

# SCIENTIFIC CHALLENGES IN DESIGNING AND IMPLEMENTING PUBLIC HEALTH DATA MANAGEMENT AND COMMUNICATION SYSTEMS: The case of HAITool – An Antibiotic Stewardship Decision-Support System

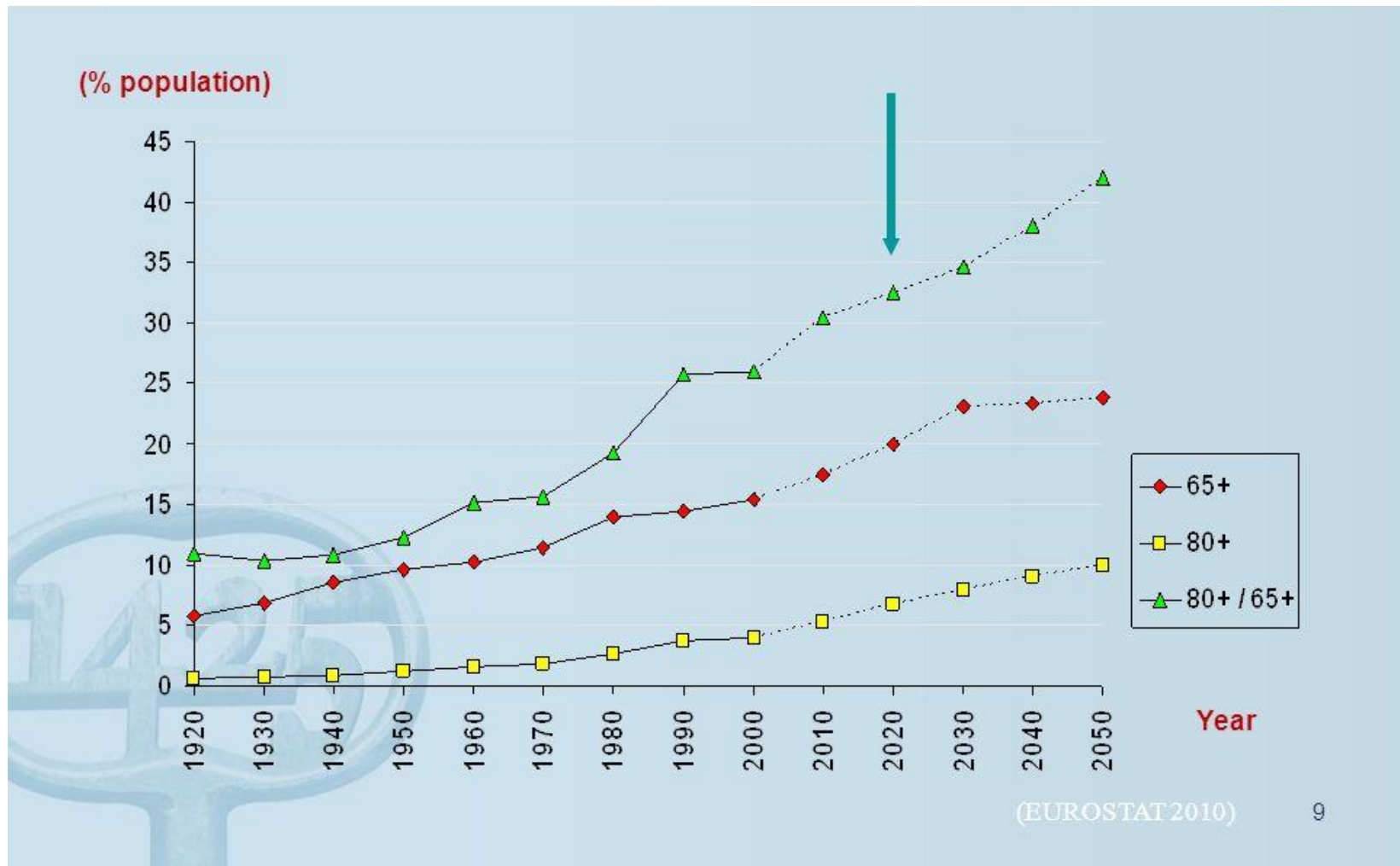
Luís V. Lapão, Alexandra Simões, João Gregório, Mélanie Maia,  
Pedro Póvoa, Isabel Couto, Miguel Viveiros

4 Julho 2017

# Disclosure of Interest

**None Declared.**

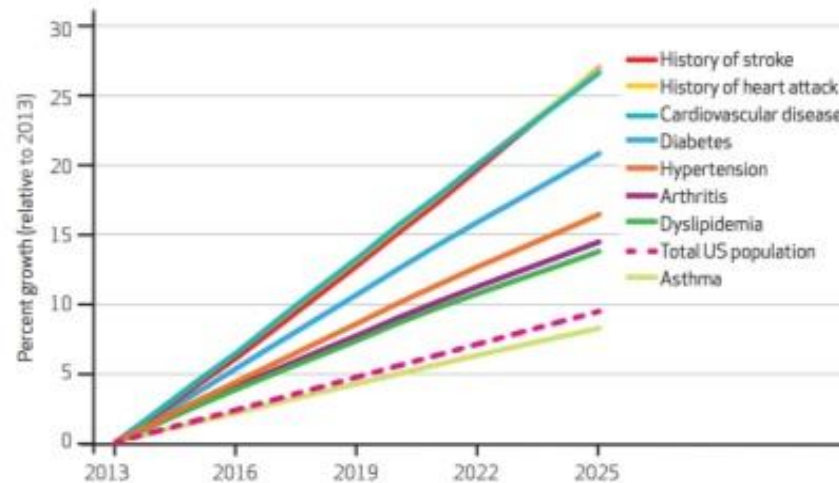
# FACT #1: POPULATION IS AGEING, GLOBALLY



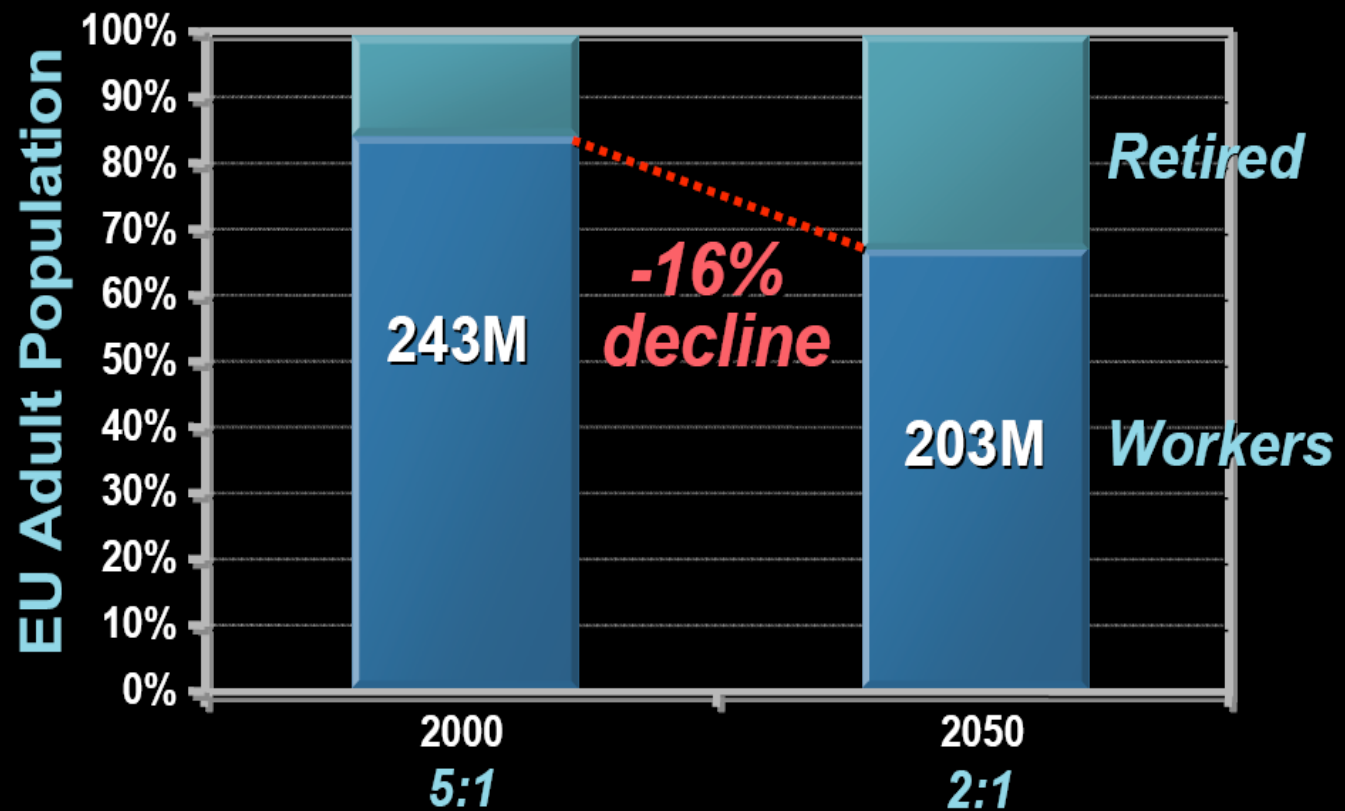
# FACT #2: PEOPLES' (not good) BEHAVIOUR IS LEADING TO CHRONICAL CONDITIONS PREVALENCE



