Information-enabling technologies in health care. Is there an app for that?

Geriatric Refresher Day

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I have no conflicts to declare

Many multimedia files were downloaded from internet sites with unrestricted use

Objectives

- Keep an open mind
- Look for opportunities to embed technology to help in the delivery of health care
- Dream of the future...

Game-changing individuals

- Sir William Osler
- Guglielmo Marconi
- Gordon E. Moore
- William Shatner
- Steve Jobs
- Ray Kurzweil
- Year 2023

Medicine in the 20th Century

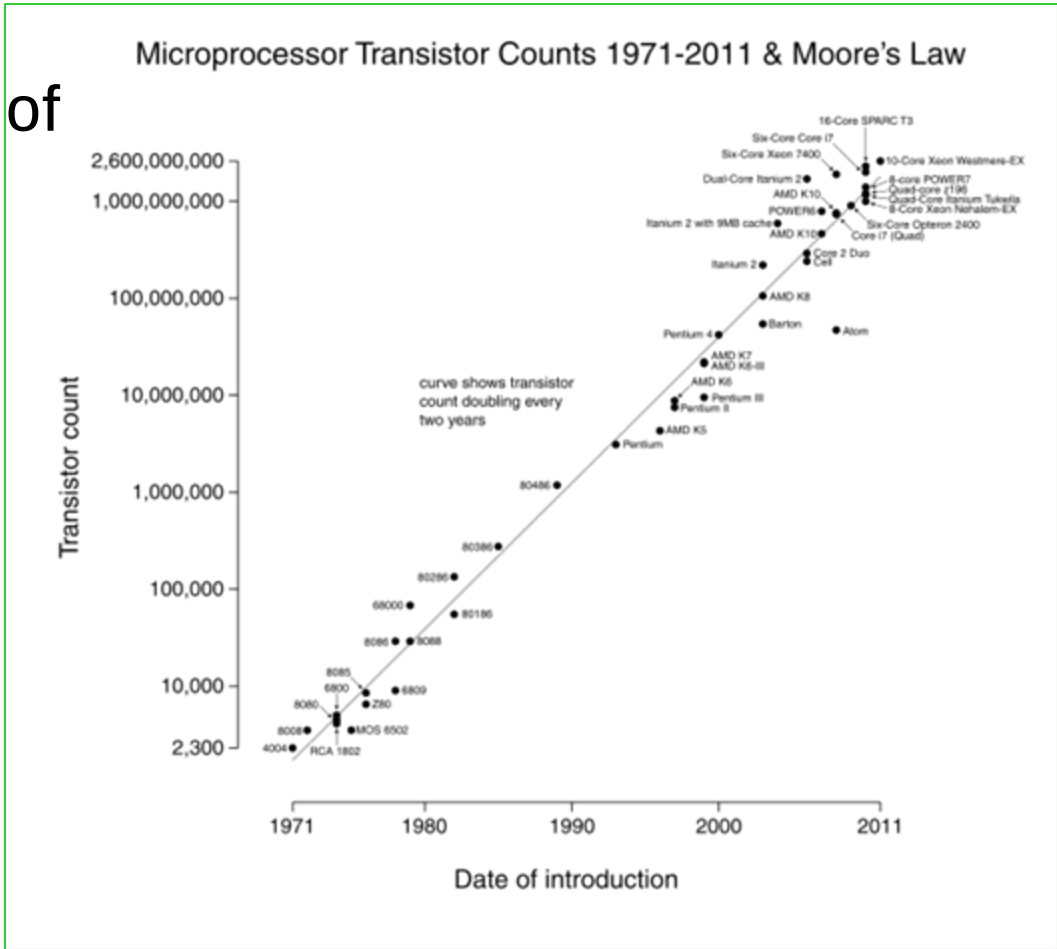
- Sir William Osler & the clinical methods
  - Principles and Practice of Medicine
  - Detailed history-taking
  - Physical examination skills
  - Clinical reasoning
  - Apprenticeship (see one, do one, teach one)
- Cochran Group
  - Evidence-based care
- Continuing Quality Improvement & error reduction
  - 6-Sigma
  - Leapfrog group

Technology & ICT in the 20th Century

- Guglielmo Marconi's first trans-Atlantic wireless communications 1901 between:
  Signal Hill, St. John's, Newfoundland & Poldhu, Cornwall, England
- Alexander Graham Bell, transistor, Intel 8088, Microsoft...Apple
- Cellular phones, wireless networks, bluetooth...

Gordon E. Moore

- CEO Intel corp
- Moore's Law:
  - Doubling of number of transistors, capacity occurs every 18-months



Steve Jobs

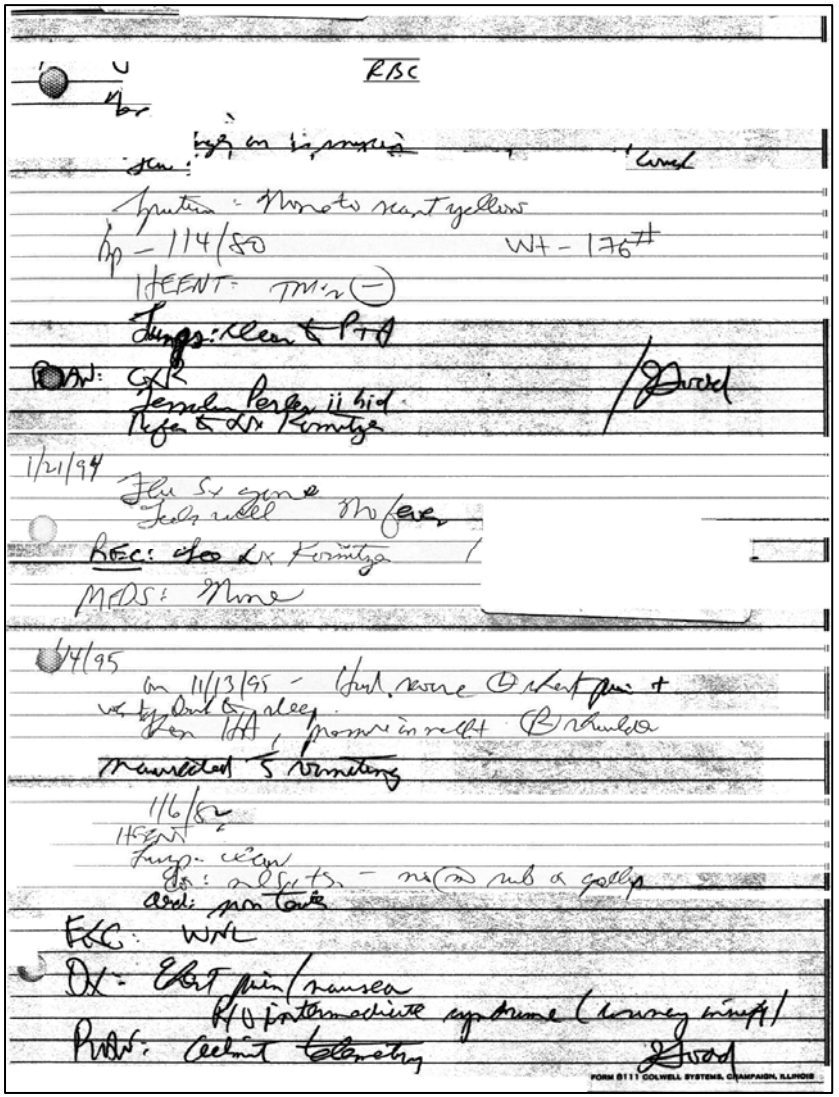
Trends in healthcare

- Explosive growth of technologies applied to healthcare
  - Digital imaging
  - Gene sequencing
  - Mono-clonal antibody production for therapeutics
- Appearance of global diseases
  - SARS (Severe Acute Respiratory Syndrome), bird flu
  - Multi-drug resistant organisms (malaria, TB, MRSA, VRE)
  - Bio-terrorism
- Healthcare in the global village

