 8 sept., 1980" and "Aide ?". The examination details are "RX bilatérale des genoux" dated "18 juin, 2018 08:05 AM".

The main content area displays six panels of X-ray images:

- 1: RAD Genou (Anteroposterior view, D)
- 2: RAD Genou (Anteroposterior view, G)
- 3: RAD Genou (Séries 4) (Lateral view, D)
- 4: RAD Genou (Séries 5) (Lateral view, G)
- 5: Rapp. d'exam. (CR) (Séries 1000) (Report table)
- 6: Patella (Séries 2970) (Patella views, D)

The report table in panel 5 contains the following data:

Numéro	Examen	Statut	Observations	Statut	Observations
1	18/06/2018 08:05 AM	OK			
2	18/06/2018 08:05 AM	OK			
3	18/06/2018 08:05 AM	OK			
4	18/06/2018 08:05 AM	OK			
5	18/06/2018 08:05 AM	OK			
6	18/06/2018 08:05 AM	OK			

Logos for CHU de Liège, IFA Agfa HealthCare, LIÈGE université, Diversa Santé Wallon, and CROIX-ROUGE de Belgique are visible at the bottom.

Data sharing with external care providers

Access to CHU shared documents via the « Réseau Santé Wallon »

The Wallon Health Network allows an exchange of computerized health documents (examination results, medical reports, letters, etc.) between healthcare providers working for the same patient.

All health care providers involved in these situations may have access to information about themselves. This exchange of information between healthcare providers facilitates its management.

In order for a healthcare provider to have access to the patient's health data, a therapeutic link must be established.

Département de gestion des systèmes d'informations (GSI)

Directeur de département : Pr. Philippe Kolh

Secteur Appui méthodologique aux Projets GSI et Planification (APP)

Responsable de secteur : Noémi Javaux

GESTION DES SYSTÈMES INFORMATIQUES

Coordinateur de département *Michel Raze*

Secteur Accompagnement, Paramétrage et Formation (APF)

Responsable de secteur : Isabelle Simon

Service des Applications Informatiques (SAI)

Chef de service : *Michel Raze*

Secteur médical

Responsable de secteur : *Denis ménager*

Secteur administratif

Responsable de secteur : *Eric Waseige*

Secteur Offre aux patients et médecins extérieurs

Equipe DBA

Service Architecture Technique et Infrastructure (ATI)

Chef de service : *Laurent Debra**

Secteur helpdesk

Responsable de secteur : *Didier Degey**

Secteur réseau

Responsable de secteur : *Simon François**

Secteur systèmes

Responsable de secteur : *Claudio Virgili**

Secteur téléphonie

Responsable de secteur : *Vincent Garroy**

Secteur web et portail

Responsable de secteur : *Frédéric Geraerds**

GESTION DES INFORMATIONS MÉDICO-ÉCONOMIQUES

Service des Informations Médico-Économiques (SIME)

Chef de service : *Philippe Kolh*

Secteur codage et nomenclature

Responsable de secteur : *Stéphanie Leroy*

Secteur exploitation des données

Responsable de secteur : *Jessica Jacques*

Secteur appui à la recherche clinique et biostatistique

Responsable de secteur : *Nathalie Maes*

Secteur gestion des dossiers médicaux

Responsable de secteur : *Jocelyne Kariger*

* Personnel de l'Université de Liège

□ Rés transversales

The SIME's Missions

- making patient's clinical data available, whether they are stored under paper or electronic format
- coding medical information and ensure consistency with the patient's identification
- analyzing the institution's activity and its medical and economic components
- offering methodological support to clinical research, including the biostatistical aspects

86 agents – 78,5 FTE

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Responsable de secteur : *Jocelyne Kariger*