Projected Growth in Population with Chronic Conditions  
2013-2025



## FACT #3: THE GROWING *DEFICIT* OF PROFESSIONALS



The New York Times, April 4, 2004

# FACT #4: CHRONIC DISEASES (MULTIMORBIDITY) ALREADY REACHING TWO THIRDS OF HEALTHCARE COSTS

1980

**\$245 000 Million**

*an average of \$1,066 per person*

2001

**\$1.4 000 000 Million**

*an average of \$5,039 per person*

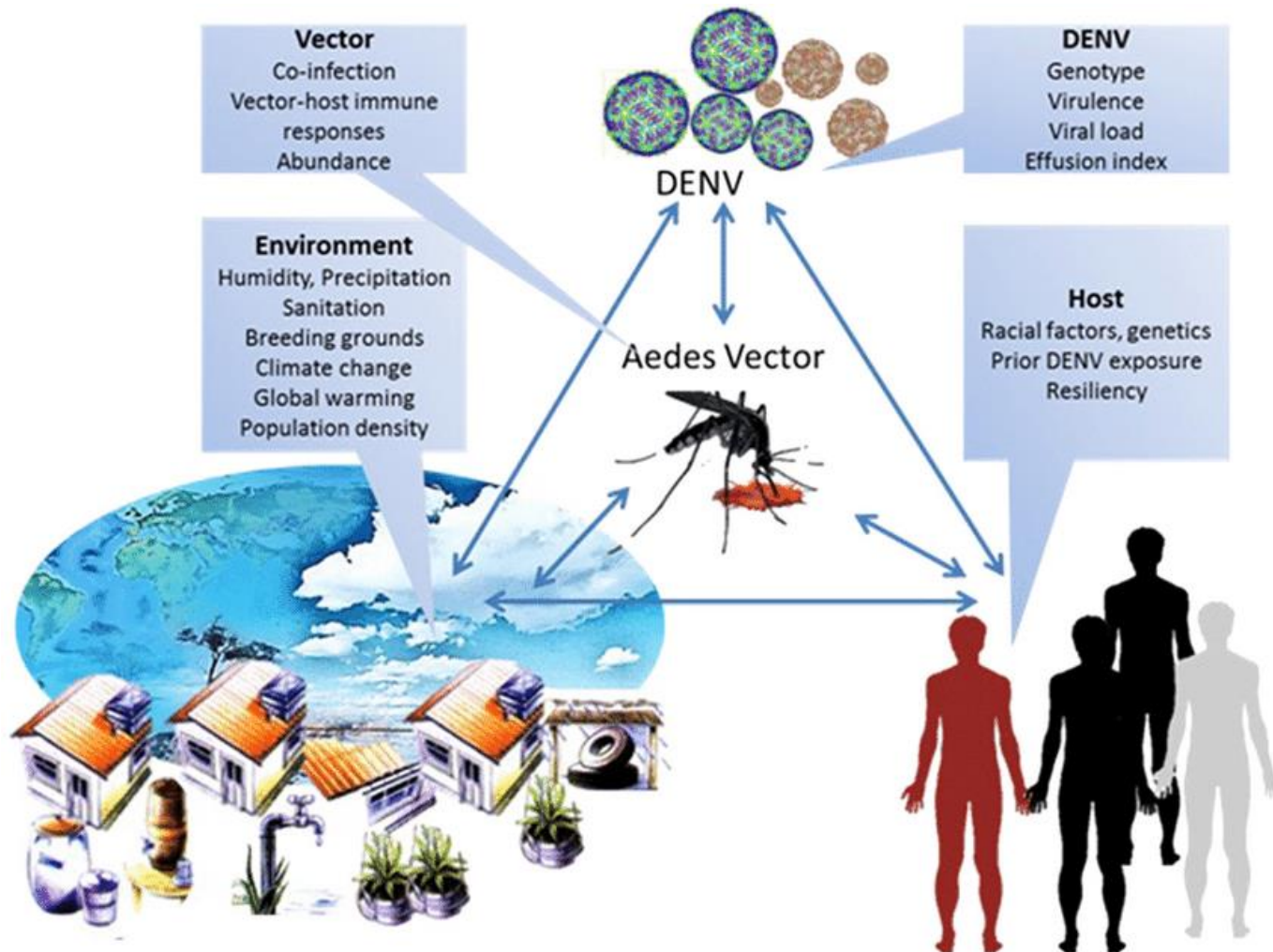
2011

**\$2.8 000 000 Million**

*an average of \$9,216 per person*



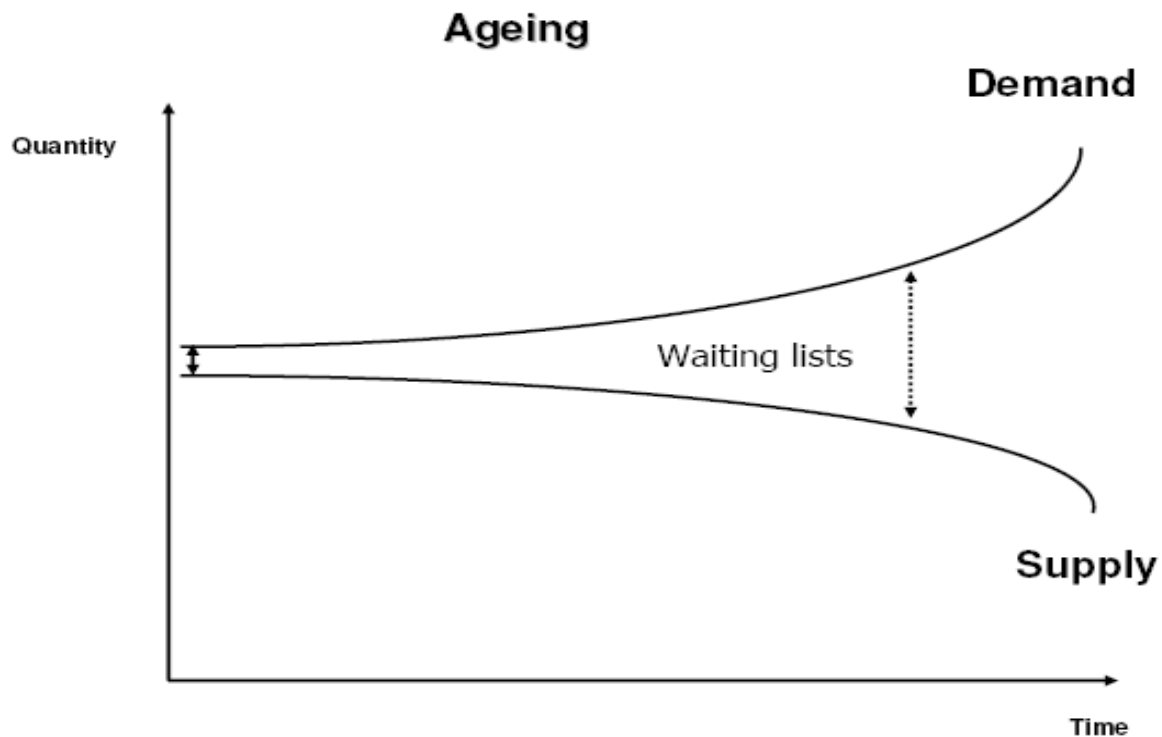
# FACT #5: CLIMATE CHANGE AND GLOBALIZATION ARE CREATING THE CONDITIONS TO MORE INFECTION DISEASES SPREADING



# HOW SHOULD WE DEAL WITH THIS GROWING GAP?

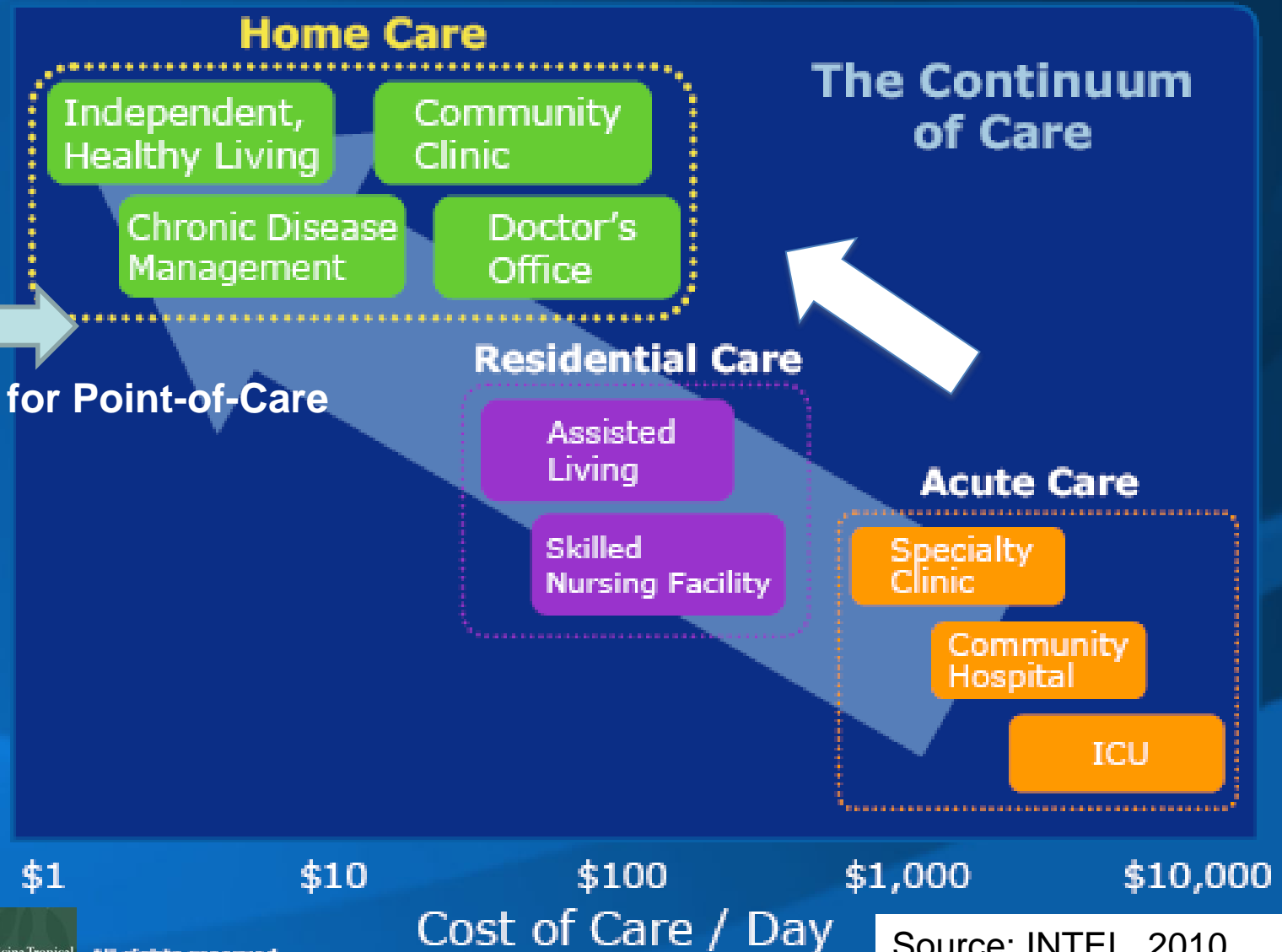
Ageing will cause a dramatic gap!

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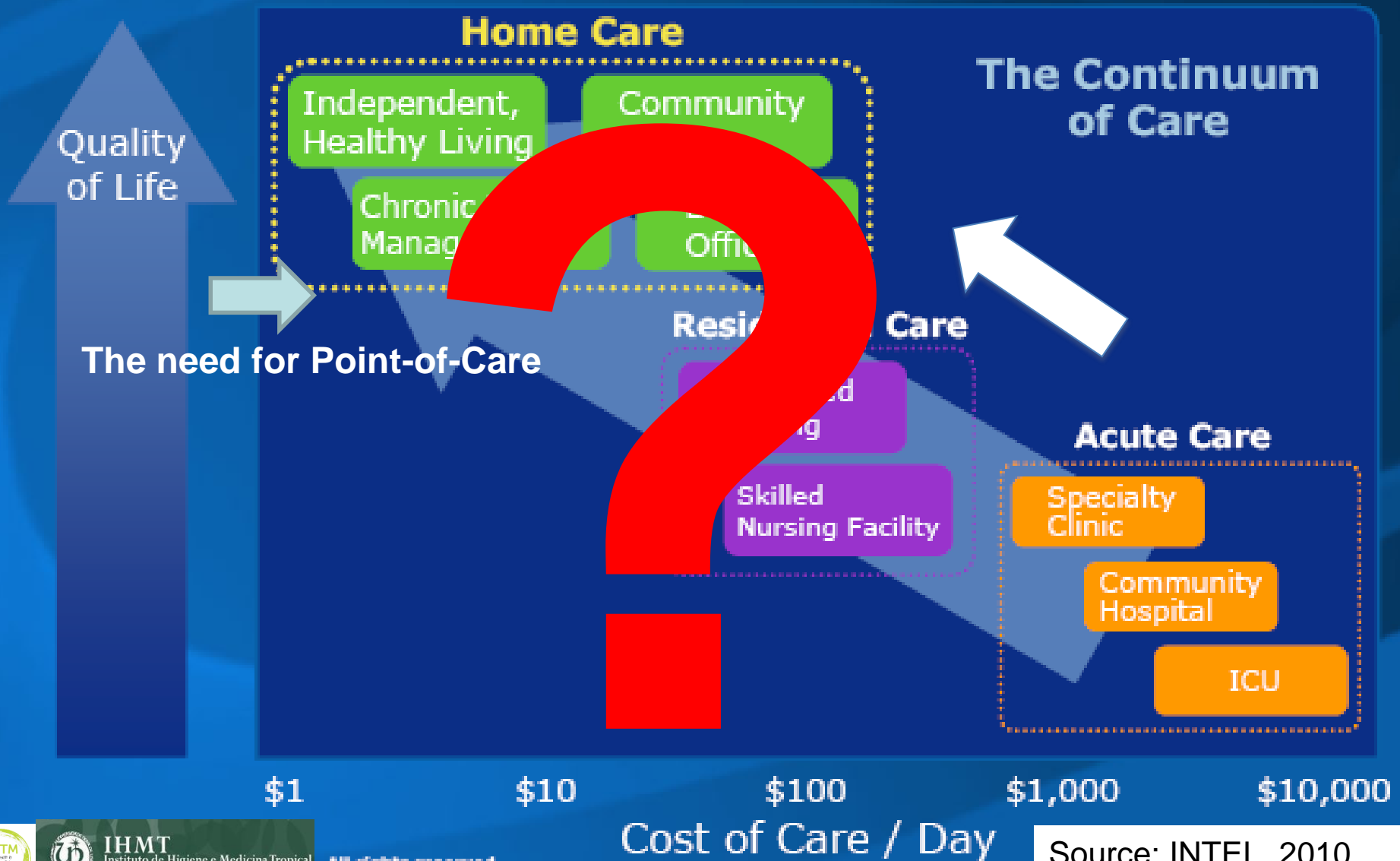