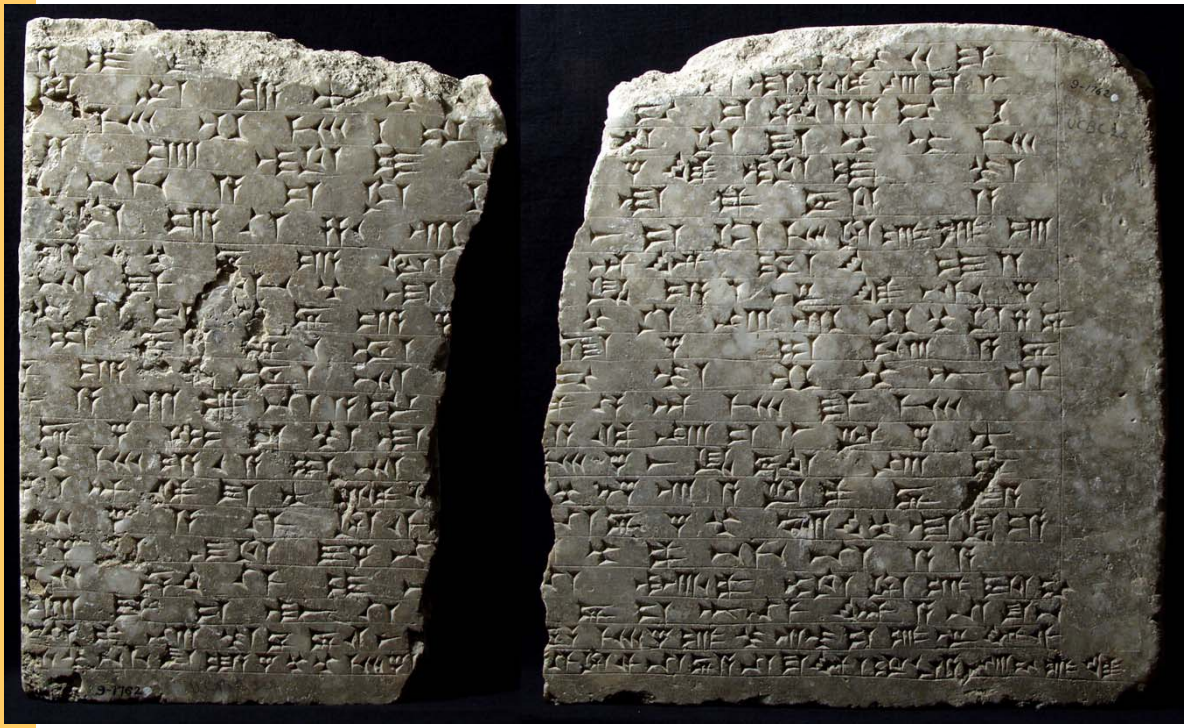
ICT today - 2013

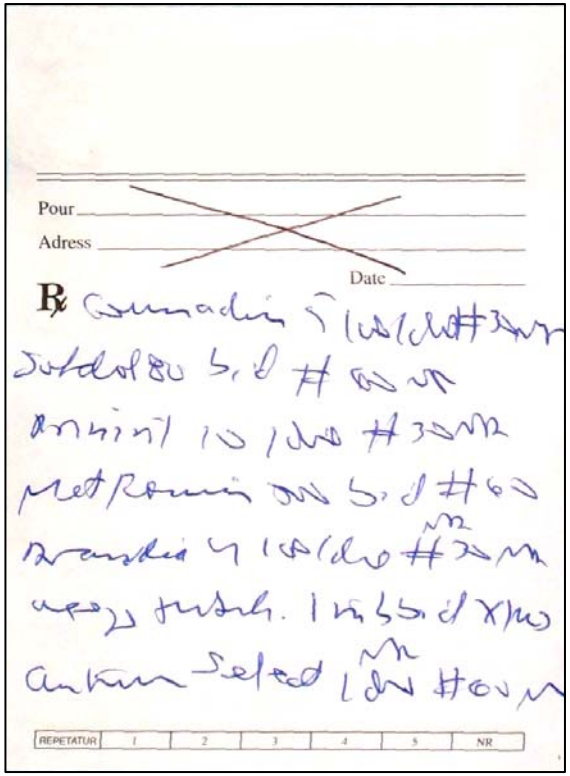
- Implementations of different standards
  - GSM *vs* CDMA; 110V *vs* 220V
- Different implementations of standards
  - Health Level 7 dialects for health data interchange messaging
- (Thank God ArcNet is dead!)
- Great single-purpose mobile devices but multi-purpose convergence devices are disappointing (yes including the iPhone 5)
- Every mobile device uses a different battery, different OS, different setup, etc...