Data Analysis Area

Two main missions

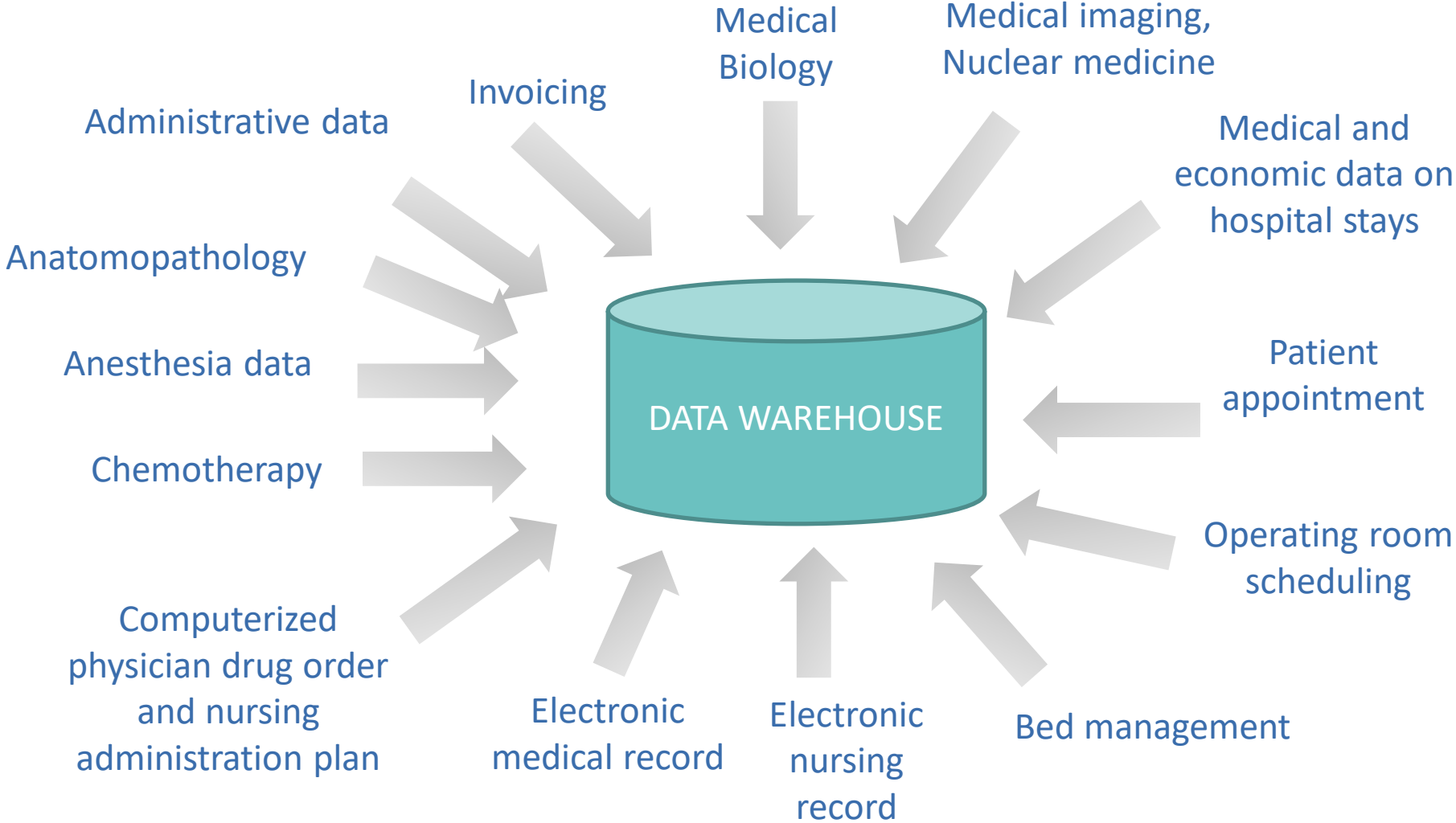


1. Provide medical data

2. Analyze the medico-economic situation



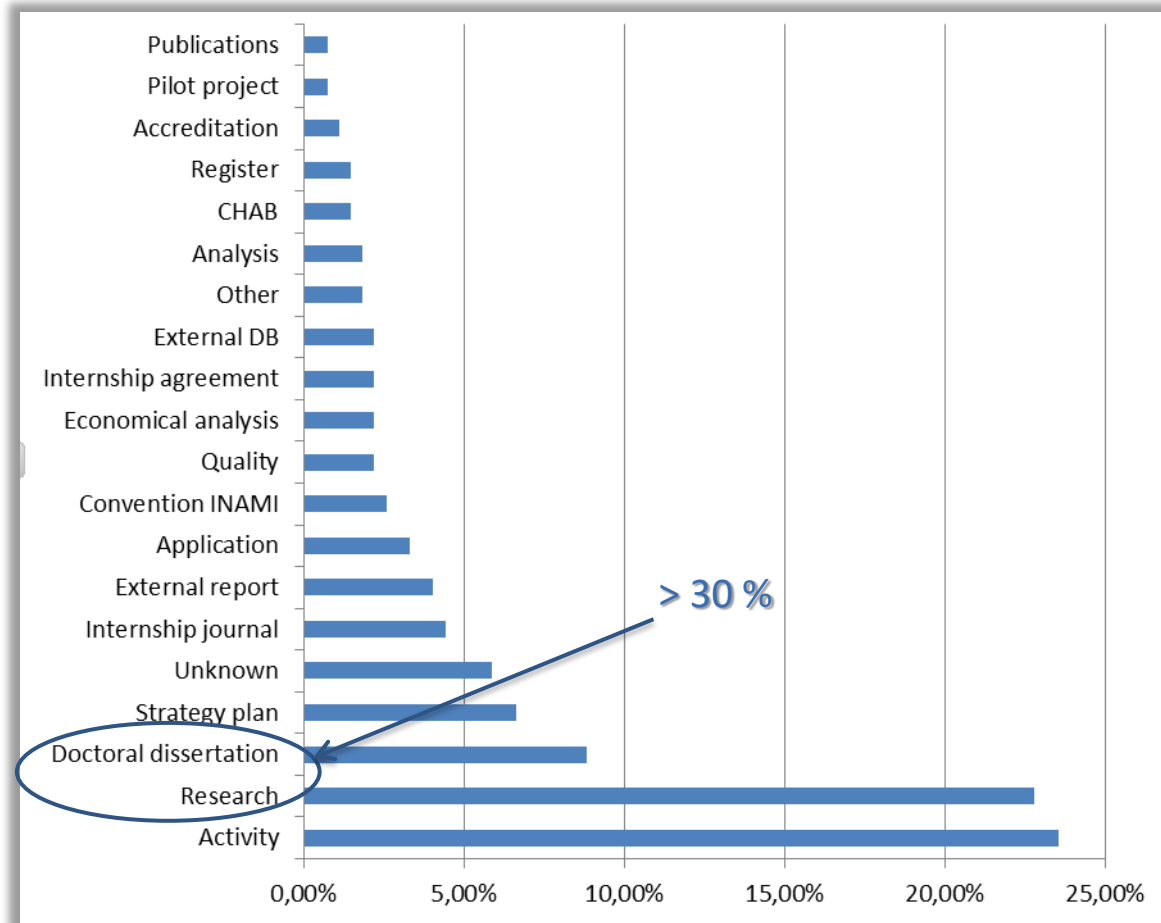
DataWareHouse Content



Data cover patient history since 1999 and are updated daily

Source	Tables	Champs
Patient et administrative	75	1300
Suivi budgétaire	20	400
Dossier médical	15	250
Facturation	45	1250
GIFA	32	650
QDOC	10	125
RCM	15	140
RHM	33	750
Radiothérapie	22	250
Ultragenda	20	225
Ressources humaines	37	550
Paie	10	100
ERP	180	8000
APO	15	375
UNILAB	25	300

Making clinical data available



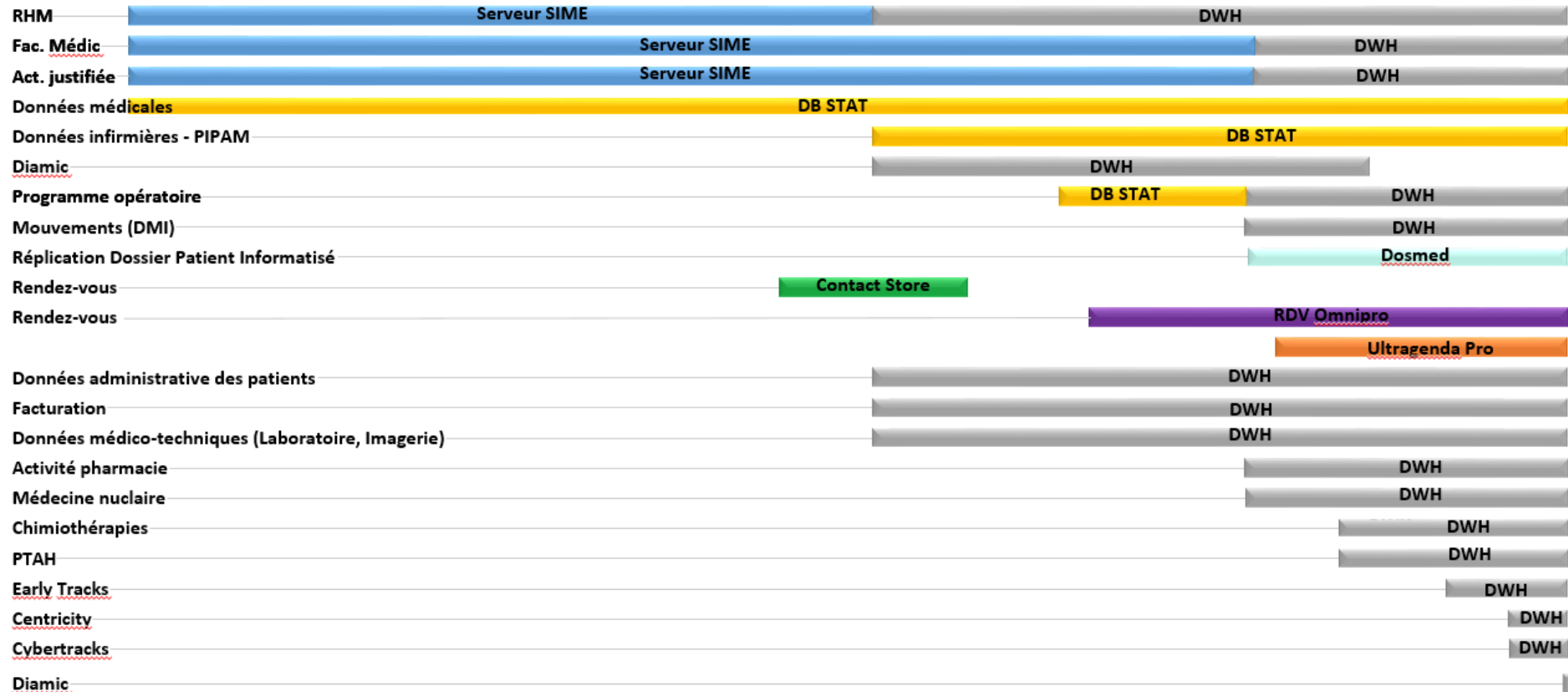
Over half of the medical services have at least once asked the SIME for data

More than 30% of all demands are related to research activity

What data are clinicians interested in?

Electronic patient record	40%
Patients' characteristics and whereabouts	39%
Invoicing	16%
Administrative and medical data	15%
Laboratory	6%
Medical imagery	3%

A keyword : patience ...



2021

Success factors

- ✓ To have a successful EMR experience !
 - ✓ Large use in hospital, in most of context/API, with a single Patient Identifier
- ✓ Define roles
 - - IT for DWH ETL
 - - Data Analysts for exploitation of the clinical data
- ✓ Close synergy between IT and Data Analysts
- ✓ Data analysts must have a scientific background
- ✓ The possibilities depend on the maturity of the EMR
- ✓ Data analysts must have access to the finest data

VALIDATE – VALIDATE – VALIDATE !

