E-health: bridging the gap

Manjit Dosanjh

CERN

Erice, 12 May 2010

Communication

"If you talk to a man in a language he understands, it goes to his head. If you speak to him in his language, it will go to his heart."

Nelson Mandela

Information Communication Technologies (ICTs)

What are they:

Radio, television, internet, telephones, cellular phones, satellites, portable devices, conference/ meeting tools, pod-cast, facebook, skype, twitter, blogs,.........

What effect are they having:

- producing fundamental changes in all areas
- providing a unique interaction between the user and the subject
- starting to enable a more citizen-centred, personalised information.............

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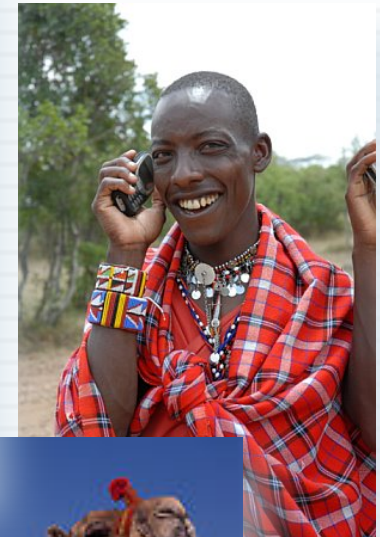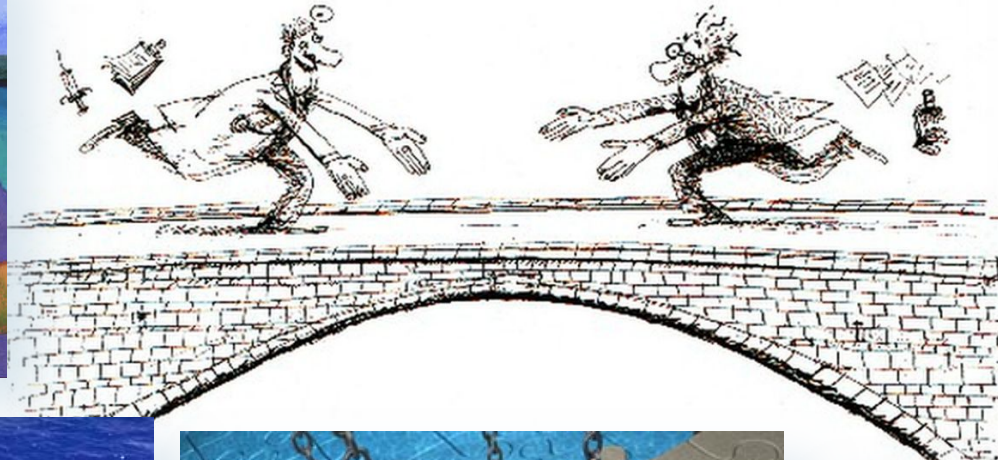
ROLE OF ICTs IN HEALTH

ICTs provide opportunities for individuals, medical professionals and healthcare providers to communicate

ICTs are producing fundamental changes in healthcare and are enabling a more individual-centred information

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Electronic Medical Records

m-Health

eHealth?

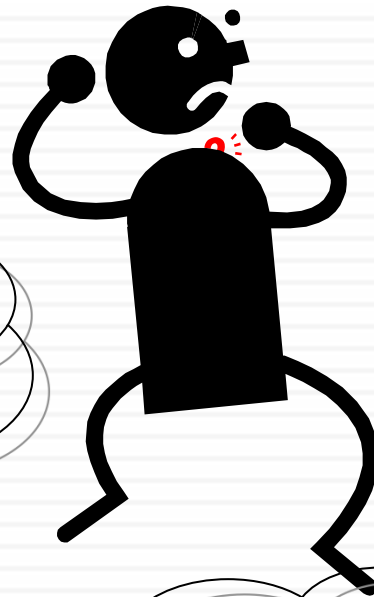e-Cardiology

Telemedicine

e-Radiology

Consumer Health Informatics

Virtual healthcare teams

Health knowledge management
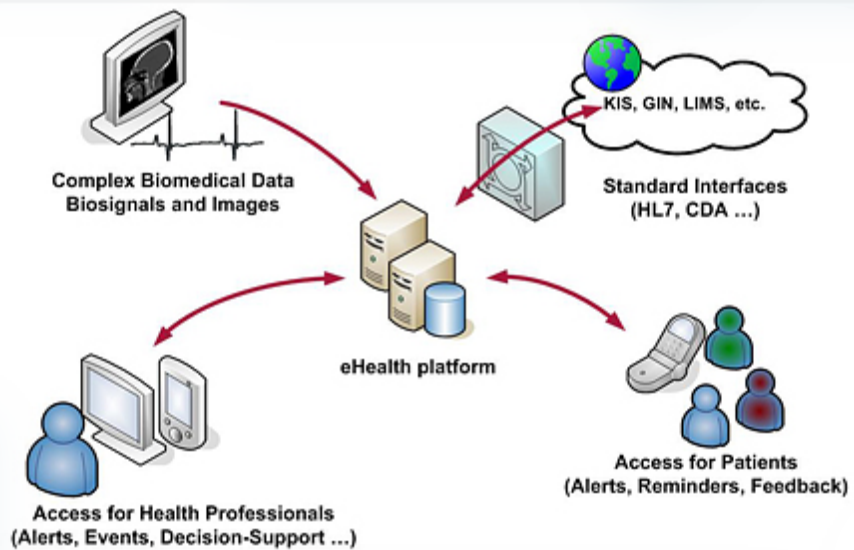
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e-Health: Health enhanced by ICTs

"e-Health" the right information, at the right time, in the right place

- For ubiquitous management of citizens' health
- To assist health professionals
- To integrate advances in health knowledge into clinical practice
- To streamline the citizens' healthcare system and
- To empower the patients to take informed decisions

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Complex Biomedical Data
Biosignals and Images

KIS, GIN, LIMS, etc.