# ...MOVING FROM A REACTIVE SYSTEM TO A MORE PRO-ACTIVE SYSTEM

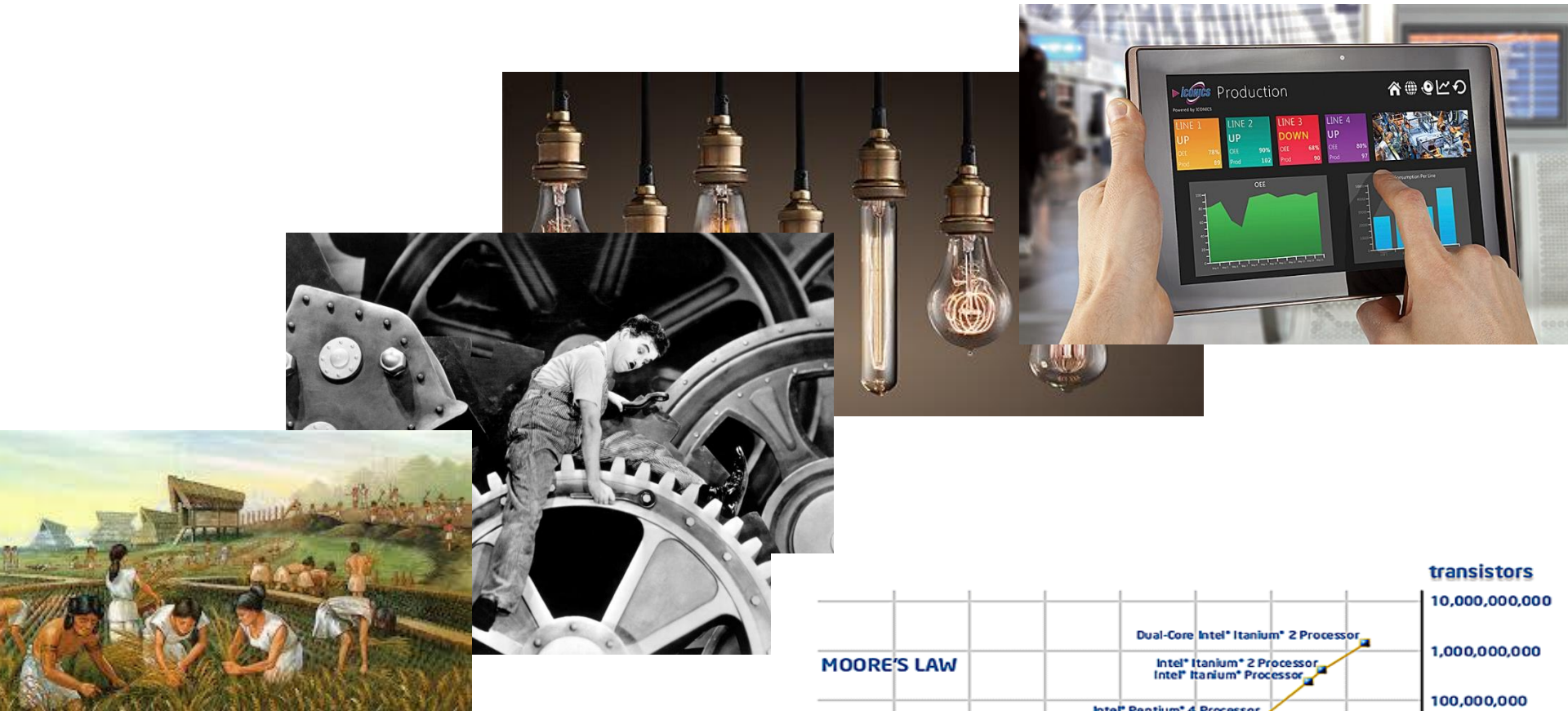


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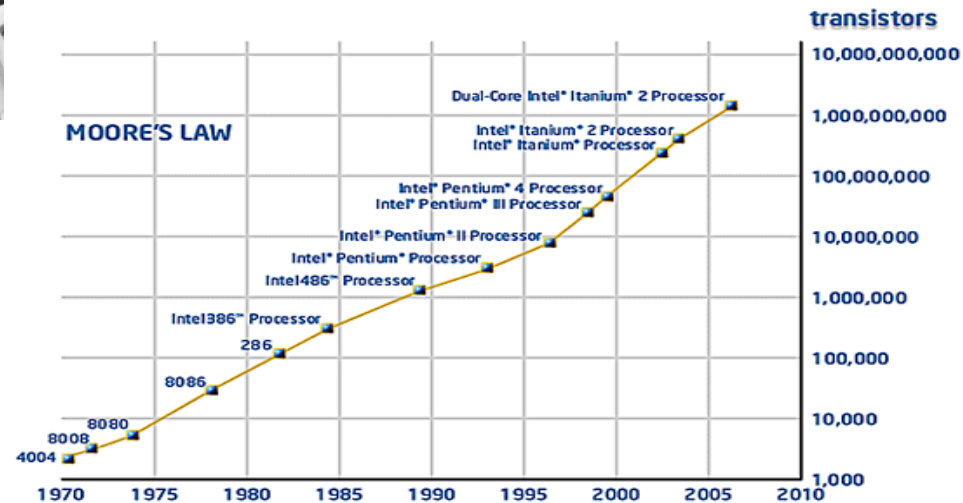


# THE DIGITAL REVOLUTION IS HERE...

After Agriculture, Industrial, and Electrical/Ignition Motor Revolutions



This technological revolution could have a significant impact on Health...



...NEW EQUIPMENTS ARE ARRIVING WITH THE POTENTIAL TO LEVERAGE THE CAPACITIES OF HEALTHCARE PROFESSIONALS ... MORE QUALITY AND PRODUCTIVITY...