Perspectives in the Exploitation of clinical data

1. Dashboard Reporting
2. Provision of COVID clinical data
3. Sharing clinical data with pharmaceutical industries
4. Re Use of the clinical data for the research

1. Dashboard reporting: focus on oncology

The main difficulty is to define the oncological patient

1. Define the data source

- Based on the Belgian Cancer Registry
- Or RHM/MKG
- Or Radiotherapy Data

2. Determine the date of incidence

3. Open a 5-year-sliding window taking into account recurrence or new cancer

Patients nouveau diag (evol)

2.890 (+4,7%)

Nouveaux patients (evol)

3.395 (+1,1%)

Patients actifs (evol)

13.757 (+2,9%)

Patients potentiels (evol)

18.979 (+2,8%)

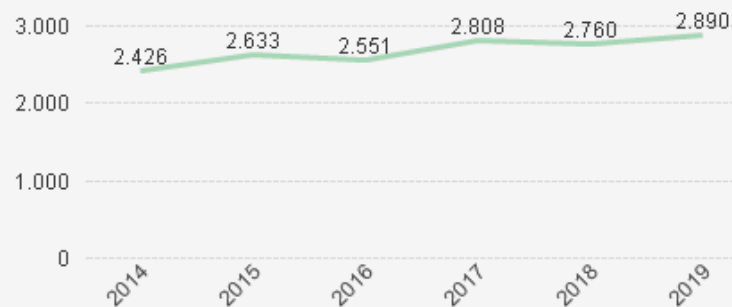


2014 2015 2016 2017 2018 2019

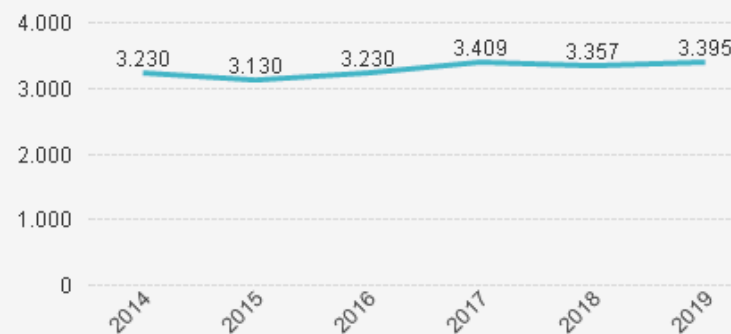
Catégorie cancer
Sous-cat cancer

Patients Registres/COM Stat RBC

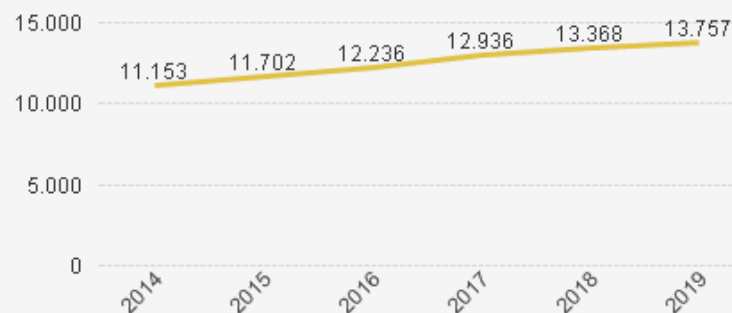
Nombre de patients avec un nouveau diagnostic onco