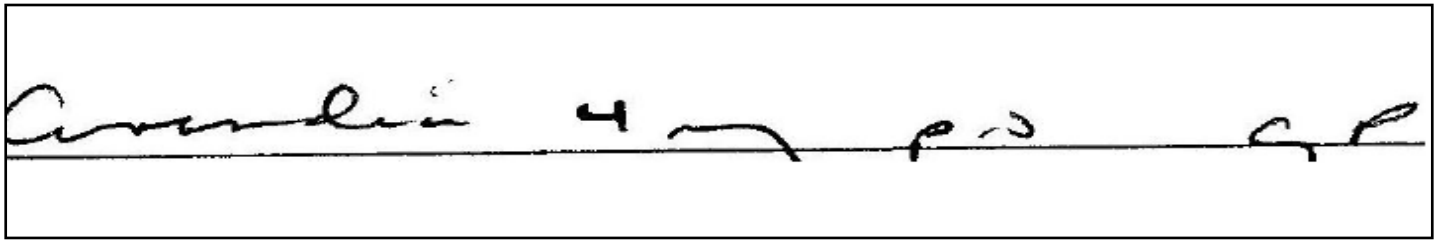
Health care technology 2013



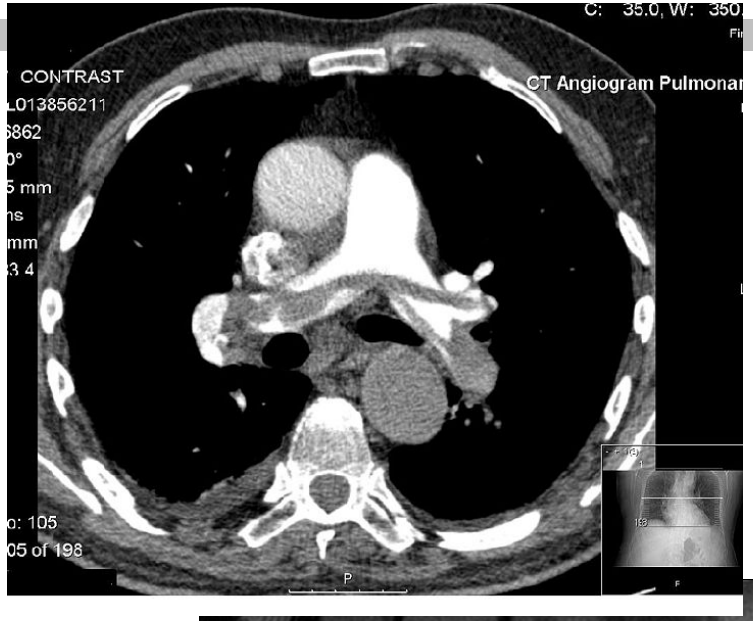
Prescription writing

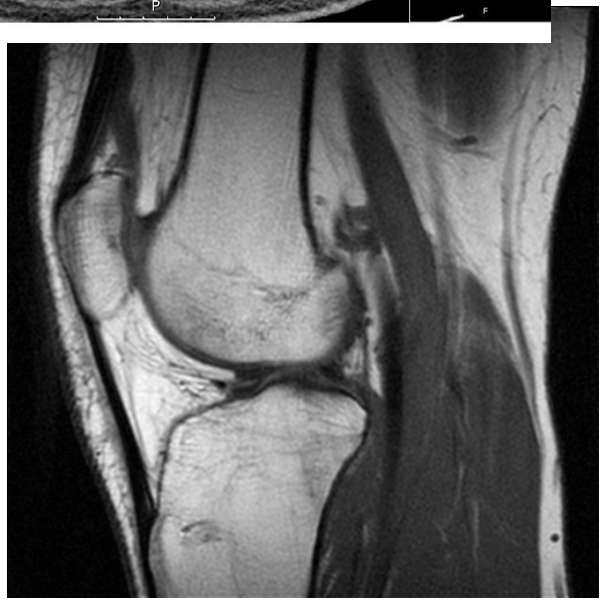




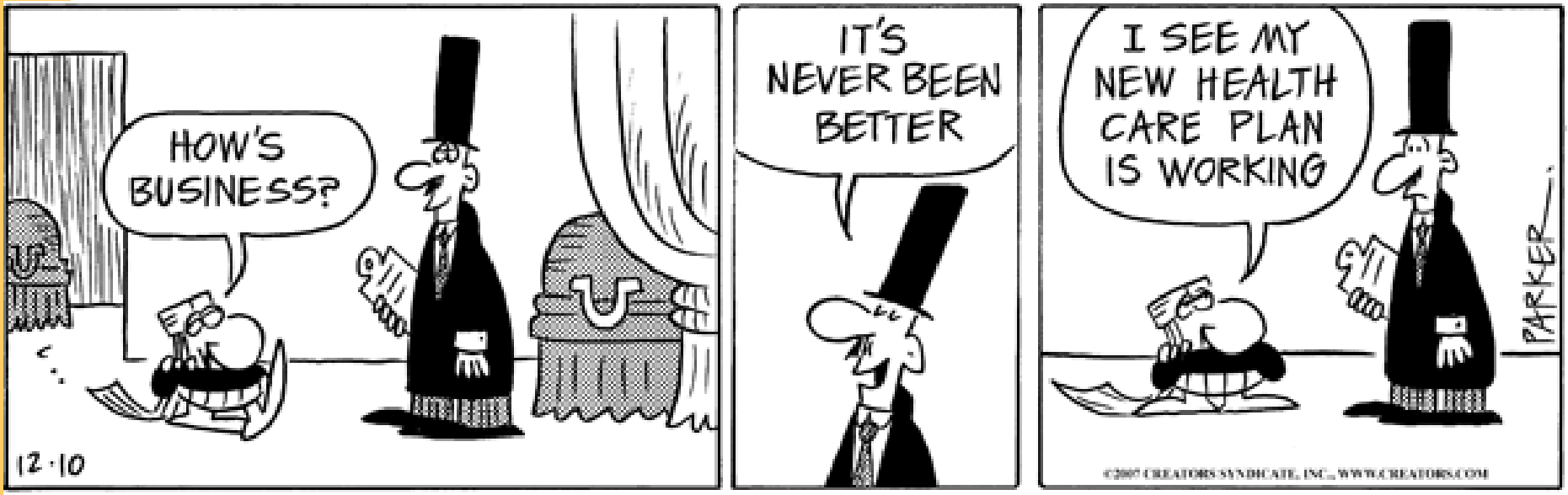


Doughnut machines





Healthcare & costs

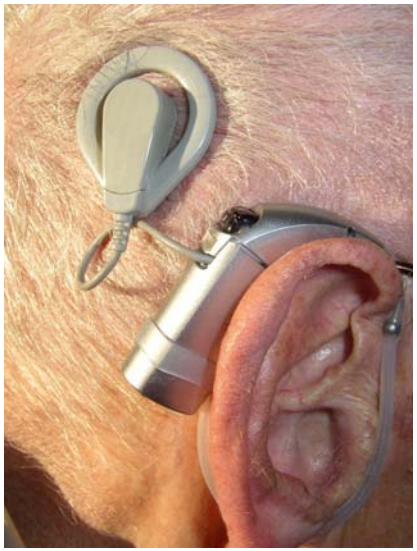


Healthcare workers have to work smarter, faster, and safer within the same budgetary envelope. Therefore WE NEED HELP!

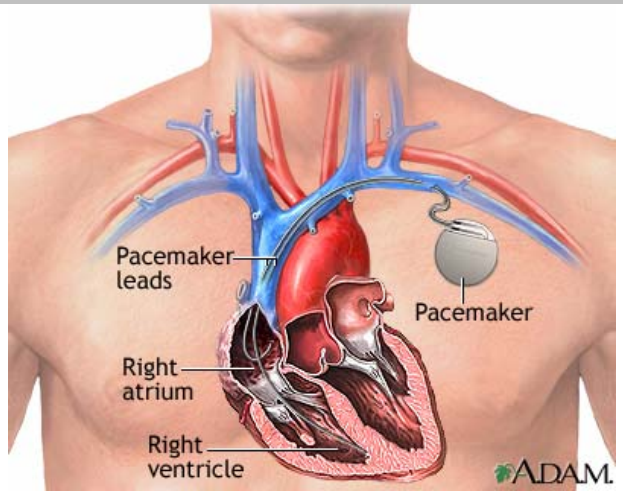
Why is ‘trek’-care so successful?

- Voice-activated, wireless
- Optimal infection control (touchless)
- Mobile, ultra-portable
- Nano-technology
- *Instantaneous results*
- Durable, reliable documentation
- Species & person specific
- Galactic knowledgebase

Are we that far off today?