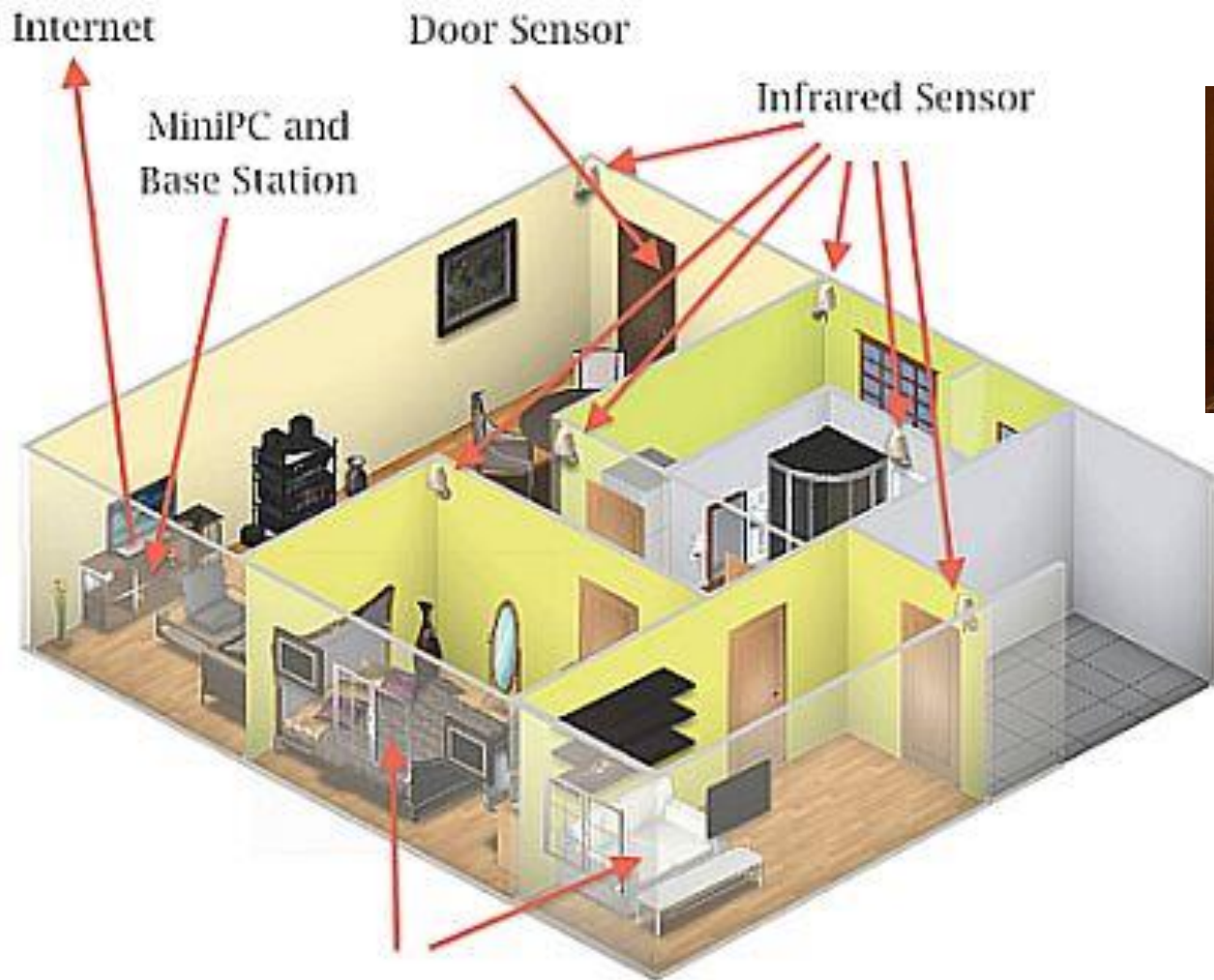




# ... AND REACH MORE PEOPLE AT HOME

## THE CHALLENGE OF ORGANIZING NEW SERVICES TO ADDRESS CHRONIC PATIENTS NEEDS

Ambient Assisted Living – Project COST AAL APELLE – European Union

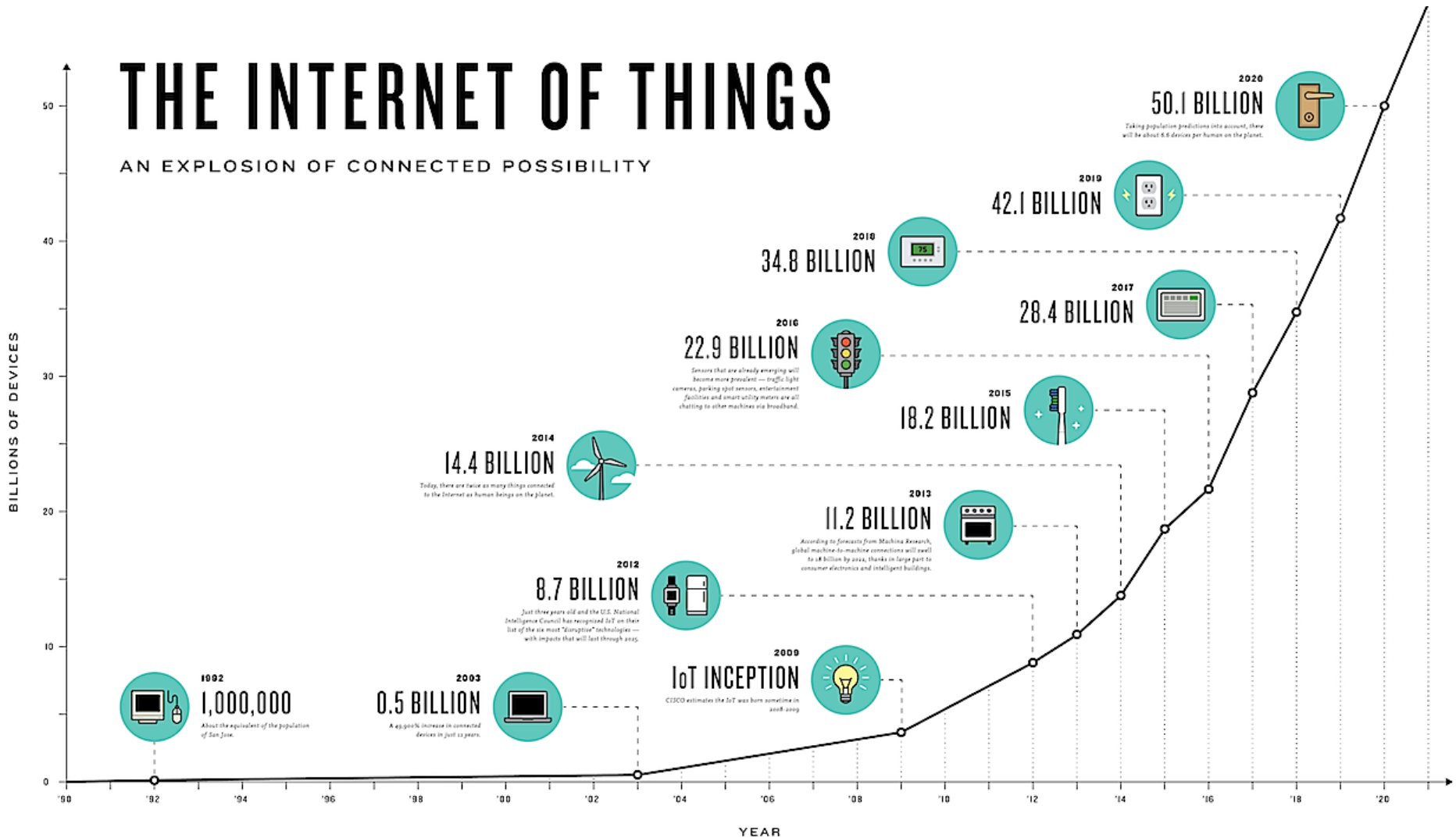


# INTERNET OF THINGS IN HEALTH SHOULD BE FRAMED WITHIN THE HEALTHCARE SYSTEM CONTEXT

Services, Technology Management, Security...Ethics

## THE INTERNET OF THINGS

AN EXPLOSION OF CONNECTED POSSIBILITY





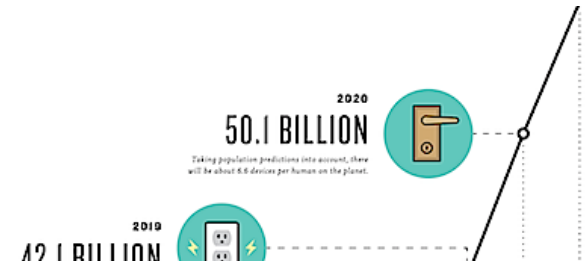
# INTERNET OF THINGS IN HEALTH SHOULD BE FRAMED WITHIN THE HEALTHCARE SYSTEM CONTEXT

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AN EXPLOSION OF CONNECTED POSSIBILITY

Marques et al. *BMC Medical Informatics and Decision Making* (2017) 17:15  
DOI 10.1186/s12911-017-0410-z



BMC Medical Informatics and  
Decision Making

RESEARCH ARTICLE

Open Access



How can information systems provide support to nurses' hand hygiene performance? Using gamification and indoor location to improve hand hygiene awareness and reduce hospital infections

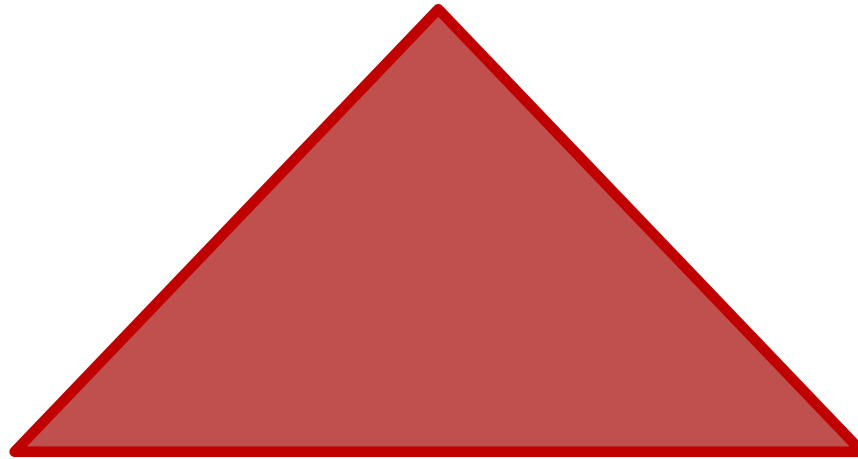
Rita Marques<sup>1,2</sup>, João Gregório<sup>1</sup>, Fernando Pinheiro<sup>3</sup>, Pedro Póvoa<sup>3,4</sup>, Miguel Mira da Silva<sup>2</sup> and Luís Velez Lapão<sup>1\*</sup>

**SOCIETY CHANGE**



**HEALTHCARE SERVICES DIGITAL TRANSFORMATION**

**Digital Technologies**

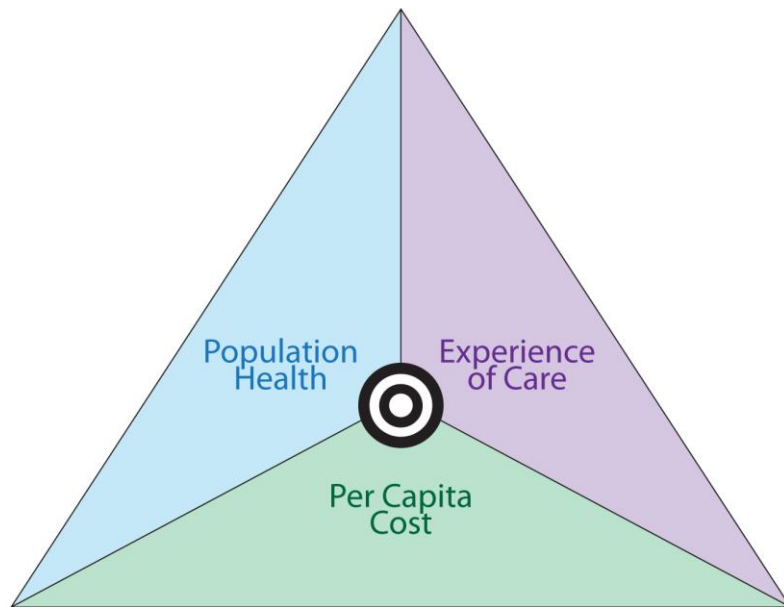


**Patient Management/  
Processes Knowledge**

**Health  
Workforce  
Strengthening**

# THEREFORE, PUBLIC HEALTH MUST INCREASE THEIR SOPHISTICATION IN INFORMATION MANAGEMENT

(Baker et al. 2016)



**Triple Aim**



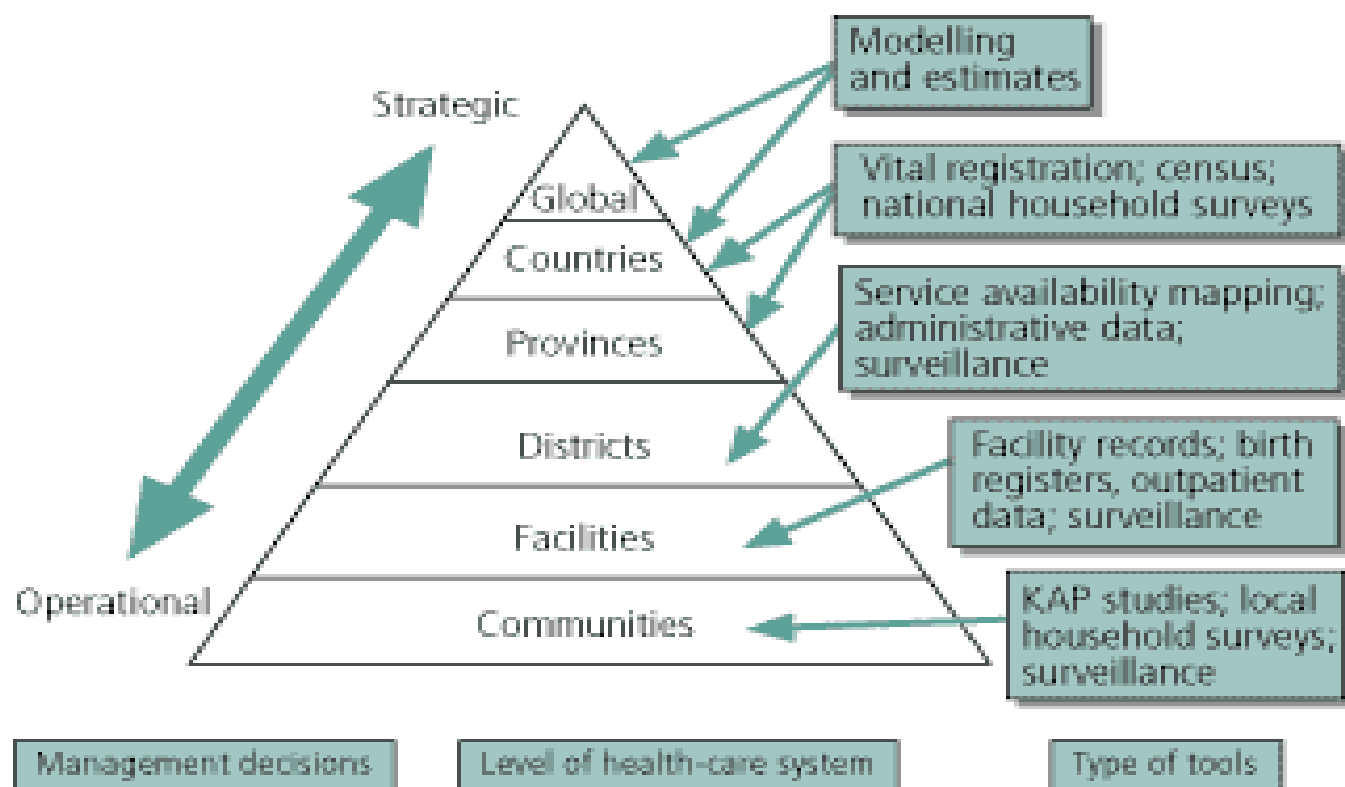
## CO-DESIGN & ALIGNMENT with CLINICAL PROCESSES