Standard Interfaces
(HL7, CDA …)

eHealth platform

Access for Patients
(Alerts, Reminders, Feedback)

Access for Health Professionals
(Alerts, Events, Decision-Support …)

Examples of e-Health

Products

- ▢ Electronic Health Records (HER)
- ▢ Digital Medical imaging
- ▢ Multidimensional image analysis
- ▢ Surgery assisted by computer
- ▢ Health smart cards
- ▢ Intelligent wearable devices for continuous monitoring, etc.

Systems:

- ▢ Internet, Intranet and regional health networks
- ▢ Satellite access and specific handsets
- ▢ Portable and communicable intelligence devices, etc.

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ICTs in health today
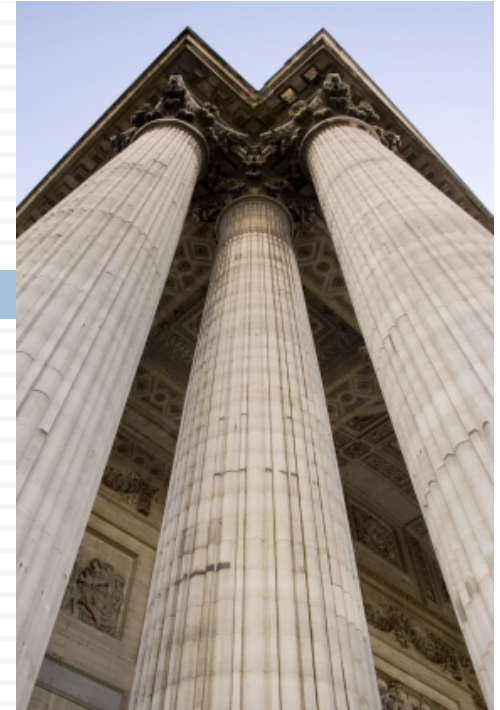
The third pillar of the health industry:

☐ Chemistry: drugs, chemicals (19th Century)

☐ Physics: x-rays, isotopes, imaging (20th Century)

☐ ICTs: knowledge systems for health (21st Century)

Paradigm shift from health systems focused on curing disease in patients by health professionals in health care facilities, to a focus on the citizen-empowering him/her with information to maintain his health everywhere and at any time

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5 Steps of eHealth (R. Mayer, Med-Austron)
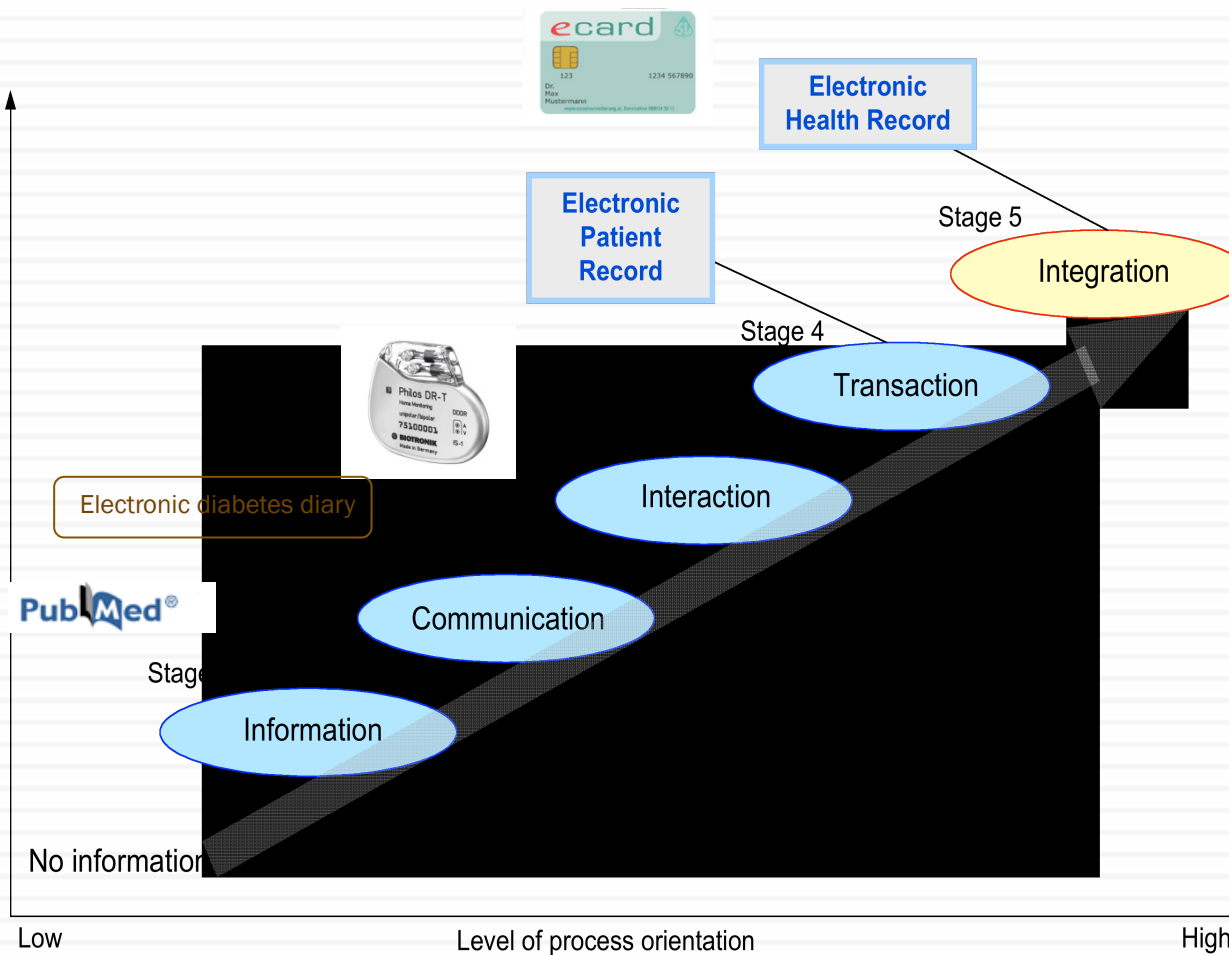
Step1 Information