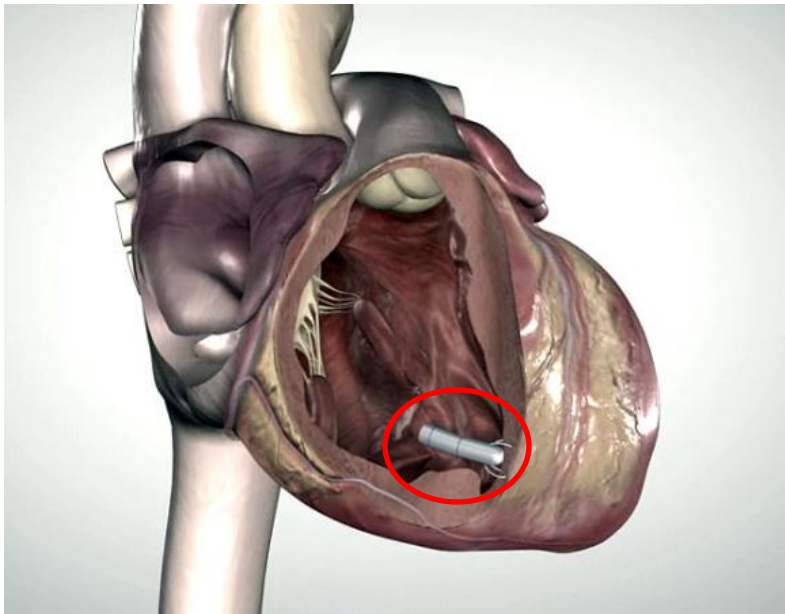


Consider cardiac pacemakers



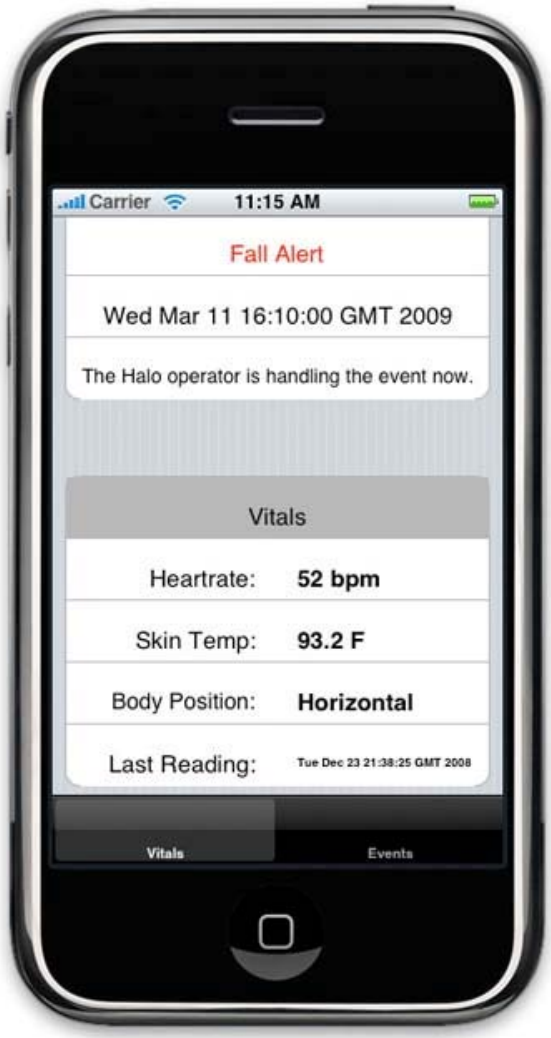
←2012

2014→



Seniors Using iPhone Apps to Alert When They Fall

Filed under General Senior News — no comments



Each year falls create fractures, bruising, and serious injuries for the elderly, as their bodies are not as durable and they often cannot get up on their own. The elderly often live at home alone until they move into senior housing, and not having anyone around is a frequent worry for their loved ones who are concerned with their safety. Now there are some new apps for the iPhone or iPod Touch that seniors can use to help alert others when they take a fall. The two apps starting to generate buzz in the space are Fall Alert and iDown, which both rely on the internal accelerometer which allows the app to detect rapid acceleration like a fall. Seniors using iDown will only have emails sent to others when they take a fall, but those using Fall Alert will have the app call a designated phone number.

The iDown and Fall Alert apps are still relatively new, and early reviews indicate that they still have work to do to become more useful to those seniors who are looking for extra support if they were to take a fall. Falls happen in all sorts of directions, and the accelerometer is only so intelligent on picking up all falls, so many people who have downloaded the app report that it only works about half of the time. If app developers continue to improve upon this technology, it could give millions of seniors an easy way to add a fall detection app into their everyday life to help keep them safe.

ICML | Atlanta
International Conference on Machine Learning

16-21 JUNE 2013 ATLANTA

Role of Machine Learning in Transforming Healthcare

26
days until
Submission Deadline

107
days until
Workshop

Rationale and Objectives

Rationale

The rapid growth of information technology promises to change the practice of medicine as we know it. Large volumes of clinical data are now digitized as part of routine patient care, and clinical decisions are made more accurately and more efficiently than ever before with the growing prevalence of Electronic Medical Record (EMR) systems. In the United States, for instance, EMR adoption has increased dramatically in recent years, driven in part by the recent regulatory mandates and government funding, in particular the HITECH Act in the American Recovery and Reinvestment Act (ARRA). The growth of EMR systems creates the opportunity to extract key, actionable information from the electronic data more robustly and to use it meaningfully (i.e. to reach the Meaningful Use criteria), improving clinical, financial and operational outcomes.

However, both the data and its application within health care are challenging: The data are collected from heterogeneous sources. They are high-dimensional. There is provider bias in the collection process; stake holders (e.g., patient and provider preferences) influence choices made along the way. Acquiring labels is often expensive and non-trivial; for example, experts may disagree on a diagnosis. In addition, for our work to impact health care, it is valuable to deeply understand the context within which it will be deployed.

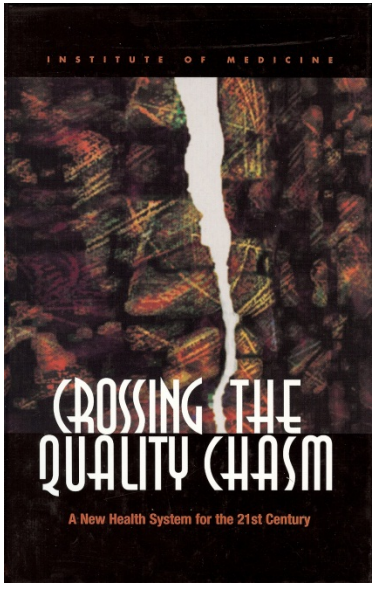
Purpose of the Workshop

The purpose of this multi-disciplinary workshop is two-fold:

1. Learning from domain experts from large healthcare organizations (e.g., Kaiser) and senior researchers from related disciplines like operations research, health services, and statistics.
2. Techniques and methodologies machine learning community is using and in process of developing to address these challenges

Convergence of ICT & Healthcare

- Absolutely an essential tool !
- Information management
  - Care of more elderly patients with complex conditions
  - Help to improve the signal to noise ratio (information overload)
- Knowledge mining & integration
  - Doubling approx every 14months
  - mega 10^6; giga 10^9; tera 10^{12}
  - peta 10^{15}; exa 10^{18}, zetta 10^{21};yotta 10^{24}...
- Remote sensing
- Institute Of Medicine 2000 report
- Wireless technologies & networks
  - Personal area/body area networks
  - Wide area networks



Health care & ICT: Mission Impossible?