# PUBLIC HEALTH INFORMATION MANAGEMENT

AbouZahr & Boerma 2005

Fig. 1. Data needs and sources at different levels of the health-care system

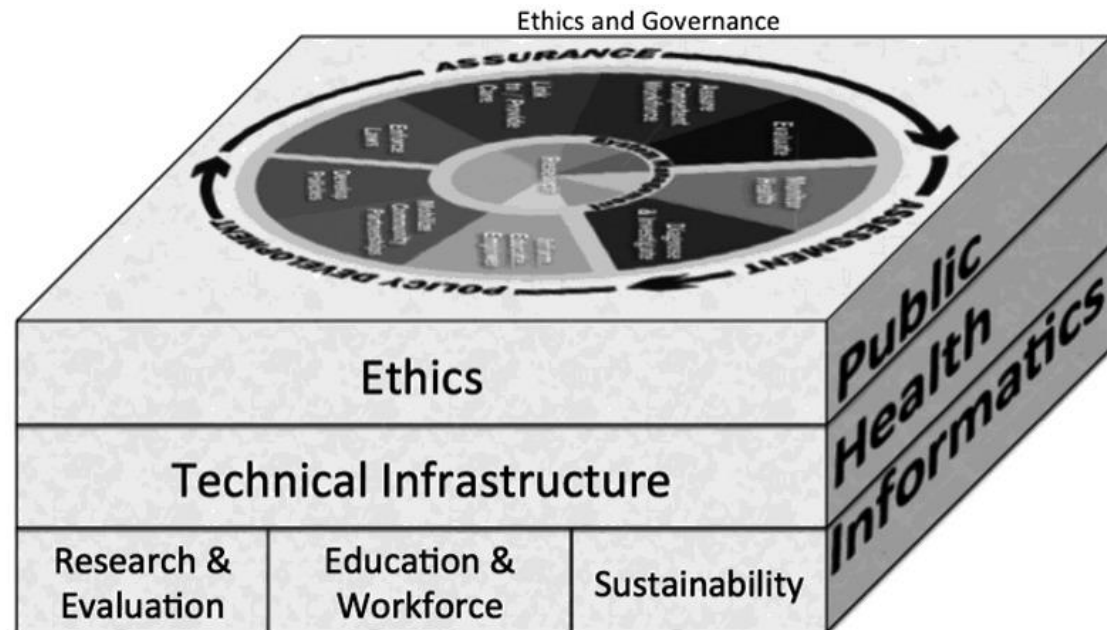
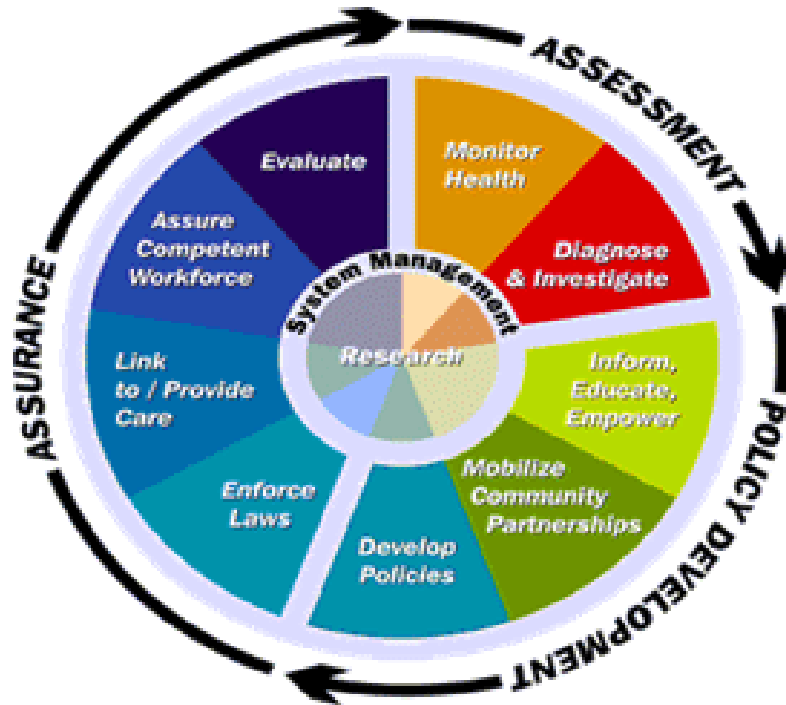


KAP = Knowledge, attitudes and practices.

WHO 05.43

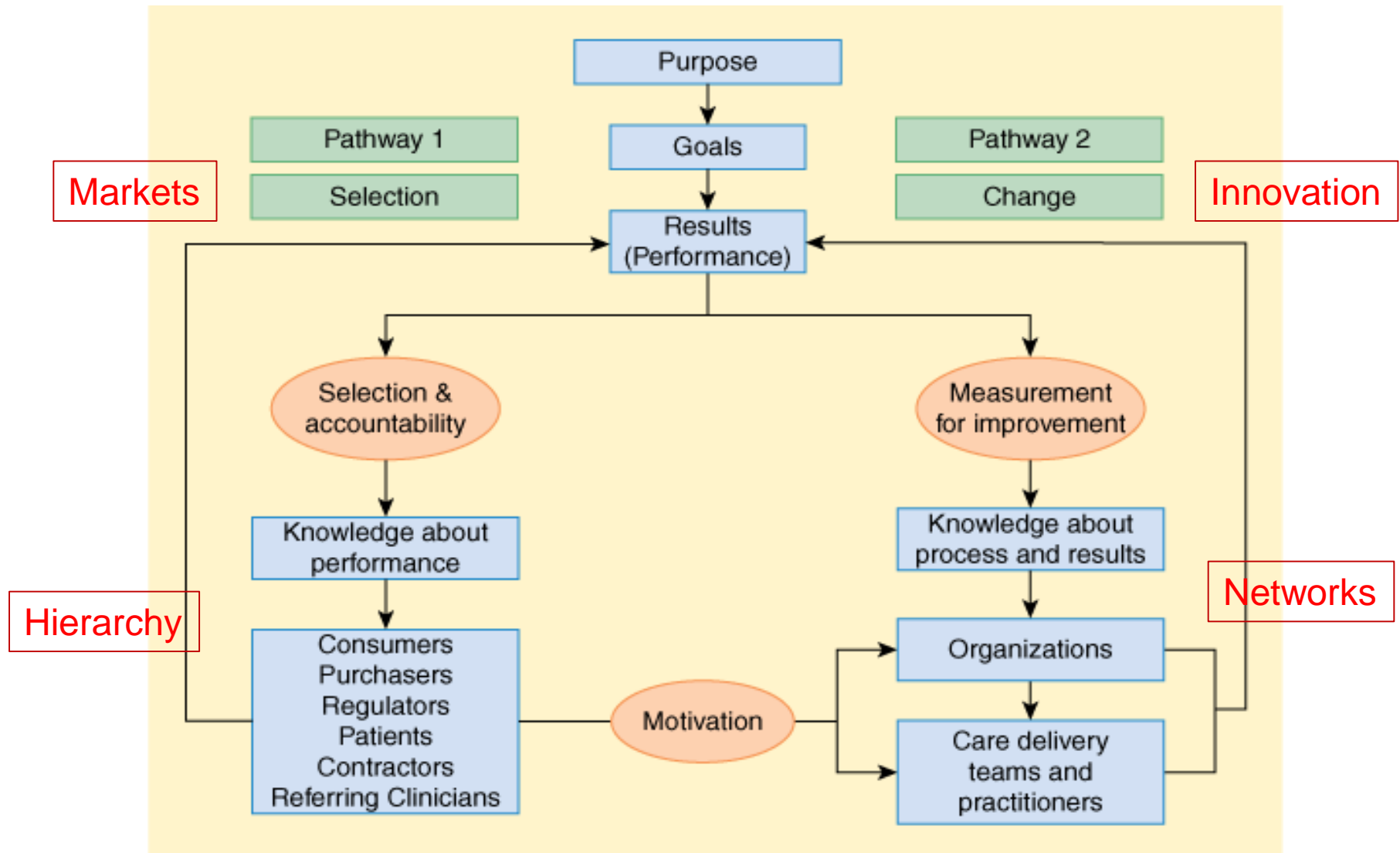
# TO SUPPORT IT...PUBLIC HEALTH INFORMATICS

(Dixon, Kharrazi & Lehmann, 2015)





# HOW TO GET FROM HEALTH INFORMATION TO QUALITY IMPROVEMENT? TRANSLATION!



Source: Wachter RM: *Understanding Patient Safety, 2nd Edition*:  
[www.accessmedicine.com](http://www.accessmedicine.com)

# The (BIG) problem

## Healthcare-associated infections (HAIs)

- Infections acquired during the course of healthcare treatment
- Important cause of morbidity and mortality



37.000



16M



7000M

World Health Organization, 2011

## Antibiotics and antibiotic resistance

Inappropriate  
prescription

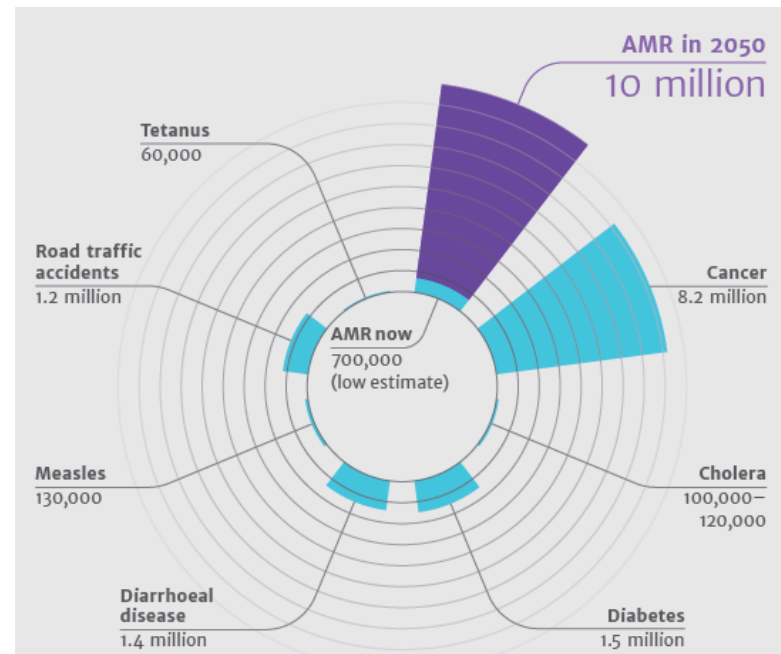


Antibiotic resistant  
microorganisms



Increase morbidity,  
mortality, and HAIs costs

Huttner, A., Antimicrob Resist Infect Control, 2013



The Review on Antimicrobial Resistance, Chaired by Jim O'Neill, December 2014

**Antibiotic resistance will kill 10 million people in 2050!**

# ...AND TACKLE A SET OF “COMPLEX” BARRIERS

Hospital organisation, management, and structure for prevention of health-care-associated infection: a systematic review and expert consensus. *The Lancet Infectious Diseases*, Nov 2014

## Hospital organisation, management, and structure for prevention of health-care-associated infection: a systematic review and expert consensus



Walter Zingg, Alison Holmes, Markus Dettenkofer, Tim Goetting, Federica Secci, Lauren Clack, Benedetta Allegranzi, Anna-Pelagia Magiorakos, Didier Pittet, for the systematic review and evidence-based guidance on organization of hospital infection control programmes (SIGHT) study group\*

Despite control efforts, the burden of health-care-associated infections in Europe is high and leads to around 37 000 deaths each year. We did a systematic review to identify crucial elements for the organisation of effective infection-prevention programmes in hospitals and key components for implementation of monitoring. 92 studies published from 1996 to 2012 were assessed and ten key components identified: organisation of infection control at the hospital level; bed occupancy, staffing, workload, and employment of pool or agency nurses; availability of and ease of access to materials and equipment and optimum ergonomics; appropriate use of guidelines; education and training; auditing; surveillance and feedback; multimodal and multidisciplinary prevention programmes that include behavioural change; engagement of champions; and positive organisational culture. These components comprise manageable and widely applicable ways to reduce health-care-associated infections and improve patients' safety.