- Estimated ~ 20,000 health websites
- Used by over100 million people
  - 75% of people who have web access
  - Average of 3.3 times per month
- More than consulting doctors
- Second most searched topic
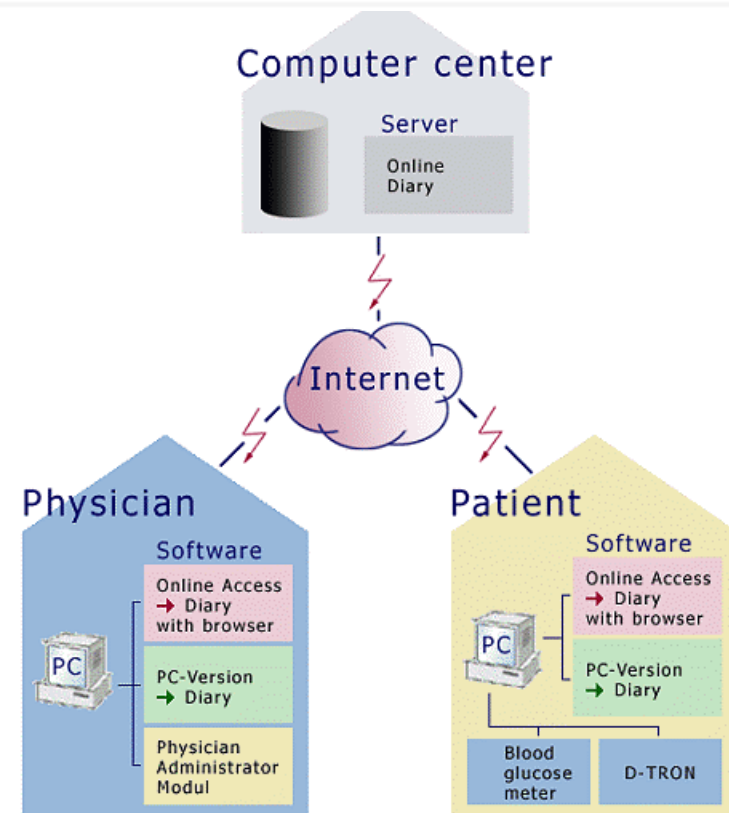
Step 2 Communication - online diabetes diary

Diabetes-diary allows

☐ to document the blood glucose values

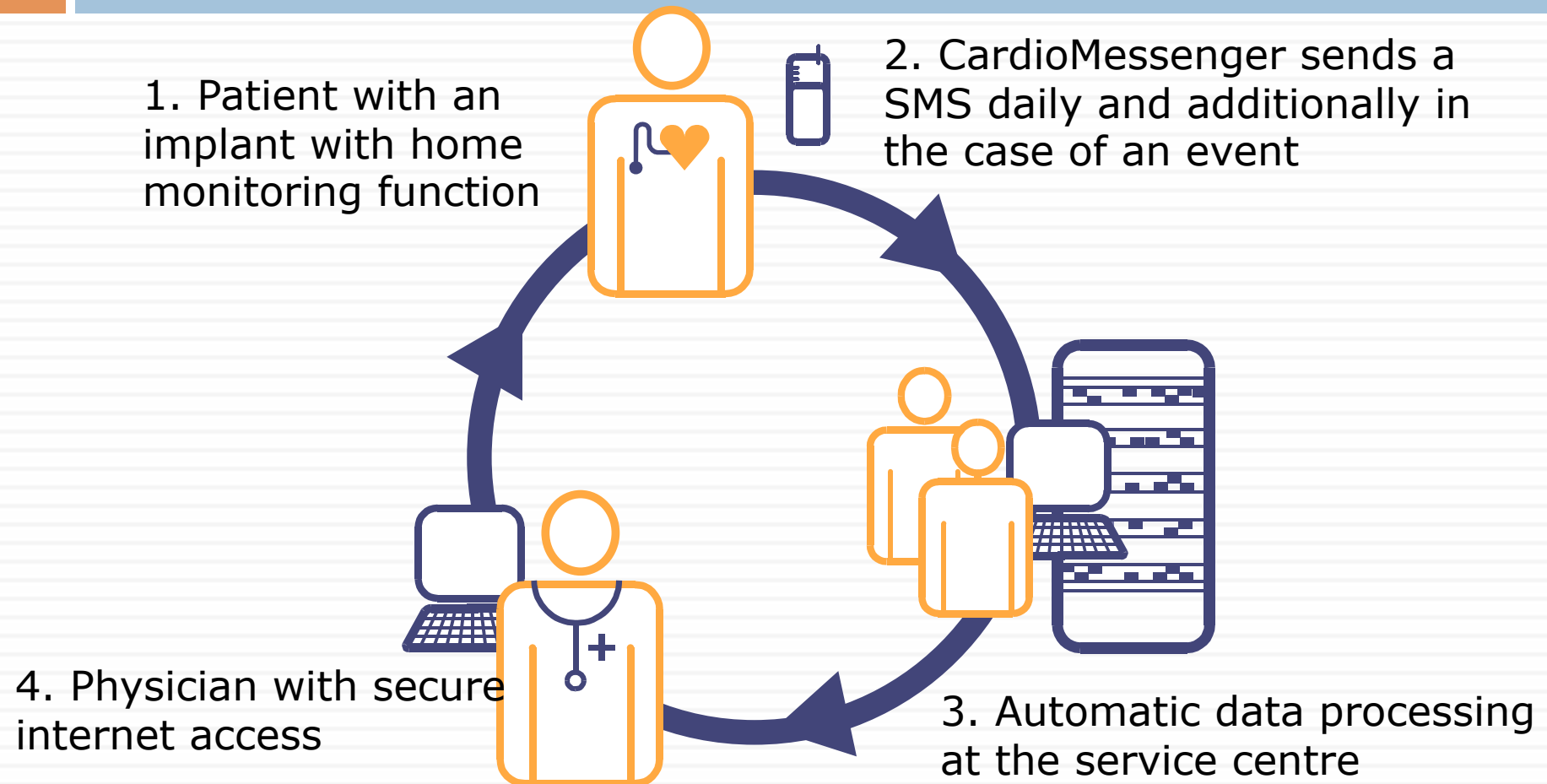☐ enables the physician to access the data

The patient can

☐ communicate with the physician online

☐ save time and unnecessary office visits.