Health care

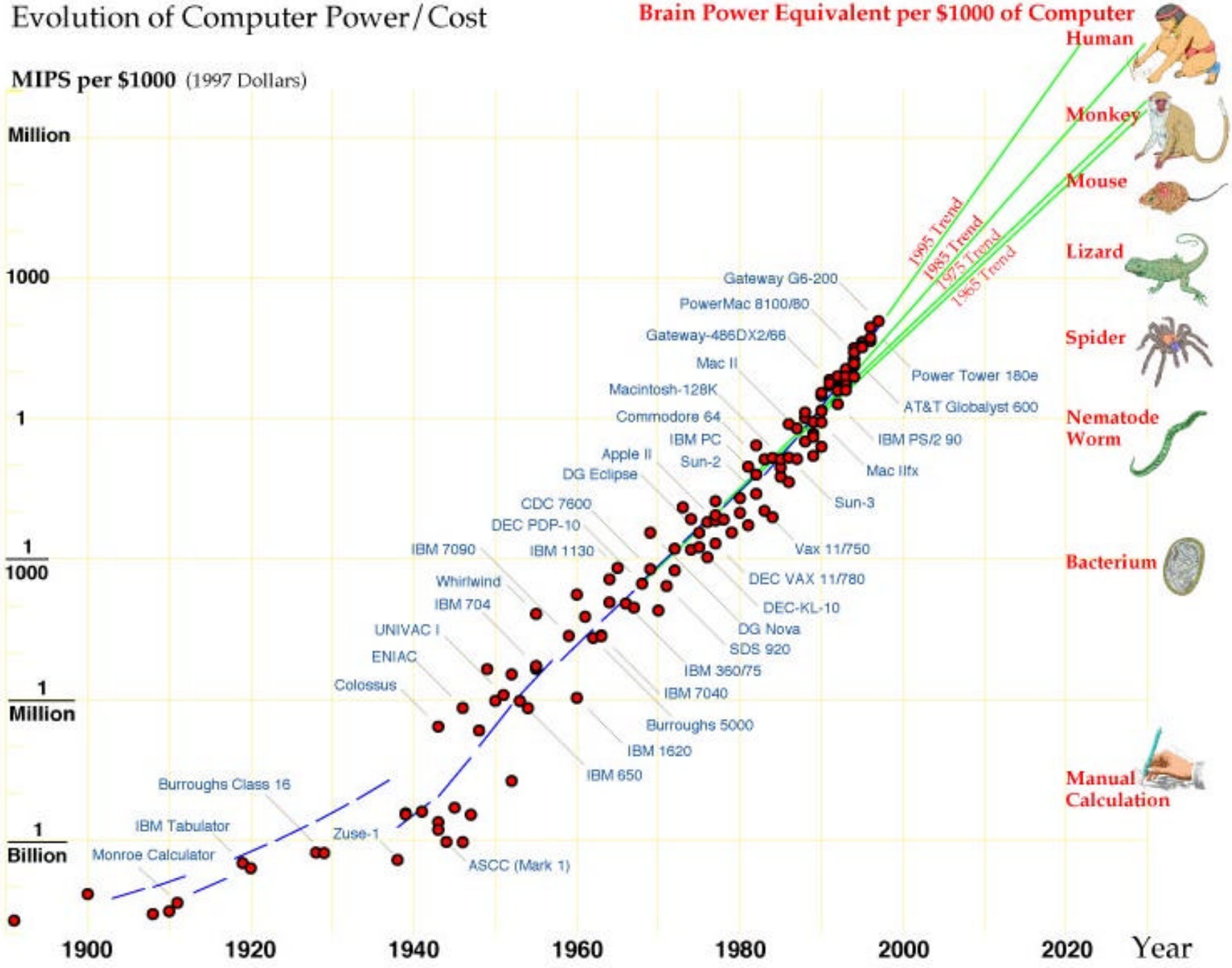
- Complex & uncertain
- Questionable reliability
- Uneven quality
- Non-standardized
- Regulated

ICT

- Precise
- Reliable
- High quality
- Standardized
- Regulated

Healthcare as a 'final frontier' of ICT development needs to

Co-existence →Collaboration → Convergence


Evolution of Computer Power/Cost
Brain Power Equivalent per $1000 of Computer
MIPS per $1000 (1997 Dollars)
Million
1000
1
1/1000
1/Million
1/Billion
Human
Monkey
Mouse
Lizard
Spider
Nematode Worm
Bacterium
Manual Calculation
1995 Trend
1985 Trend
1975 Trend
1965 Trend
Gateway G6-200
PowerMac 8100/80
Gateway-486DX2/66
Mac II
Macintosh-128K
Commodore 64
IBM PC
Apple II
Sun-2
DG Eclipse
CDC 7600
DEC PDP-10
IBM 7090
IBM 1130
Whirlwind
IBM 704
UNIVAC I
ENIAC
Colossus
Burroughs Class 16
IBM Tabulator
Monroe Calculator
Zuse-1
ASCC (Mark 1)
IBM 650
IBM 1620
Burroughs 5000
IBM 7040
IBM 360/75
SDS 920
DG Nova
DEC-KL-10
DEC VAX 11/780
Vax 11/750
Sun-3
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IBM PS/2 90
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Year

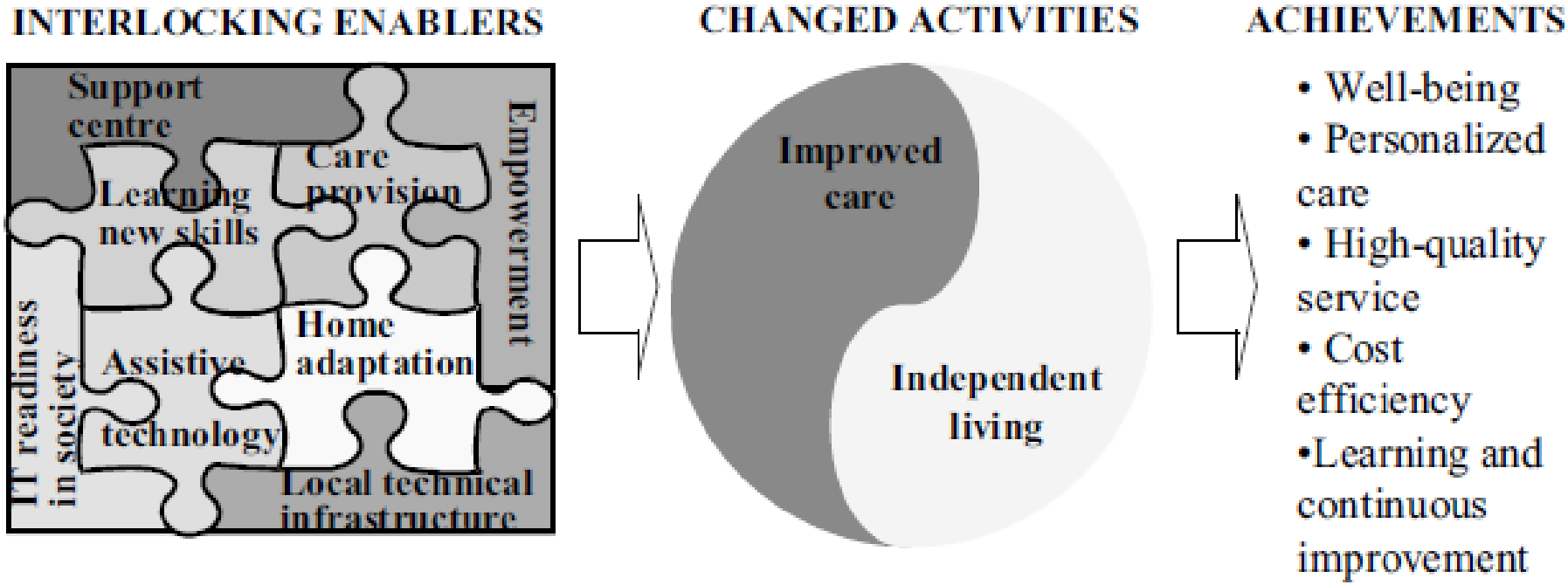


Figure 1 Effects of the introduction of ICT and expected achievements as a consequence of independent living in the area of elderly care

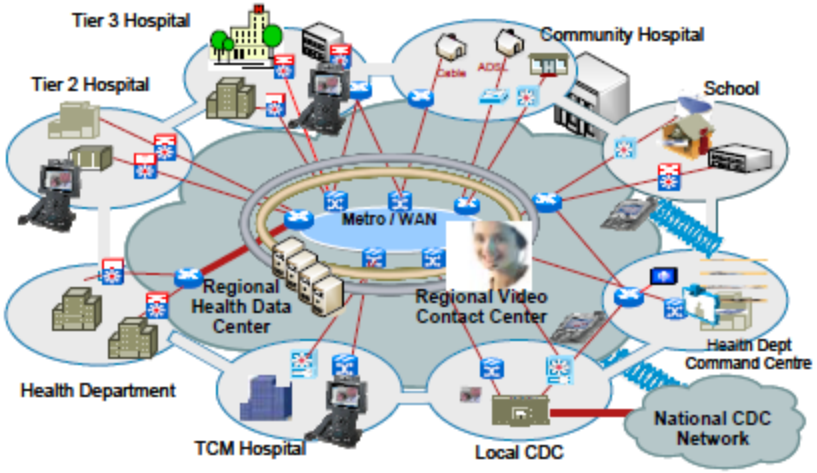
Economic analyses for ICT in elderly healthcare: questions and challenges