### Introduction

Health-care-associated infections (HAIs) affect millions of patients worldwide every year.<sup>1,2</sup> In the European Union (EU) alone, the estimated number of HAIs is 4 544 100 annually, leading directly to around 37 000 deaths and 16 million extra days of hospital stay.<sup>1</sup> Several evidence-

arrangements to implement infection-control programmes, including access to qualified infection-control professionals and the roles of management and advisory committees; targets and methods of HAI surveillance, outbreak management, and the role of feedback; methods and effectiveness of educating and training health-care

*Lancet Infect Dis* 2014

Published Online  
November 11, 2014  
[http://dx.doi.org/10.1016/S1473-3099\(14\)70854-0](http://dx.doi.org/10.1016/S1473-3099(14)70854-0)

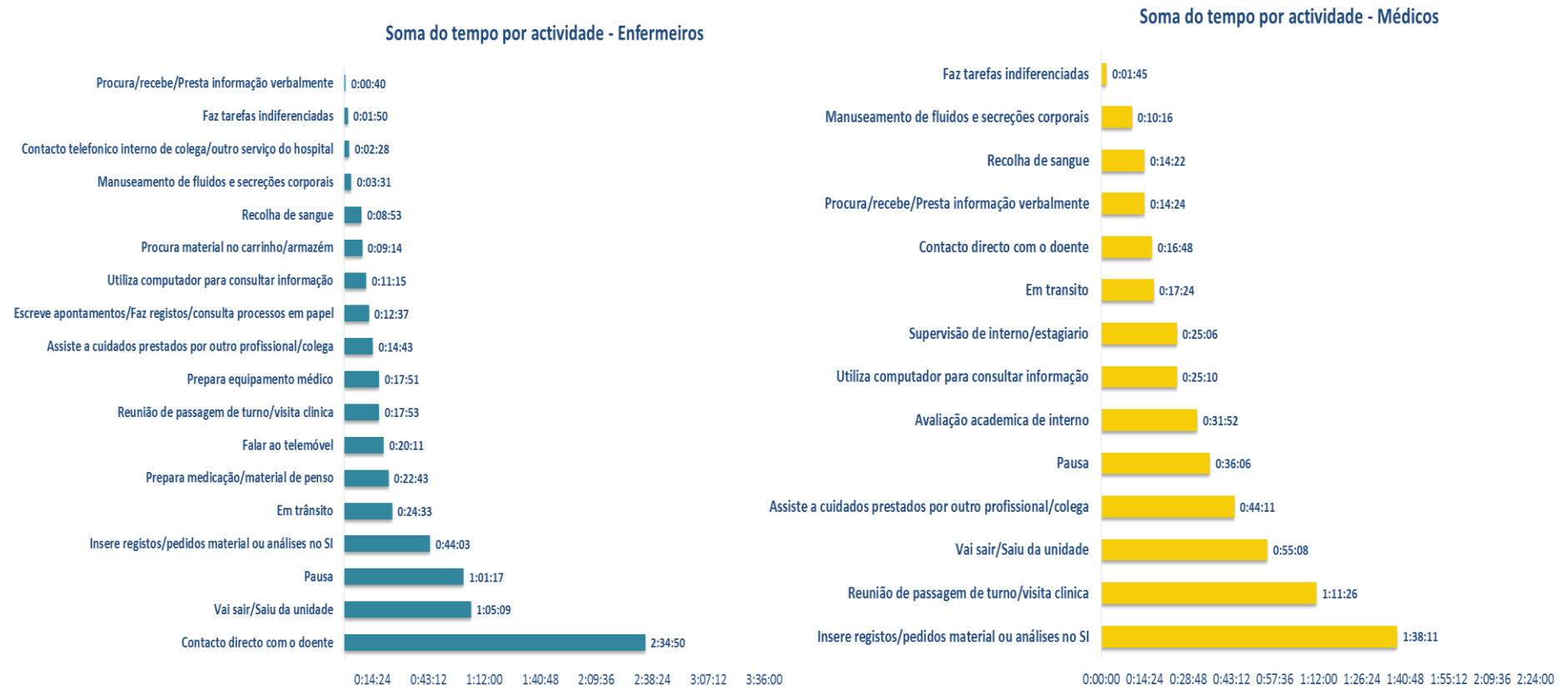
\*Further contributors are listed in the Acknowledgments section

Infection Control Programme, University of Geneva Hospitals and Faculty of Medicine, Geneva, Switzerland

(W Zingg MD, L Clack, Prof D Pittet MD); Infection Control Programme, Imperial College London, London, UK (Prof A Holmes MD, F Secci PhD); Department of Environmental Health Science, University Hospital of Freiburg, Freiburg,

# WHY HEALTH PROFESSIONALS “DO NOT HAVE TIME”?

## Nurses and Physicians observed use of time (per activity)



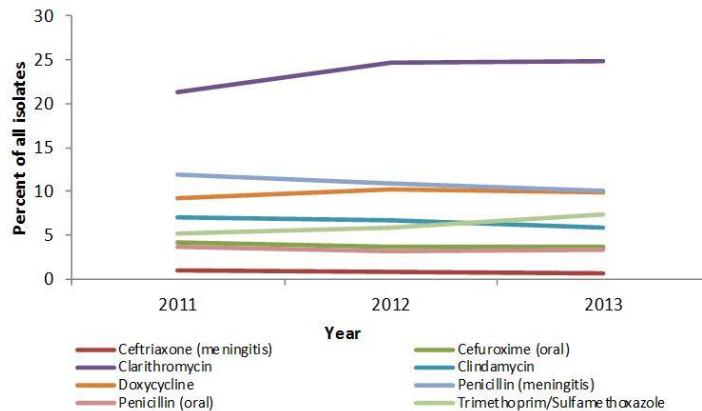
		Profissionais observados	Frequen cy	Valid Percent
Serviço X	Valid	Enfermeiro	79	59,8
		Médico	53	40,2
		Total	132	100,0

	MULTITASKING			
Unidade onde decorreu observação			Frequen	Valid
Serviço X	Valid		cy	Percent
		Não	116	87,9
		Sim	16	12,1
		Total	132	100,0

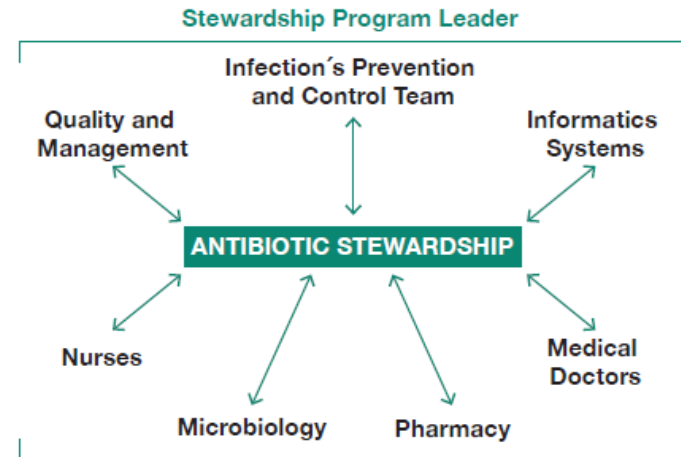
# To solve the problem...

## better information management

### Surveillance system



### Antibiotic Stewardship Programs

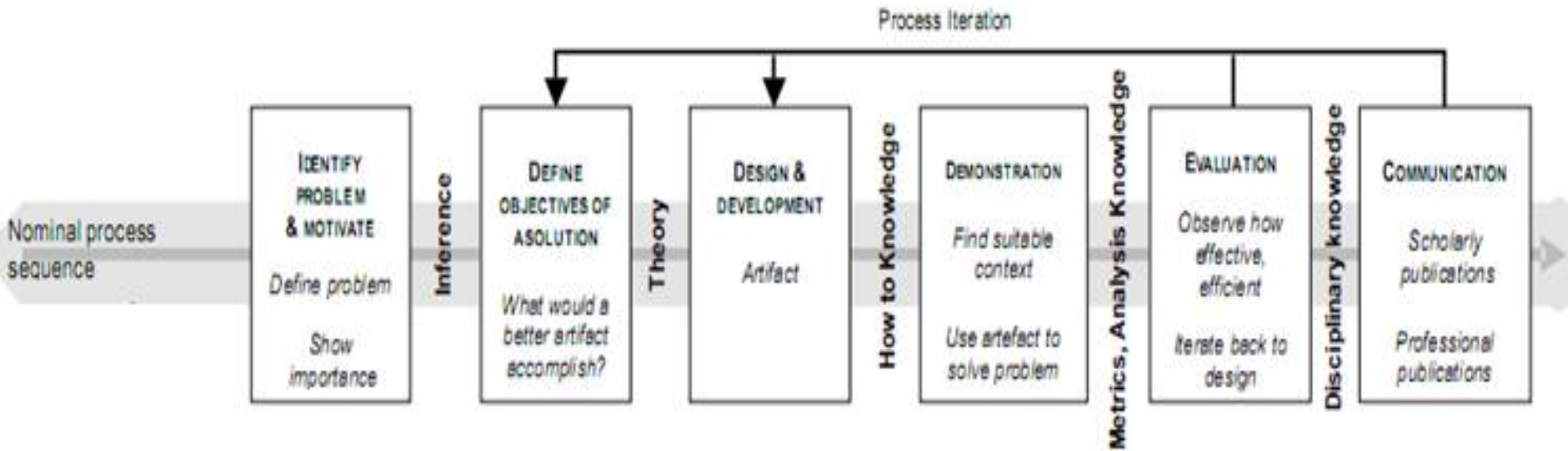


- ✓ Increase the amount of information available
- ✓ Improve decision process
- ✓ Improve quality of care

- ✓ Decrease prevalence of antibiotic resistance bacteria
- ✓ Contribute to optimization of antibiotic prescription
- ✓ Promote antibiotic adequate use
- ✓ Reduce costs

# Methods

## DESIGN SCIENCE RESEARCH METHODOLOGY IS AN “IMPLEMENTATION” RESEARCH METHOD



Peffers et al., 2007

Epistemology:

**We can intervene in the world to improve it**





## Lean in the Health Management: An Opportunity to Improve Focus on the Patient, Respect for Professionals and Quality in the Health Services

Luís Velez LAPÃO✉<sup>1</sup>

Acta Med Port 2016 Mar;29(3):xxx-xxx • <http://dx.doi.org/10.20344/amp.6615>

**Palavras-chave:** Assistência Centrada no Doente; Eficiência Organizacional; Gestão da Qualidade Total.

**Keywords:** Efficiency, Organizational; Patient-Centered Care; Total Quality Management.

Os casos de Flinders Medical Center (Austrália), Royal Bolton (UK), ThedaCare e Virginia Mason (USA) são exemplos de hospitais que conseguiram melhorar o seu desempenho através da utilização de metodologias Lean. Todavia, nem sempre o processo é tão fácil como aparenta. Não é que a aplicação de Lean seja difícil mas exige condições

procurar aprender com o que se faz e actuar para a sua melhoria contínua.<sup>7</sup> Isto diz respeito aos gestores, mas também aos profissionais de saúde e aos doentes.