from: http://www.diabetes-diary.com/

Computer center
Server
Online Diary

Internet

Physician
Software
Online Access → Diary with browser
PC-Version → Diary
Physician Administrator Modul

Patient
Software
Online Access → Diary with browser
PC-Version → Diary
Blood glucose meter
D-TRON

Copyright ©2001-2005 DiabLink GmbH & Co. KG

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Step 3 Interaction - Telemonitoring

1. Patient with an implant with home monitoring function

2. CardioMessenger sends a SMS daily and additionally in the case of an event

3. Automatic data processing at the service centre

4. Physician with secure internet access

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Step 4 Interaction - Electronic health card

- For example : Austria

- Rollout at end of 2005

- Electronic handling of a complete (treatment) process

Includes:

- On the reverse side = EHIC - European Health Insurance Card

- Digital signature

(R. Mayer, Med-Austron)

Constraints

- Access rights defined by the patient

- Two types of cards with identification/authentification tools :

  - patient card (PC) : no medical information
  - health provider card (HPC)

- Data is stored at source of production : no central repository

- Health record is made up temporarily, through simultaneous presence of PC and HPC

- Confidentiality and security guaranteed

Step 5   Integration

- [ ] Central data repository

or

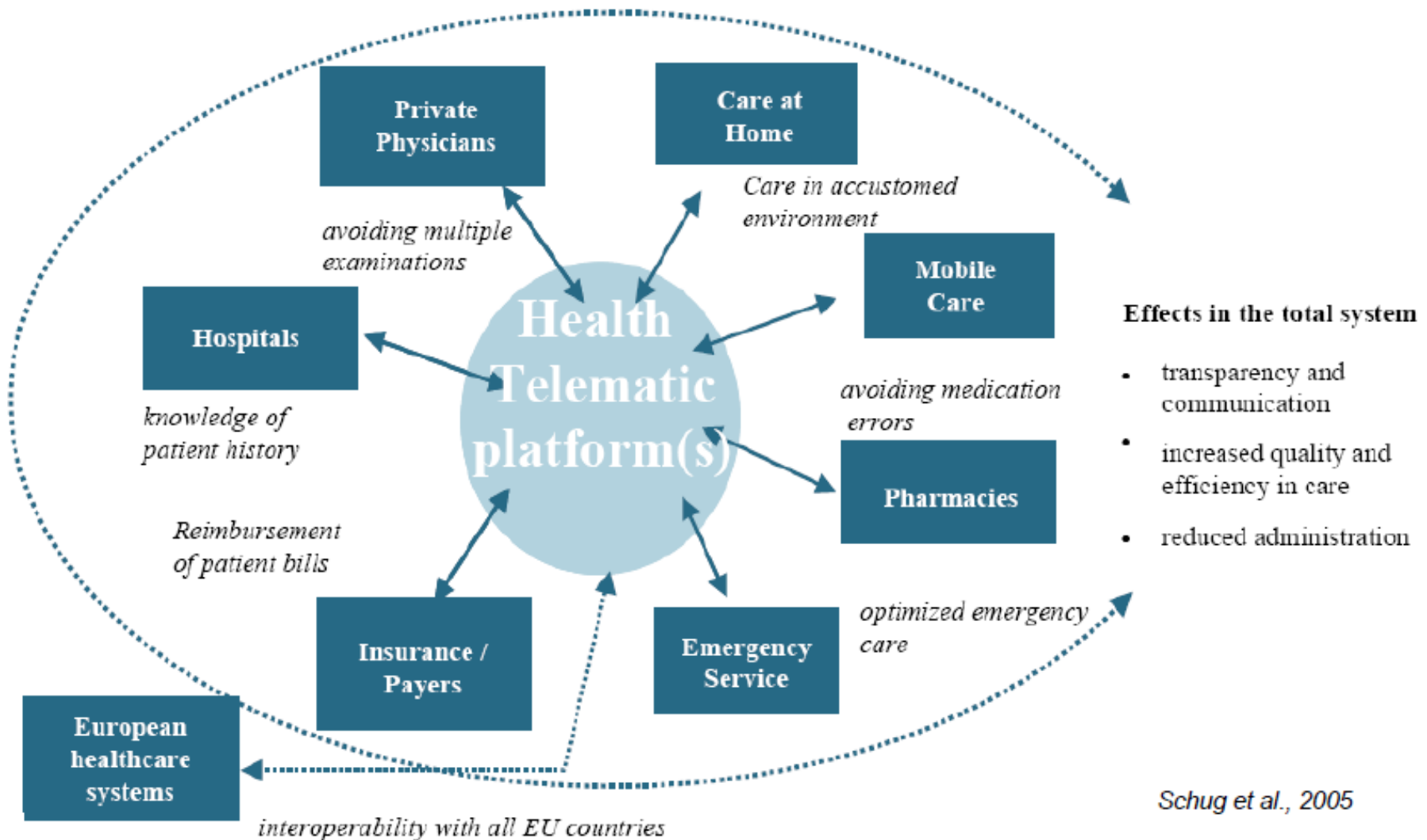- [ ] Local data repositories + central index

- [ ] Case record

or

- [ ] Life long electronic health record

Various combinations are under discussion in many countries

Interoperability is prerequisite for connecting eHealth applications

Private Physicians

Care at Home

Care in accustomed environment

avoiding multiple examinations

Mobile Care

Hospitals

Health Telematic platform(s)

avoiding medication errors

knowledge of patient history

Pharmacies

Reimbursement of patient bills

Insurance / Payers

Emergency Service

optimized emergency care

European healthcare systems

interoperability with all EU countries

Effects in the total system

- transparency and communication
- increased quality and efficiency in care
- reduced administration

Schug et al., 2005

Situation and Challenges

Users

- from **multiple disciplines** with **specific views** on data
- **across Europe**
- with **different** levels of **technical knowledge**
- with **different privileges**