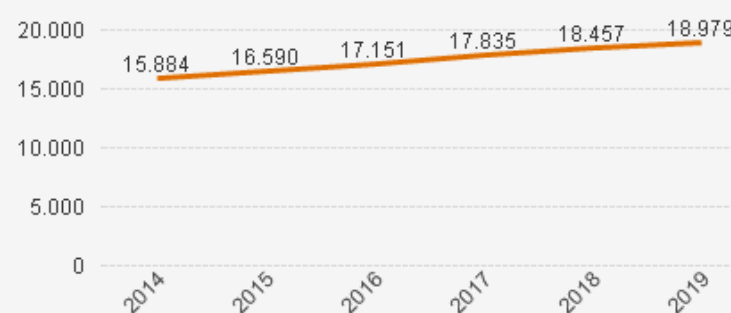
Nombre de nouveaux patients onco



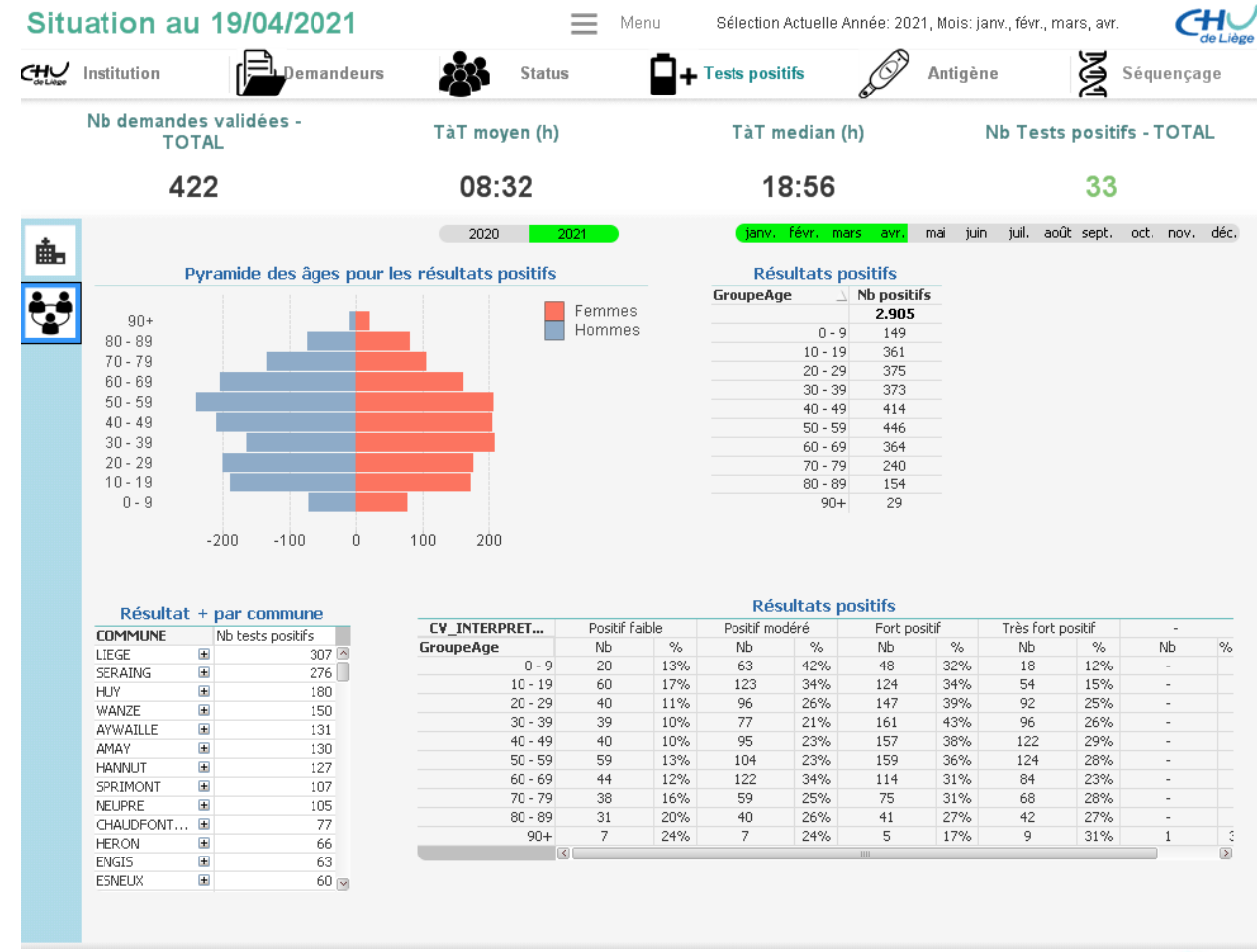
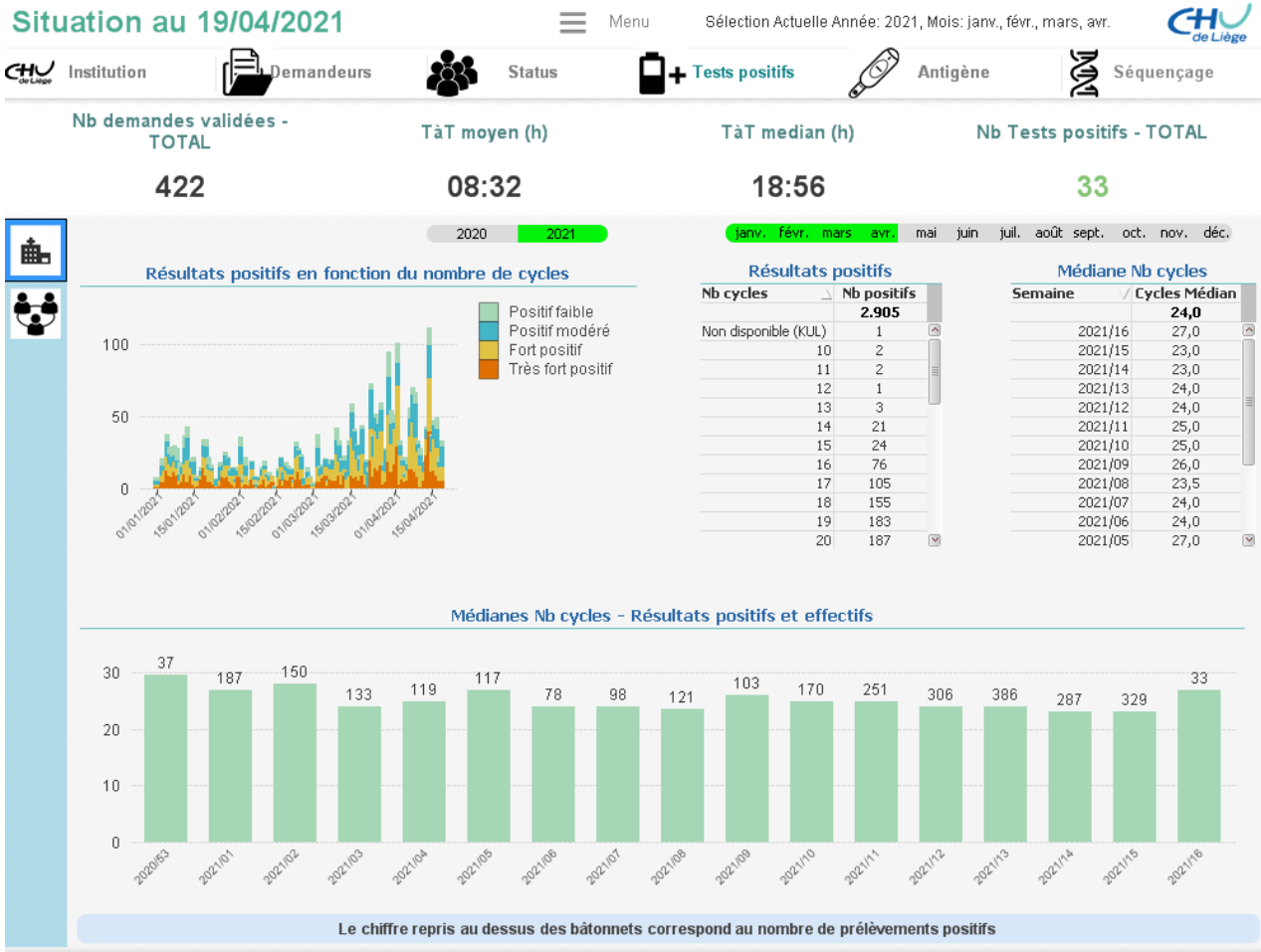
Nombre de patients onco actifs