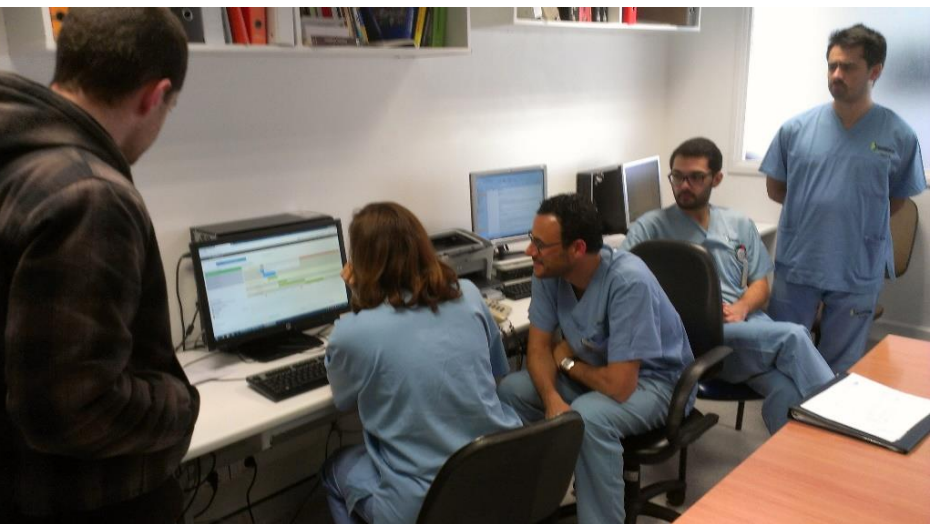
Há um aspecto central na teoria da gestão que é o acesso à informação, sem a qual não é possível compreender como a organização está a funcionar e corrigir os erros

**A UNIVERSAL TRUTH:**  
**NO HEALTH WITHOUT**  
**A WORKFORCE**



# ENGAGING THE PROFESSIONALS

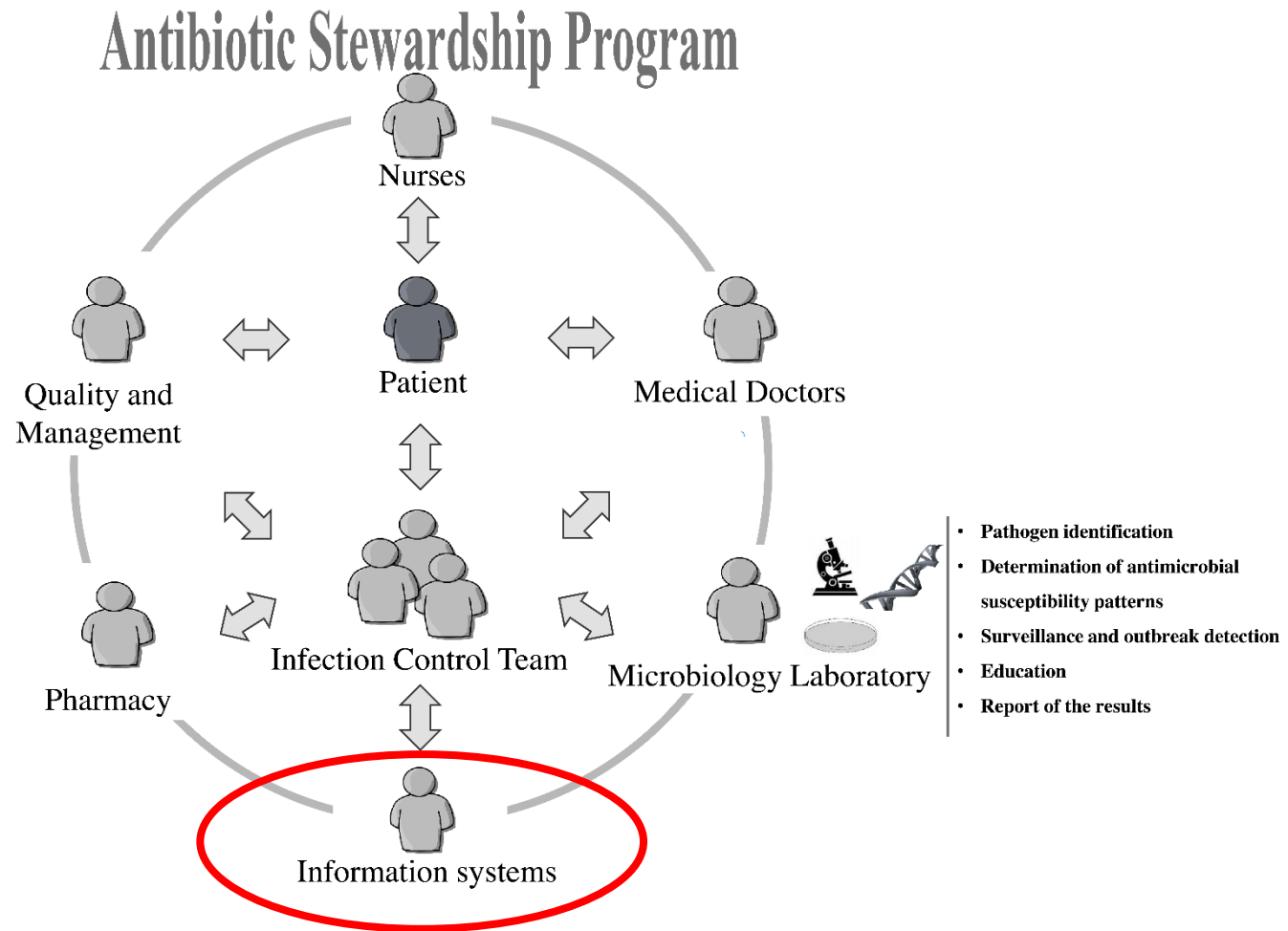
Participative Design Theory (Sjöberg & Timpka, JAMA 1998)





# Considering a Co-Design Approach...

Antibiotic Stewardship is a Team Building Endeavour...



# Objectives

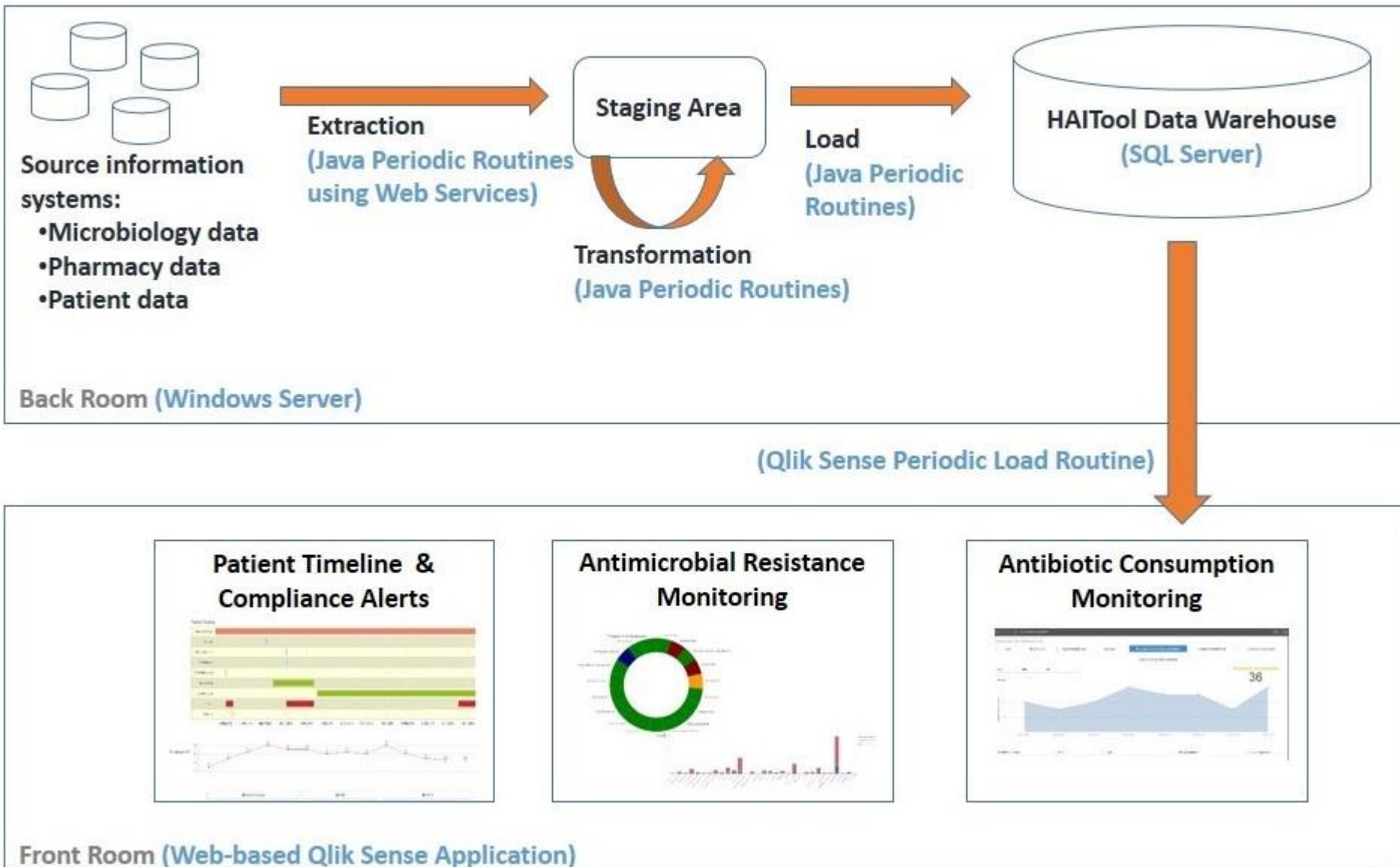
**To co-design and implement an information system, that impacts on antimicrobial resistance and antibiotic use (while supporting an Antibiotic Stewardship program).**

The **health information system** should be able to:

- ✓ Monitor antibiotic consumption
- ✓ Monitor antibiotic resistant bacteria
- ✓ Promote antibiotic prescription based on guidelines
- ✓ Improve physicians' prescription behavior