Data

- from **multiple disciplines** with **specific terminologes**
- stored **across Europe**
- In various **independent repositories**
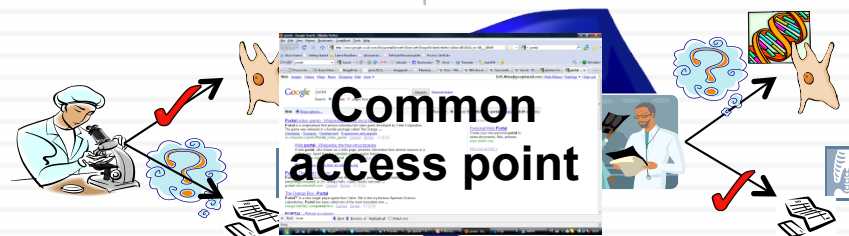- with **different** ethical and legal **requirements**

Medical Doctor

Statistician

Biologist

Chemist

Physicists

Common access point

CONFIDENTIAL

CONFIDENTIAL

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X-rays

protons

carbon ions

tumour

relative dose (%)

penetration depth in tissue (cm)

Hadron Therapy Centres provide an ideal Testbed

- Few facilities at the moment

- Patient referral is necessary both nationally and ouside

- Exchange of best practices, training, protocols for treatment

- Accept, collate, select appropriate information from referring clinics and physicians

- Strong need for ICT for both quantity and quality of data and operation of facility

- All this needs to be easily accessible by various health professionals ……

Possible Scenario
For Patient referral

**Possible data input
from referring hospital**

☐ Patient base data

☐ Medical relevant data

  ◻ Histological data

  ◻ Surgical report

  ◻ Other findings

☐ CT/MRI/PET-CT/US

☐ **RT plan + applied dose**

☐ RT planning documents

  ◻ Applied dose

  ◻ **Sum dose**

☐ Medical report

**Available data output
from Treating Facility**

The Web

- Was a response to the needs of a distributed collaborating physics community

- And saved time and effort in fetching information from other places

- It made sharing information so much easier

- Transparent access to information

- Independent of and removing barriers of space and time

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LHC data challenge

- 40 million collisions per second

- After filtering, 100 collisions of interest per second

- 10^{10} collisions recorded each year

~10 Petabytes/year of data
~10 000 times the world annual book production,
~20km CD stack

Concorde
(15 Km)

CD stack with
1 year LHC data!
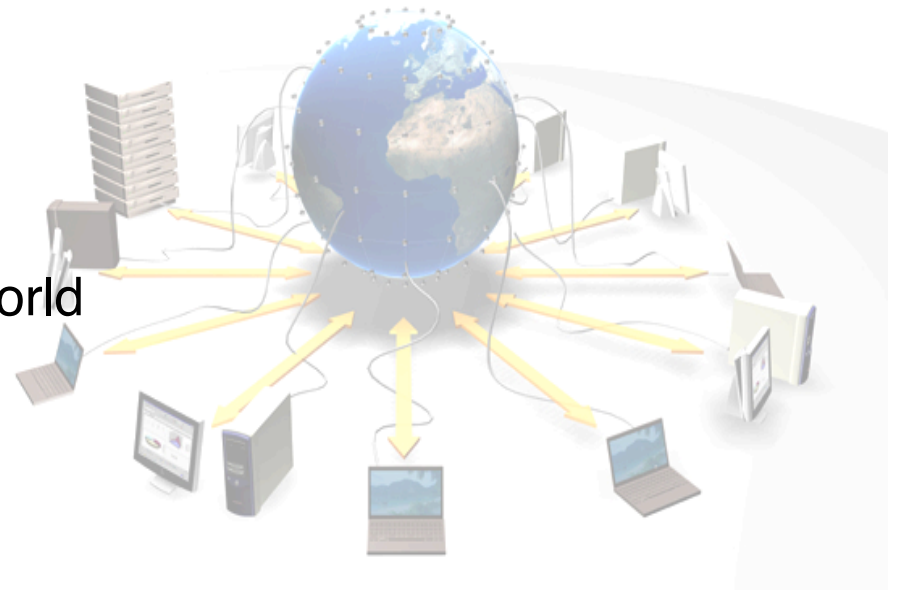*(~ 20 Km)*

Mt. Blanc
(4.8 Km)

CMS

LHCb

ATLAS
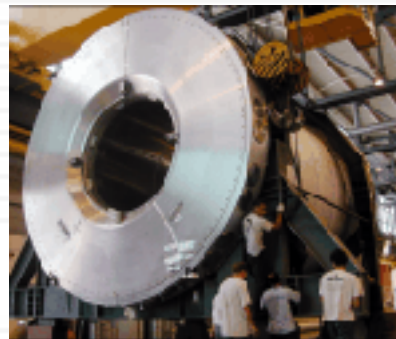
ALICE
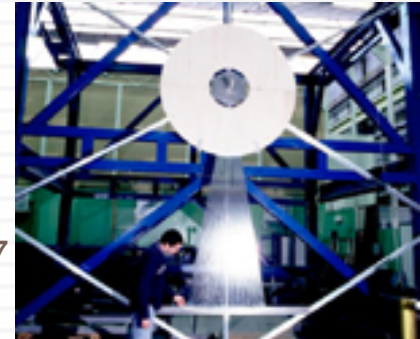
The GRID

The aim of the GRID is to give access,

again easily and transparently,

BUT not only to simple information, it allows

- Storing and computing everywhere in the world
- Easy access through the networks
- Security