Nombre de patients onco potentiels



Dashboard reporting: Focus on Testing COVID



2.Provision of Clinical COVID Data

- Unique database, developed around several disciplines
- Weekly update for clinical research
- Content
 - Patient characteristics (including risk factors)
 - Symptoms at admission
 - Treatment
 - Biological values
 - Pathway and ICU Data
- Available to more than 30 researchers in 10 disciplines
- More than 10 published publications for the analysts

3. Sharing clinical data with pharmaceutical industries: The Insite/Trinetx Projet

Challenges To Perform Clinical Trials



Loosing time with inefficient communication.



Almost 50% of all trial delays caused by patient recruitment problems



Missing out on clinical trials because of not being informed



Limited resources to spend on patient recruitment



Confronted with inefficiently designed clinical trials



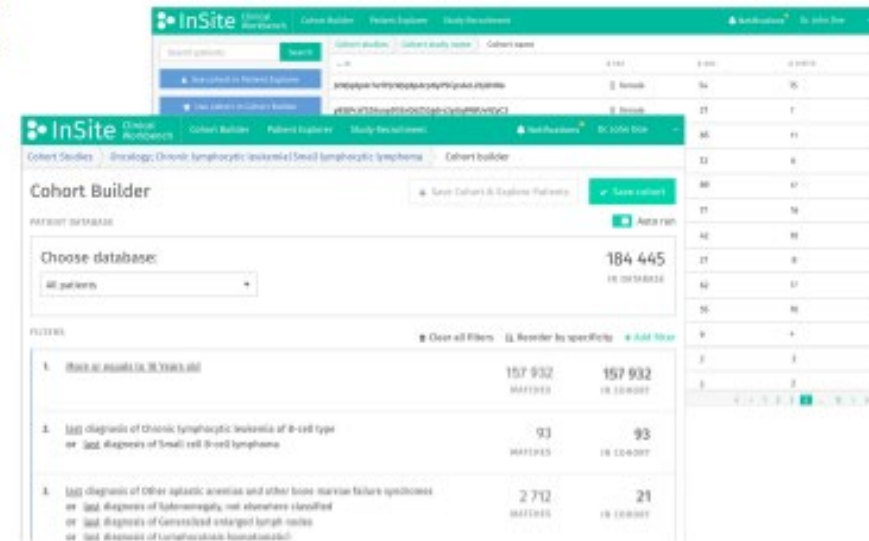
Not compensated for general feasibility assessment

InSite Empowers Trial Sites

- A platform for **trustworthy re-use of EHR** data to support innovation in clinical research and healthcare operations
- InSite **Local Platform** – **detailed data exploration** for healthcare professionals
- **Communication** with multiple sponsors