# Design & Development





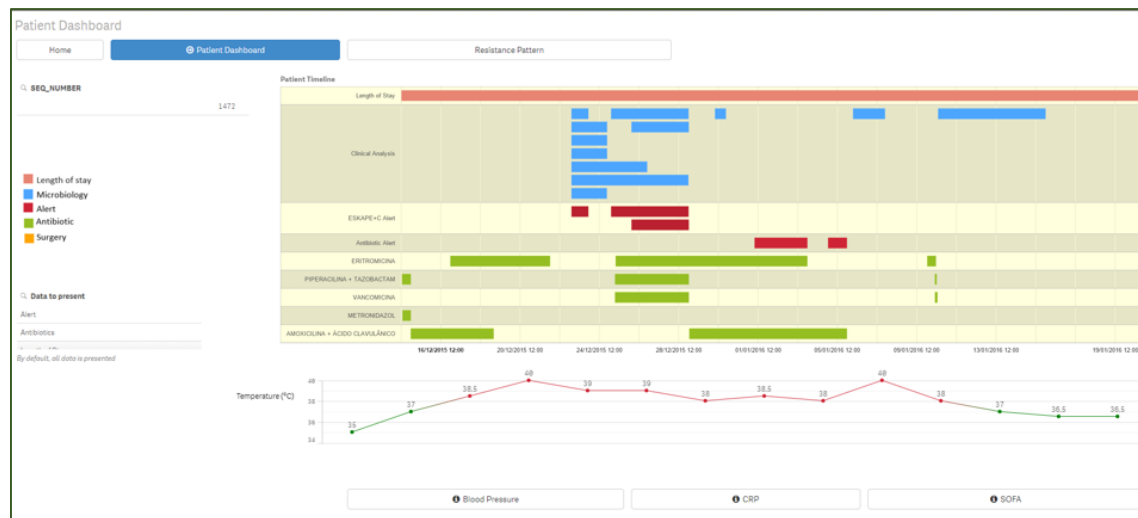
# HAITool:

A surveillance and decision-support system to help clinicians and infection control team dealing with HAIs and antibiotic use

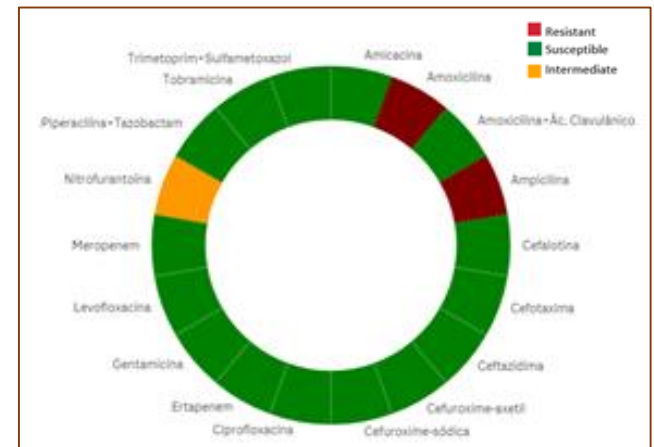
## Surveillance & Antibiotic Prescription - timeline

HAITool includes integrated views of patient, microbiology and pharmacy data, displayed in an innovative graphics presentation that enables the visualization of:

- Patient clinical evolution – Patient Timeline
- Antibiotic consumption trends
- Antibiotic resistant infections distribution
- Local antimicrobial susceptibility patterns



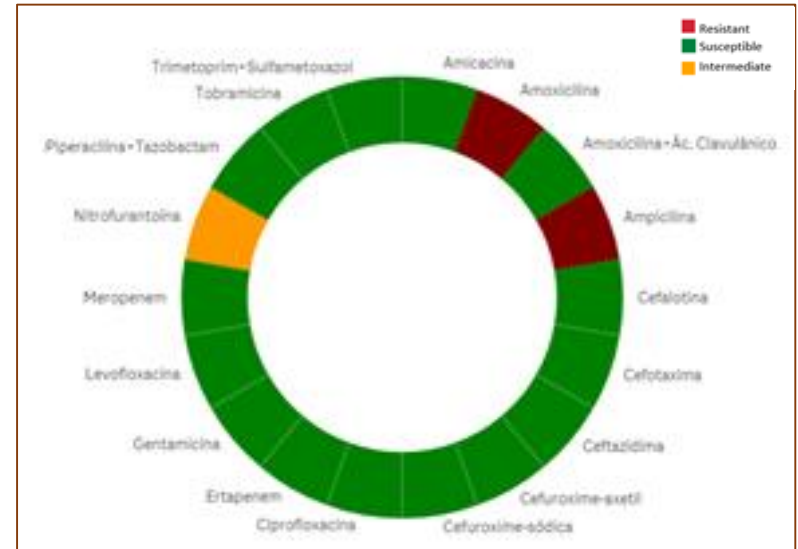
Patient Timeline visualization



Antimicrobial susceptibility patterns visualization

# HAITool: Local antimicrobial susceptibility patterns

- **Visualization of antibiotic resistance patterns** through simple and clear graphs
- Information can be filtered by microorganism, ward and patient
- A color code was used:
  - green color for antibiotics for which no resistance were found – these antibiotics are more likely to treat the patient
  - red color for antibiotics for which resistance were found – these antibiotics will not treat the patient
  - orange color for intermediate resistance cases



Antimicrobial susceptibility patterns visualization

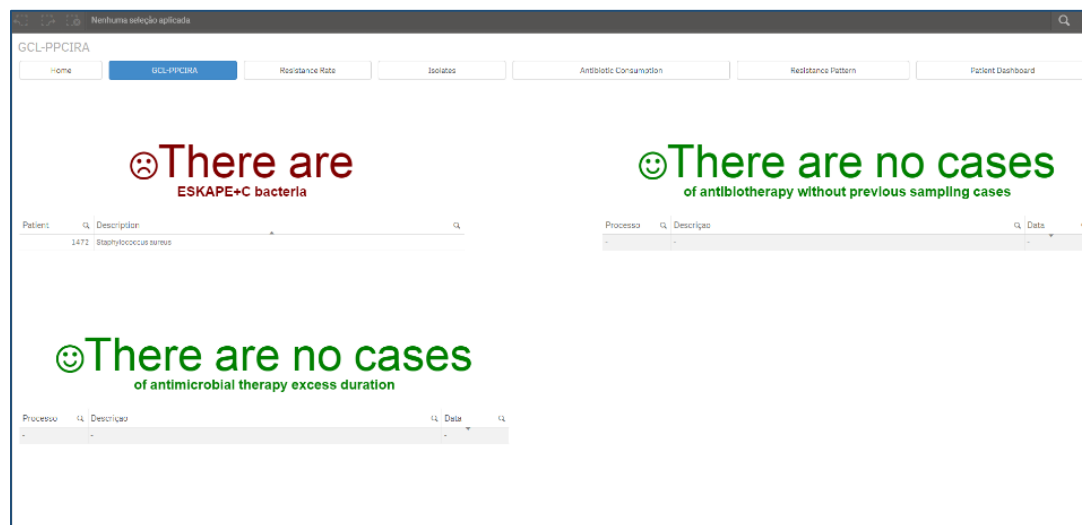
# HAITool

## Tableau d' Board - Decision support tool for antimicrobial prescription

- Alerts for antimicrobial therapy duration (an algorithm matches antimicrobial prescriptions and CDC rules/guidelines)
- Alerts for antimicrobial therapy not in accordance with microbiology lab results
- Antimicrobial therapy without previous microbiological culture

## Alerts for ESKAPE+C and multi-drug resistant microorganisms

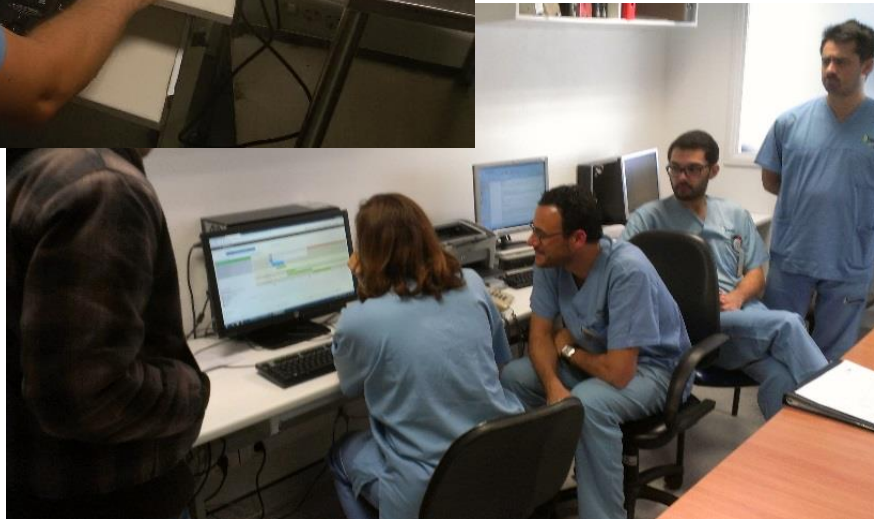
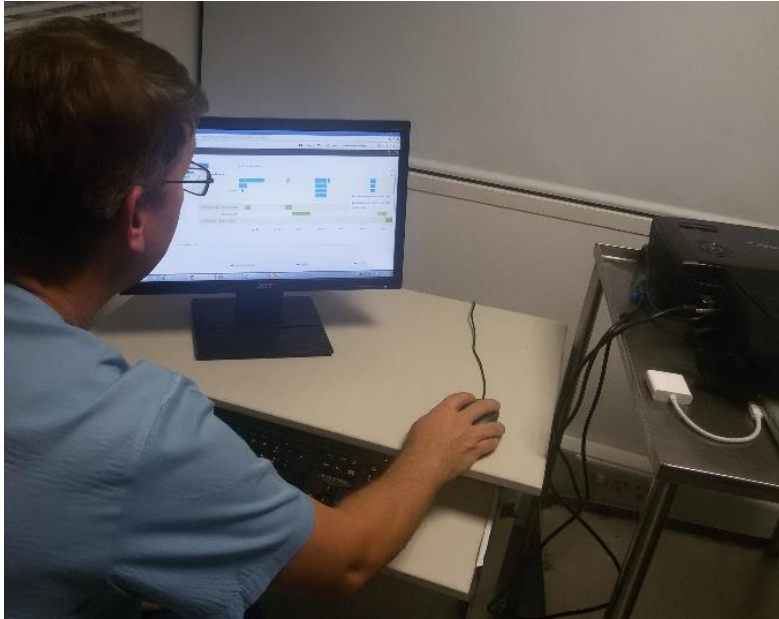
(when these microorganisms are isolated in the lab)



Alerts on Infection Control Team Homepage

# Demonstration

HAITool's demonstration took place in an Intensive Care Unit (8 beds), in a general and tertiary Portuguese hospital.



# Evaluation

## Structured interviews

- Supported by a pre-elaborated survey
- To physicians and infection control team
- To evaluate the first cycle of design and implementation of HAITool
- Answers indicated that HAITool is very useful on :
  - ✓ preventing and control antibiotic resistance
  - ✓ providing antibiotic resistant patterns
  - ✓ providing antibiotic consumption rates
  - ✓ enhance the communication between healthcare workers
  - ✓ alerts on antibiotic prescriptions compliance with norms

## Principles of Österle (Österle et al., 2011)

**Abstraction**

**Originality**

**Justification**

**Benefit**

# Conclusion

## HAITool

- ✓ Based on Antibiotic Stewardship Programs framework
- ✓ Enables monitoring of antibiotic resistance, antibiotic use and helps antibiotic prescription
- ✓ Achieved the research objectives, according to the feedback from healthcare professionals

## Limitations

- We are still studying (showing the evidence) to confirm that HAITool reduces antibiotic misuse and antimicrobial resistance levels

## Future work

- Measuring the impact of antibiotic consumption and prescription compliance with the norms, alerts effectiveness, bacteria resistances and costs
- Studying the adherence of physicians and infection control practitioners to HAITool

**HAITool is an important step forward to reduce antibiotic misuse and to control and prevent antibiotic-resistant HAIs**





# Acknowledgments

## HAITool Team

### Instituto de Higiene e Medicina Tropical

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Gunnar Skov Simonsen

Anne Mette Asfeldt

## Participant hospitals



## Partners



## Technological partners



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# Thank you!

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