Allows 24-hour computing via the GRID

•

# The User connects to his "Virtual Laboratory"

Mobile Access

Workstation

Visualising

GRID MIDDLEWARE

Integrating framework middleware

Supercomputer, PC-Cluster

Data-storage, Sensors, Experiments,   Grid enabled Applications

Internet, networks
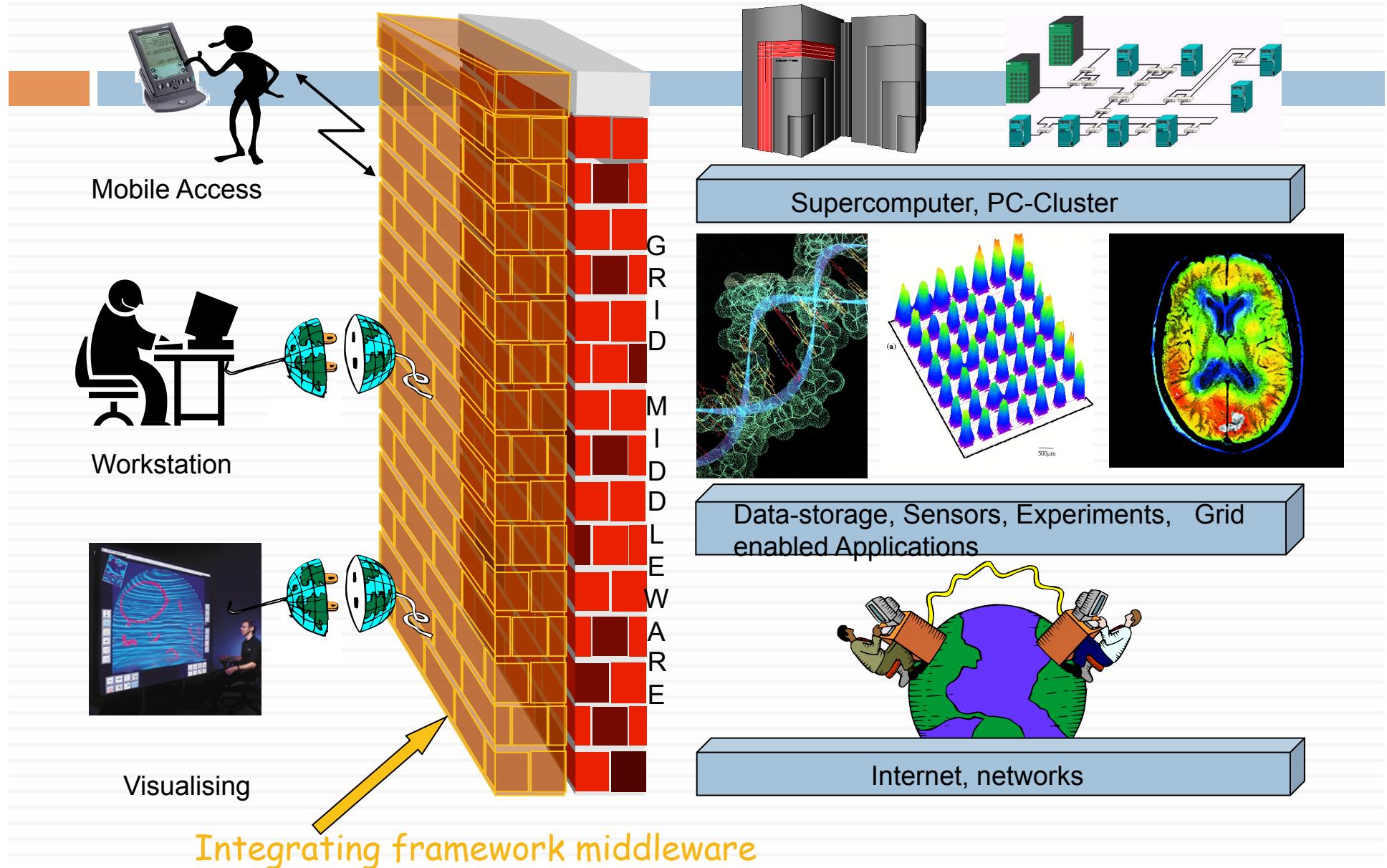
Early example of health application on the grid

Mammogrid
A Grid-powered Mammography Database

- Second Opinion
- Cancer Screening
- Education and Training
- Reference Database / Repository
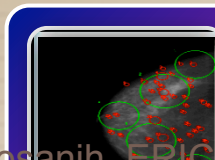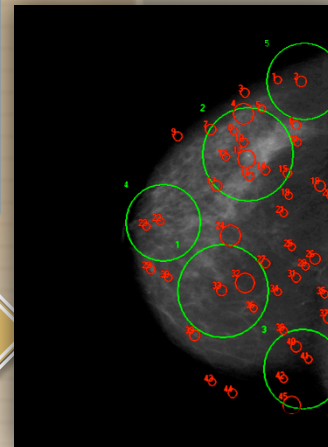
Oncology
- Breast Cancer (micro-calcifications)

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Context

Protons

- use of **protons** proposed 1946 by R.Wilson
- first use on patients in 1954 (Berkeley)
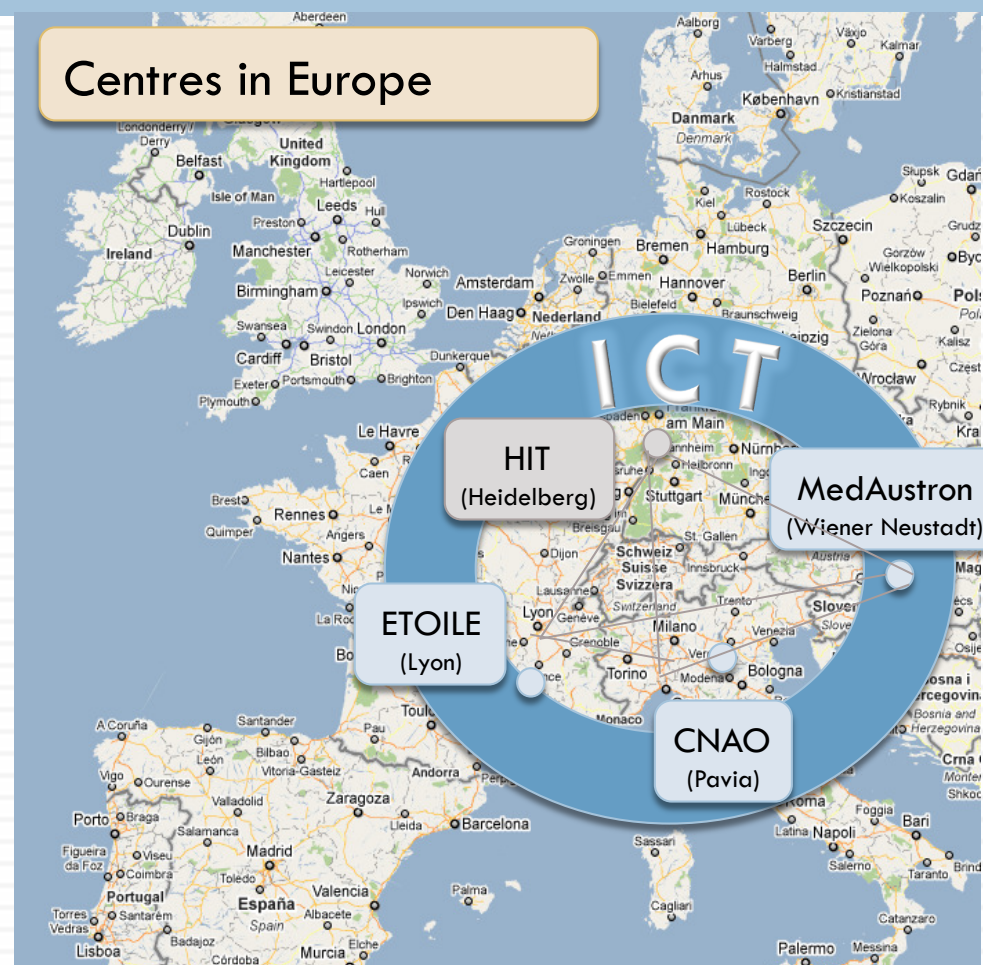- in **2009: >25 proton therapy centres**