 InSite



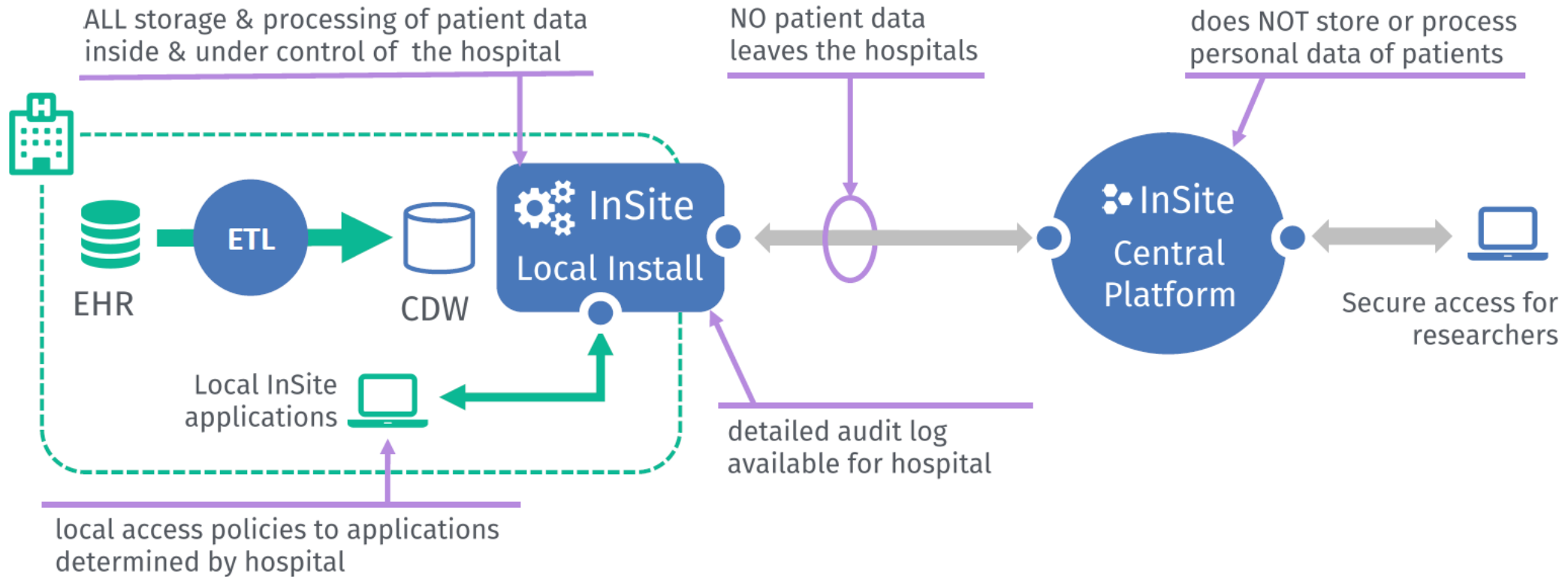
InSite Cohort Builder

Choose database: 184 445 (18/10/2017)

Filters:

Filter	Count	Count
1. ICD-10 diagnosis of Chronic lymphocytic leukaemia [Small lymphocytic lymphoma]	157 932	157 932
2. ICD-10 diagnosis of Chronic lymphocytic leukaemia of B-cell type or ICD-10 diagnosis of Small cell B-cell lymphoma	93	93
3. ICD-10 diagnosis of Other lymphatic neoplasms and other bone marrow factor neoplasms or ICD-10 diagnosis of Lymphosarcoma, not elsewhere classified or ICD-10 diagnosis of Generalized enlarged lymph nodes or ICD-10 diagnosis of Lymphosarcoma histiocytic	2 712	21

Technical Overview - Platform



The InSite Partner Hospital Network



InSite is a pan-European network, with a **healthy ambition to expand beyond EU**

11

Countries in which InSite is active

20M

Patient records on the InSite network in 2017

>100M

Patient records in the InSite partner network in 2019

InSite partner Health Care Organisations (HCOs) include

Insite join Trinext in 2019

Global collaboration **+20** Countries
+130 HCOs
+300M Patients

4



4. Re Use of the clinical data for the research

- **WearIT4Health**
- **InteropEHRate**
- **PERSIST**
- **HosmartAI**
- **Dragon**

Research projects - Interreg WearIT4Health



Programme: Interreg Euregio Meuse-Rhine

Lead partner: University of Liège

Consortium: Research centers, Hospitals from Belgium and The Netherlands

Objective: **Developing a multi-sensors, wearable, secured and wireless monitoring system for inpatients in medium care wards.**

Timeline: 2018 till October 2021

Roles of CHU Liège:

Co-creation & concept design

Integration into the EMR of the hospitals

Clinical validation study



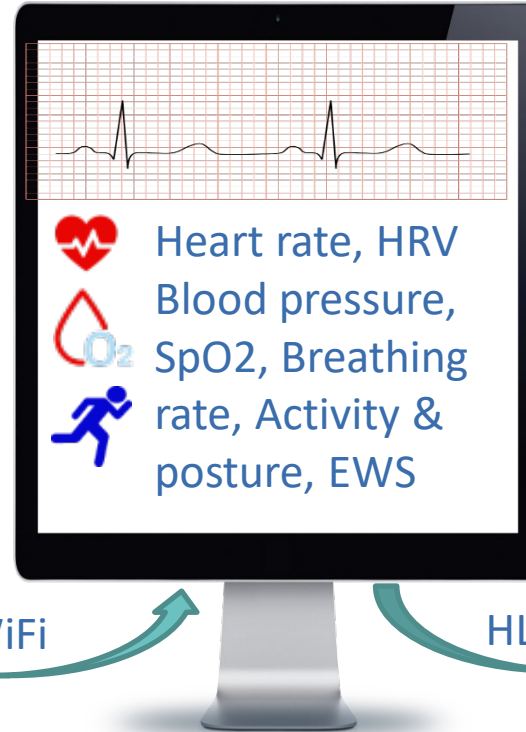
Research projects - Interreg WearIT4Health



ECG, PPG,
Temperature,
Accelerometers



Device on
the chest



WiFi

- Data processing
- AI predictive Early Warning Score

HL7 FHIR



Research projects –InteropEHRate

Programme: Horizon 2020

Lead partner: Engineering, Rome, Italy

Consortium: Italy, Greece, Belgium, Romania, Germany

Objective: **Empower patient to aggregate his/her health data and share them during medical visit, emergency and for research purposes.**

Timeline: 2019 till June 2022

Roles of CHU Liège:

Requirements definition

Co-creation of patient and health care practitioners applications

Data provider and data conversion rules

Clinical validation study



Research projects - Interreg InteropEHRate

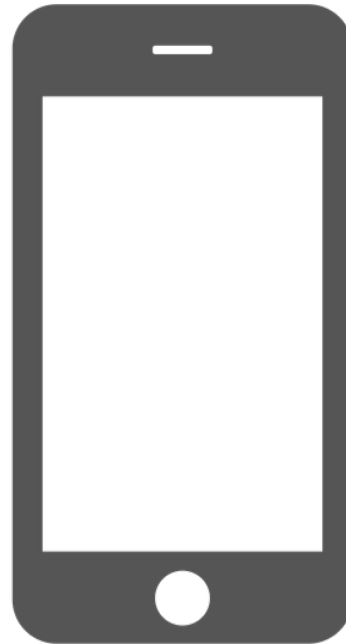


Electronic Health Record

- Medical history
- Laboratory results
- Vital signs
- ...