Vivian Vimarlund and Nils-Göran Olve

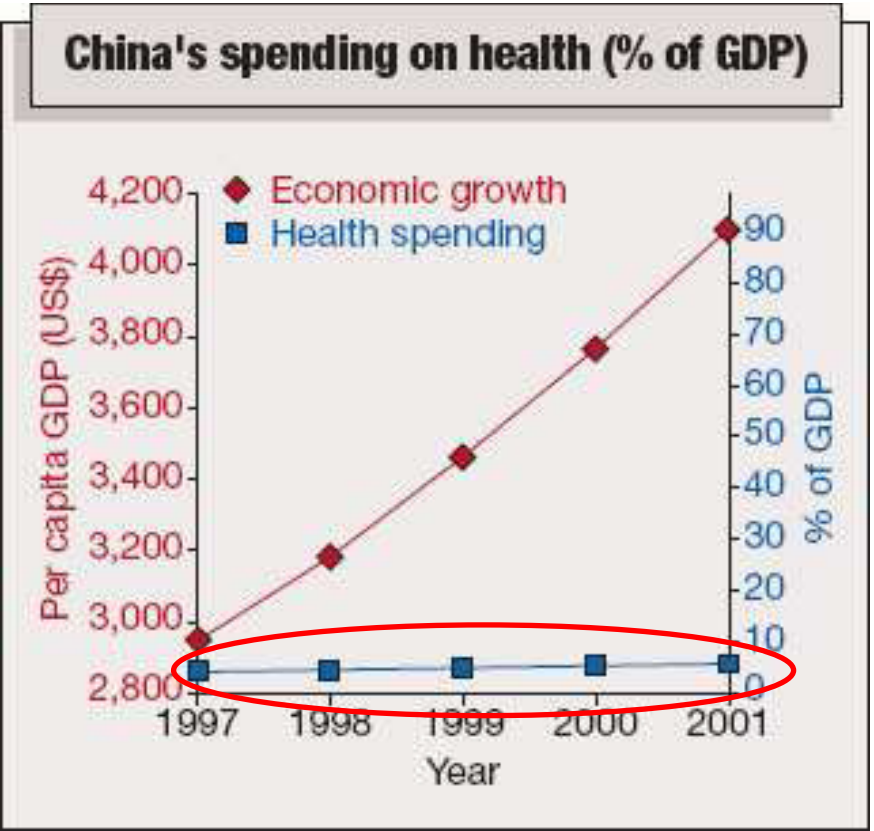
Health Informatics Journal 2005 11: 309
DOI: 10.1177/1460458205058758

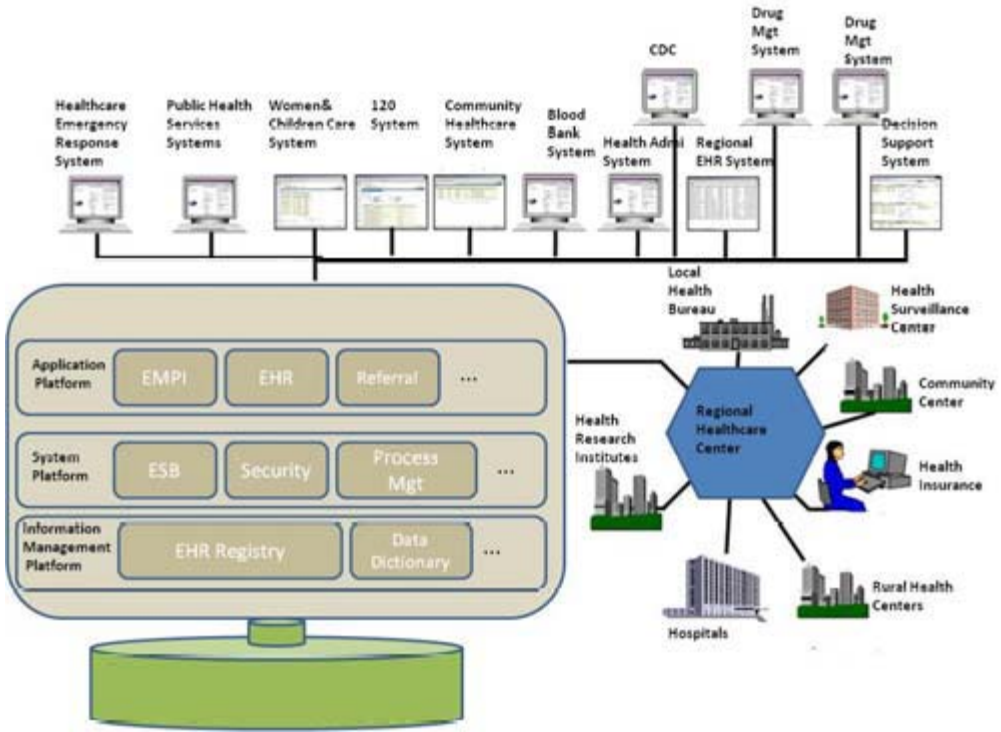
Sweden

Regional Healthcare Information Network (RHIN)