Heavy ions

- **only 2 clinical centres** using **carbon ions** (Japan) and physics research institutes **until 2009/11**
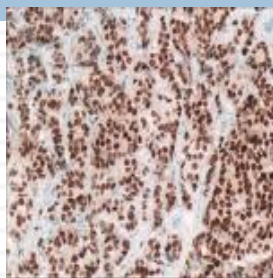- HIT inaugurated in November 2009

Connect centres ...
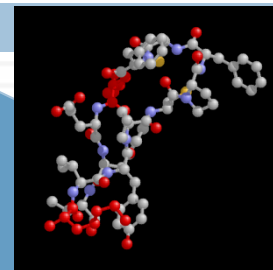... and make most of available data!

Centres in Europe

HIT (Heidelberg)

MedAustron (Wiener Neustadt)

ETOILE (Lyon)

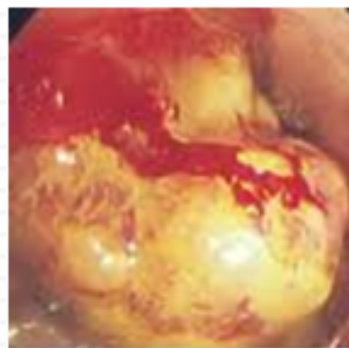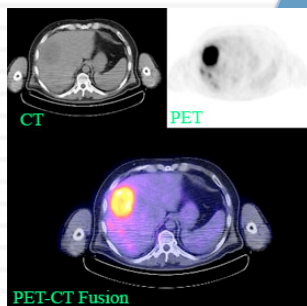CNAO (Pavia)

Disciplines

Pathology

Genetics

Radiology

Physics

Research

Oncology

ICT

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Data standards and semantics

- Heterogeneity
  - Different disciplines have different view on subject.
  - Different institutions have own measurement procedures and naming conventions
- Semantic Interoperability
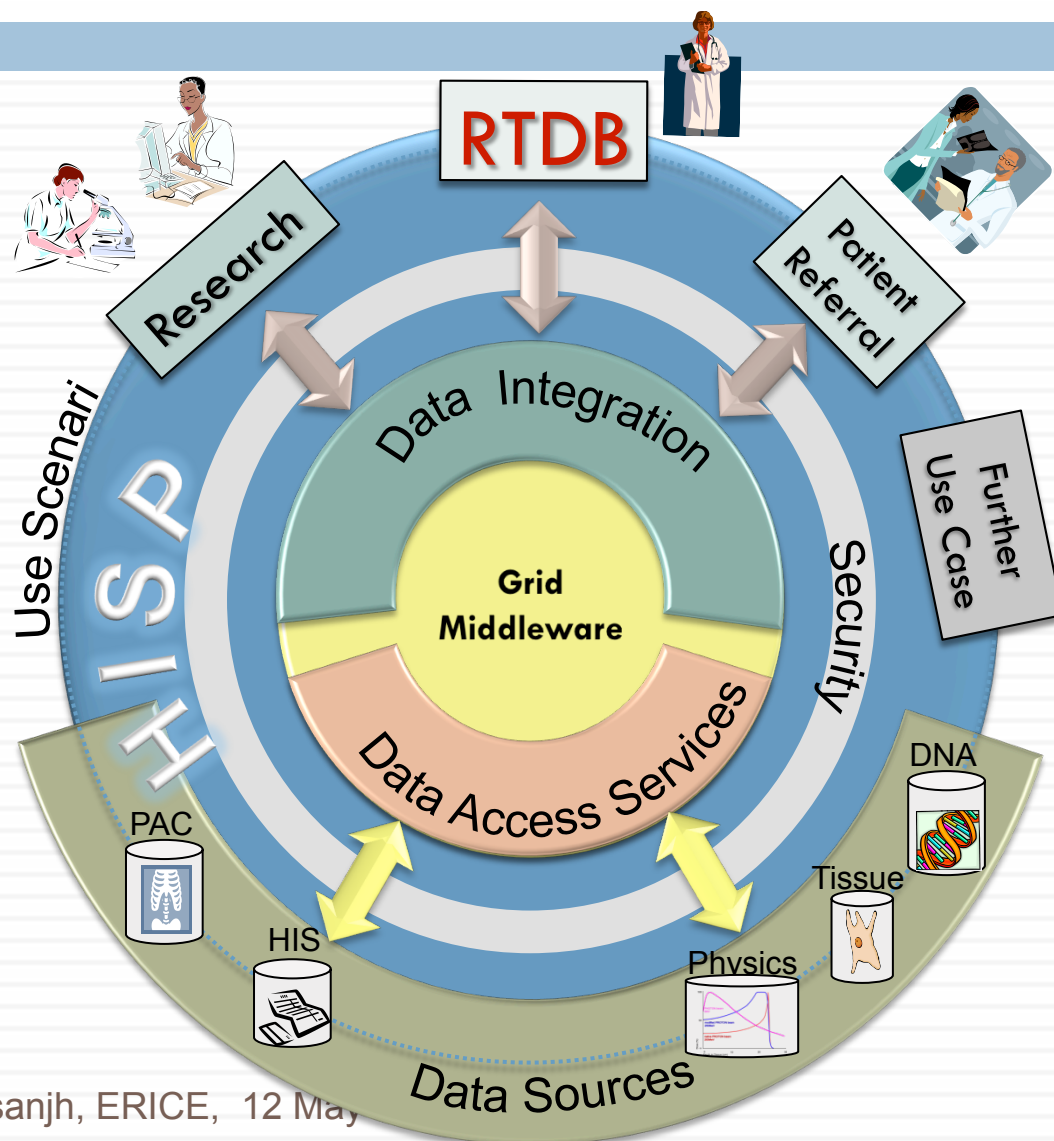 - Same meaning for sender and receiver
- Computer Interoperability