Patient Summary

- Current medications
- Allergies
- Family history
- - ...



- Medical visit (possibly abroad)
- Emergency case (possibly abroad)
- EU Research center

Smart EHR – Patient acts as a broker of his/her health data

Research projects –PERSIST

Programme: Horizon 2020

Lead partner: Gradient, Spain

Consortium: Spain, Austria, Belgium, Turkey, Germany, Slovenia, Switzerland, Latvia

Objective: **Improve the quality of life of cancer survivors with the help of artificial intelligence and Big Data.**

Timeline: January 2020 till March 2023

Roles of CHU Liège:

Clinicians expertise in oncology

Data standardization, Data anonymization, Data provider

Clinical study site



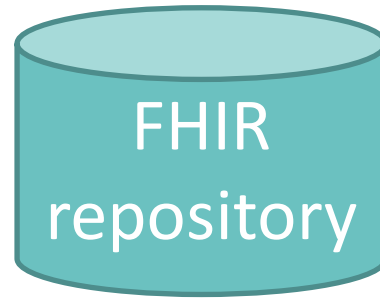
Research projects - PERSIST



- Electronic Health Record
- Cancer registry

Retrospective

Prospective



Horizon 2020
Programme



shutterstock - 534512875



PROMs / PREMs/ Psychological and physiological data **CDSS**



Research projects –HosmartAI



Programme: Horizon 2020



Horizon 2020
Programme

Lead partner: Intrasoft International

Consortium: Belgium, Greece, Slovenia, Spain (countries involved in radiotherapy pilot)

Objective: **Improve the scheduling of radiotherapy appointments using AI chatbot and digital twin.**

Timeline: January 2021 till April 2024

Roles of CHU Liège:

Domain expertise, Concept definition and Validation

Data standardization, Data anonymization, Data provider

Clinical validation study



Research projects – HosmartAI

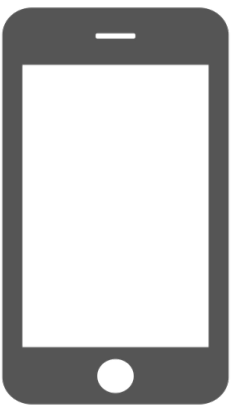
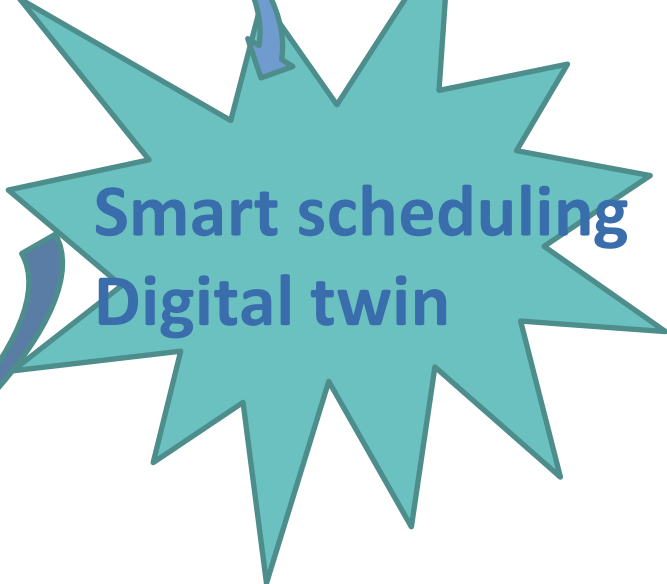


Horizon 2020 Programme

- Electronic Health Record
- Scheduling system
- Oncology Information System

Retrospective

Prospective



Speech enabled chatbot



Research projects – Dragon

Programme: IMI2 – Call 21

Lead partner: OncoRadiomics S.A., Liège, Belgium

Consortium: Belgium, United Kingdom, The Netherlands, Italy

Objective: **Rapid and secure AI imaging based diagnosis, stratification, follow-up, and preparedness for coronavirus pandemics**

Timeline: 10/2020 till 09/2023

Research projects – IMI2 – DRAGON

- **Roles of CHU Liège:**

- i. Multicentric data harmonization development
- ii. Imaging and non-imaging biomarkers exploration
- iii. Diagnosis and prognosis tools designing based on clinical evidence
- iv. Data provider
- v. Clinical validation study

- **CHU Liège coordinator**

Dr. Julien Guiot - Pneumologist

- **Data journey**

DICOM & CSV files generated by CHUL

- Data harmonization process
- Imaging and non-imaging biomarkers assays
- Design of specific AI-based models for diagnosis and prognosis purpose
- Patient empowerment through the development and validation of mobile phone application

Thank you!

 [@PhilippeKolh](https://twitter.com/PhilippeKolh)

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