Source: Cisco





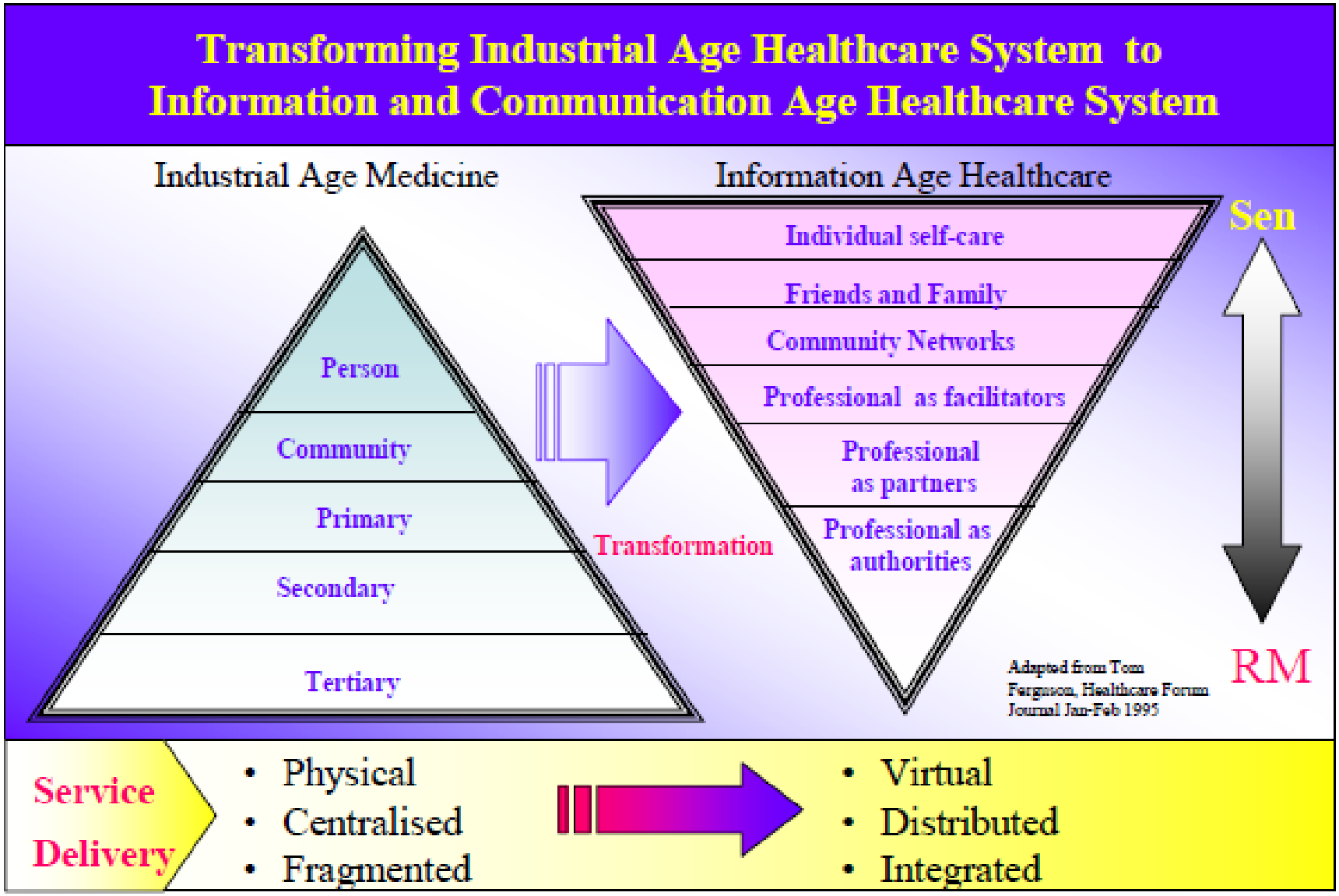
India

Linking remote communities

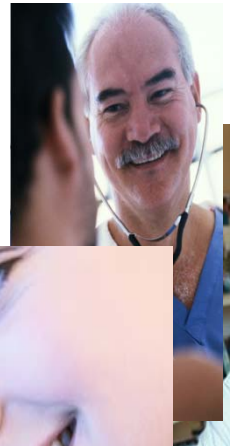
Traversing a multi-level healthcare delivery network

Ensuring access to more of the population

Transforming the Healthcare System



Malaysia Healthcare



moxxi

L'innovation par l'intégration
Innovation through integration

Guidelines for success

- Involve clinicians, especially those who understand the technology
- One-size RARELY fits all (yet)
- Manage change (process engineering)
- Manage expectations (project management)
- Target your solution(s) properly
  - Is it for the Patient? Provider? Payer?
- Continue to produce high-quality research and communicate the results

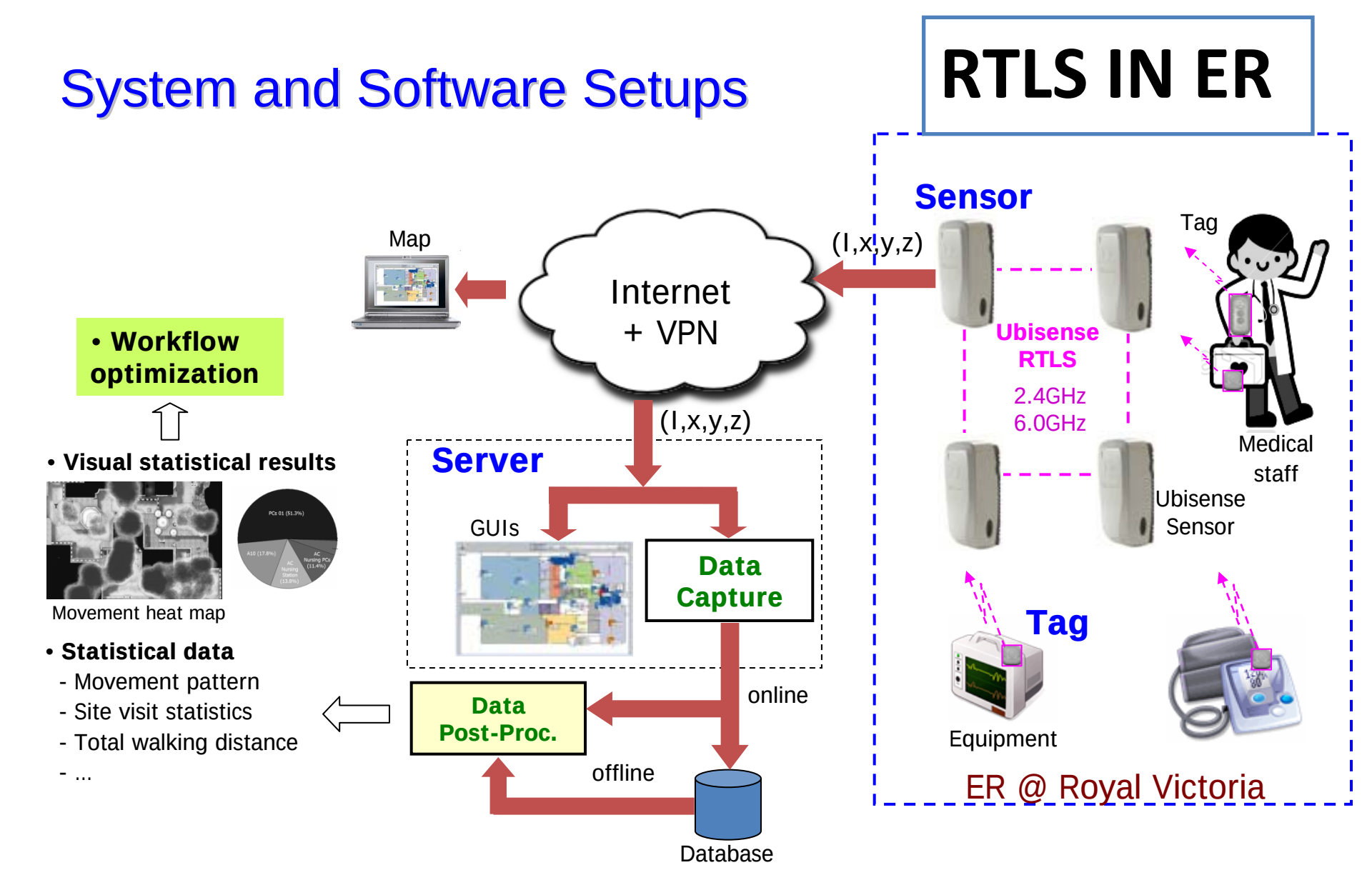
A humble clinician's perspective

- Simple to use, good battery life
- Good ergonomics
- Gives real-time, accurate information
- reduce interpretation error (semantic persistence)
- Measures what is measurable
  - I'm feeling hot today → core body temp in C
- Security & privacy are paramount
- (Sometimes a wired solution is better)

My wish list

- Seamless, reliable connectivity
- Context-aware systems
  - voice *vs* data
  - urgent real-time *vs* store & forward
  - push *vs* pull
- Location sensing (3 & 4D)
- Process
  - Fits my workflow, unless over-ridden by safety issues
  - Strong authentication is mandatory, biometrics best (something you have, know, are)