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Hadrontherapy **I**nformation **S**haring **P**latform (HISP)

Connect:
- Users
- Data sources

by
- Grid core
- Security
- Integration
- Portals
- Interfaces

RTDB

Research

Use Scenari

HISP

Data Integration

Grid Middleware

Data Access Services

Security

Patient Referral

Further Use Case

PAC

HIS

Physics

Tissue

DNA

Data Sources

PARTNER
Particle Training Network for European Radiotherapy

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Platform Infrastructure

Core services

- **Data management**
- **Metadata registry**
- **Data mining**
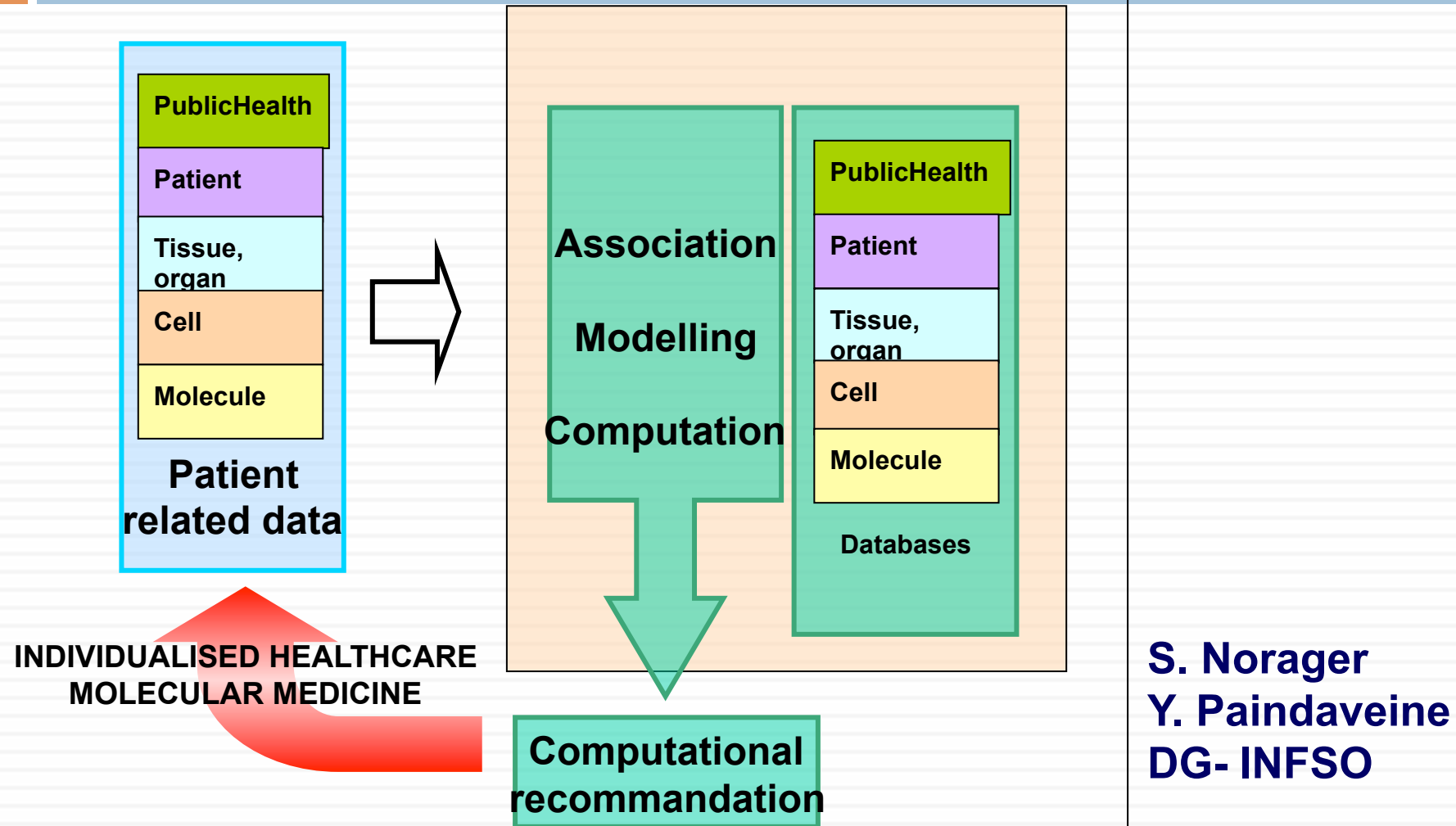- **HPC availability**
- **Encrypted storage**
- **SLA Negotiation**

Security

- **Authentication**
- **Authorization**
- **Role based access**
- **Anonymisation**
- **Single-sign-on**
- **Protection Frameworks**

Interfaces

- **Standard**
- **HL7 compliant**
- **DICOM**
- **Interoperable**
- **Transparent to HIS**

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The challenges of tomorrow…

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S. Norager
Y. Paindaveine
DG- INFSO

Usability .....

For an interface to be a success it must provide

- the right functionality
- at the right place
- at the right time
- and in the right form

from the user's point of view!

Holzinger 2000　　Manjit Dosanjh, ERICE, 12 May 2010

"Nurse, get on the internet, go to SURGERY.COM, scroll down and click on the 'Are you totally lost?' icon."

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