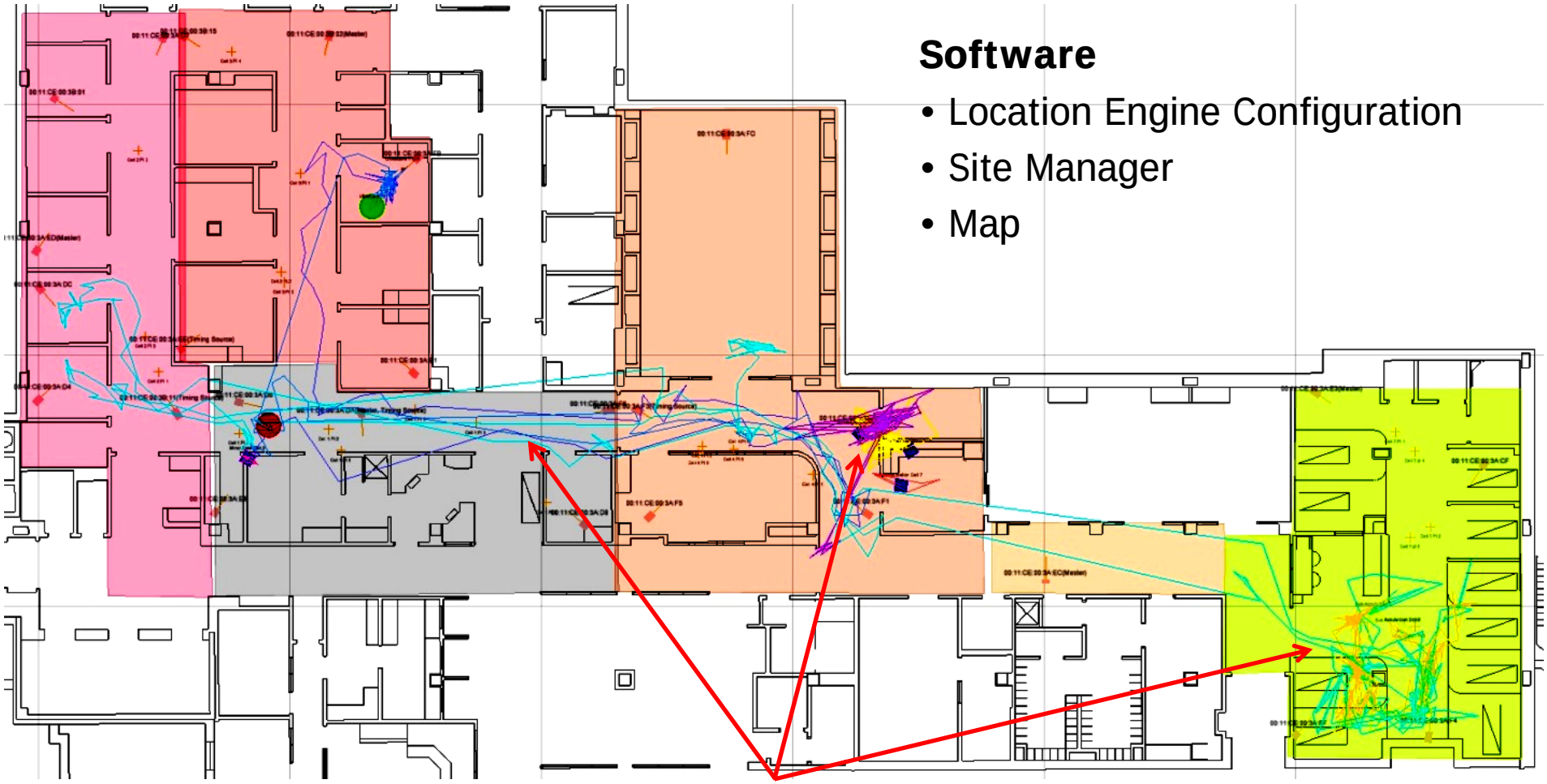
System and Software Setups



Broadband Communications Lab @ McGill

Localization System Configuration

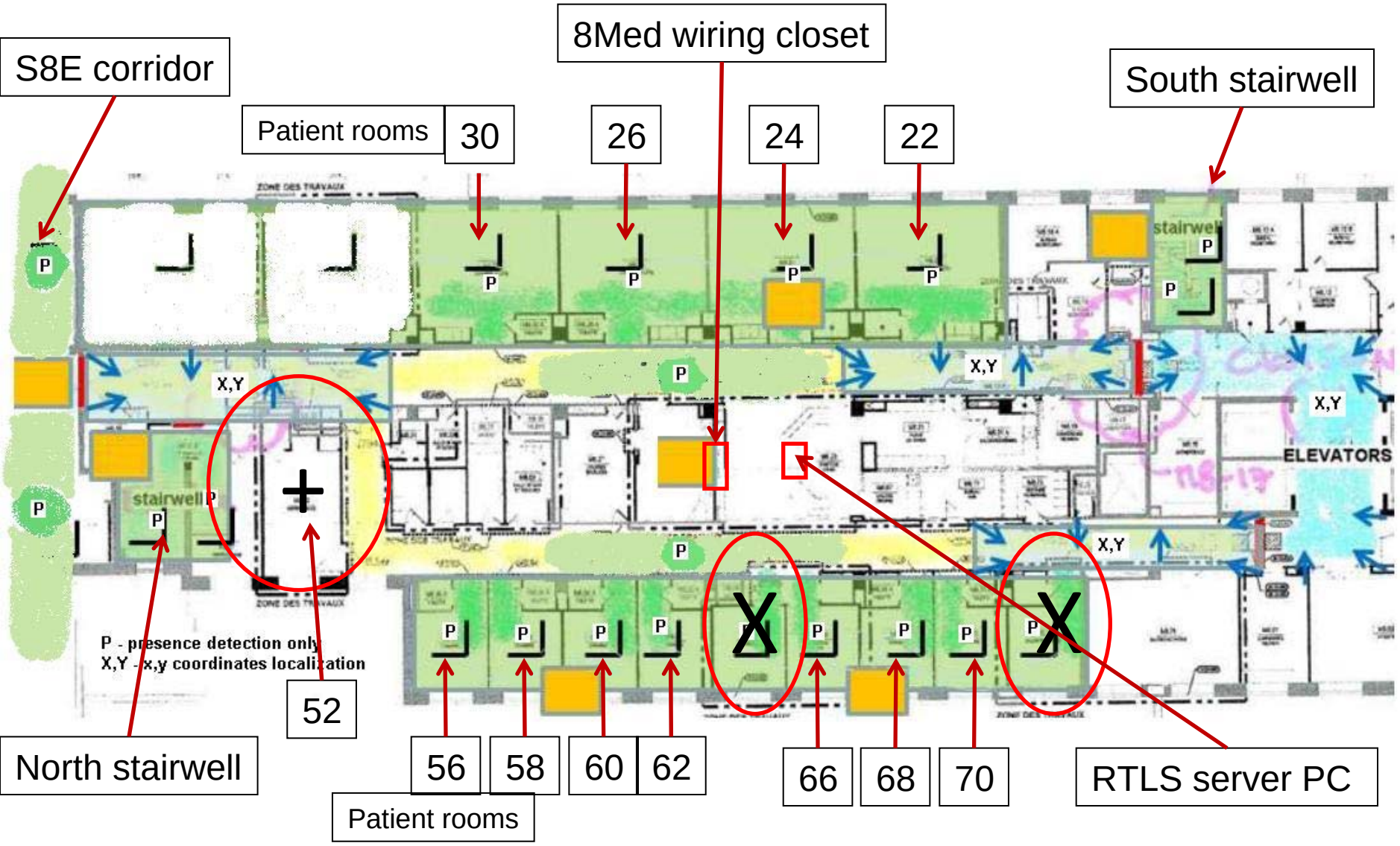
System and Software Setups



Software

- Location Engine Configuration
- Site Manager
- Map

Trails of moving tags in the ER of Royal Vic hospital



RTLS in Geriatrics

Cautionary notes apply

- Murphy's Law
- Software errors (Therac-25 radiation treatment machine story)
- Bad user design & un-intended errors
- Failure of Cedars Sinai CPOE implementation
- Increased infant deaths in Pittsburgh PICU
- Heating of pacemaker wires in MRI machines

Summary

- Technological advances will continue at an *exponential* rate
- Application of ICT to health care will be driven mostly by a non-altruistic model (safety, quality, cost)
- Next 10-15 years will probably see a convergence of genetics, nanotechnology and robotics (iMe)
- Futurists see a world where intelligence can soon be modelled and improved to the point where non-biologic exceeds human intelligence

Summary

- Smart systems anticipate problems before they happen and act accordingly to avoid the event
- Evolving concepts: collective; networked; wireless; global; recursive; automated learning; uploadable
- Shift from disease and illness to wellness
- *Yes, Virginia there is an app for that!*

The voyage begins!
Thank you.

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