CITIZEN-ORIENTED HEALTH SYSTEMS AND SERVICES

SOFTNET 2016

These slides are from the panel on

HEALTHINFO/INNOV, held on Tuesday, August 23rd in Rome, Italy.

University College of Southeast Norway

Panel on HEALTHINFO/INNOV

- **Moderator**
- Lasse Berntzen, University College of Southeast, Norway
- **Panelists**
- Toshiyo Tamura, Waseda University, Japan
- Ludek Matyska, Institut of Computer Science, Masaryk University & CESNET, Czech Republic
- Francois Allaert, Evaluation Chair ESC, University Dijon, France
- Osamu Takaki, Gunma University Hospital, Japan
- Emilio Luque, University Autonoma of Barcelona, Spain
- Jorge de Jesús Lozoya Santos, Universidad de Monterrey, México

HSN University College of Southeast Norway

CITIZEN-CENTRIC HEALTHCARE

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Citizen-centric healthcare

- It seems obvious that health systems and services should be citizen-oriented, but at the same time health systems and services are criticized for being the opposite.
- I would guess the degree of citizen-orientation varies. But let me start with some examples from my country (Norway):

Citizen-centric healthcare

- What is citizen-oriented health systems and services?
  - The right to choose a hospital
  - ·The right to choose a private alternative
  - ·The right to user controlled personal assistance
  - ·The cancer coordinator function

Citizen-centric healthcare

- But still, the health system and services has problems. You may have to wait to get examined, you have to wait for operations, and when you finally get into the hospital, you have to wait for the next test or the next consultation.

Citizen-centric healthcare

- I would guess the explanation has something to do with resource efficiency vs. flow efficiency.
- Resource efficiency has focus on utilization of resources – both technical and human.
- A consequence is waiting lines for the patients.
- Flow efficiency focus on the patient. Resources are put into use whenever needed. The patient is the most
- important. But it seems that the flow is not working very well in many situations.

Citizen-centric healthcare

- ICT may play an important role in making systems and services more citizen-oriented, but then designers and developers need a citizen-centric approach where citizens plays a role in design and development of the systems and services.

ÚSTAV VÝPOČETNÍ TECHNIKY
Masarykova univerzita

Citizen oriented health systems and services

Ludek Matyska
Masaryk University
Institute of Computer Science
and
CESNET, z.s.p.o.

User orientation

- Currently “average patient” oriented
- Individualization is needed
  - To go from “Average”, more data needed
- Closely connected with ICT:
  - Data generation
    - E.g. genomics (DNA sequencing)
  - Data collection
  - Data provisioning
    - Use for medical treatment
    - Use for further research

Data

- Primary collections (cohorts)
  - Need for long term data collection
  - Different aspects
  - Controlled environment
  - Personal data collection
    - Personal devices
- Genomics data
  - How much you need to precisely distinguish an individual?
- Data repositories sustainability
  - Private vs. state backed

Privacy

- The detailed data can be backtracked to the individual persons
  - Good is some treatment is found to be applied directly to the right person
  - Bad as the data can be misused (e.g. insurance policy)
- Also proper interpretation is needed
  - Banned paternity tests as an exercise in secondary schools
  - Proper reaction on a potential future threat (e.g. Angelina Jolie and breast cancer)

Privacy & Data

- Proper treatment of data necessary
- Data collection
  - Consent – general against a specific (UK vs. German approach)
- Data use
  - Access by the patient, physician and a researcher

Not only ICT implications

- Security
  - Data transmission and access control
- Privacy
  - Cross border issues
- Data treatment
  - Collection
  - Storage
  - Processing

  Who, where, when?
- Essential question: How we can help?

A FRAMEWORK FOR CITIZEN-ORIENTED ASSESSMENT OF MEDICAL SERVICES

Osamu Takaki
Gunma University Hospital
August 24, 2016

Our goal

- Development of a framework for *impartial and rational assessment of medical services in hospitals*

Inspiron 17 5000 Series (Intel)
$449.00

Intel® Pentium® Processor (Dual Core)

Windows 10 Home (Dell recommends Windows 10 Pro.)

4GB Memory

500GB Hard Drive

New Inspiron 11 3000 2-in-1
$469.00

6th Generation Intel® Core™ M3 Processor

Windows 10 Home (Dell recommends Windows 10 Pro.)

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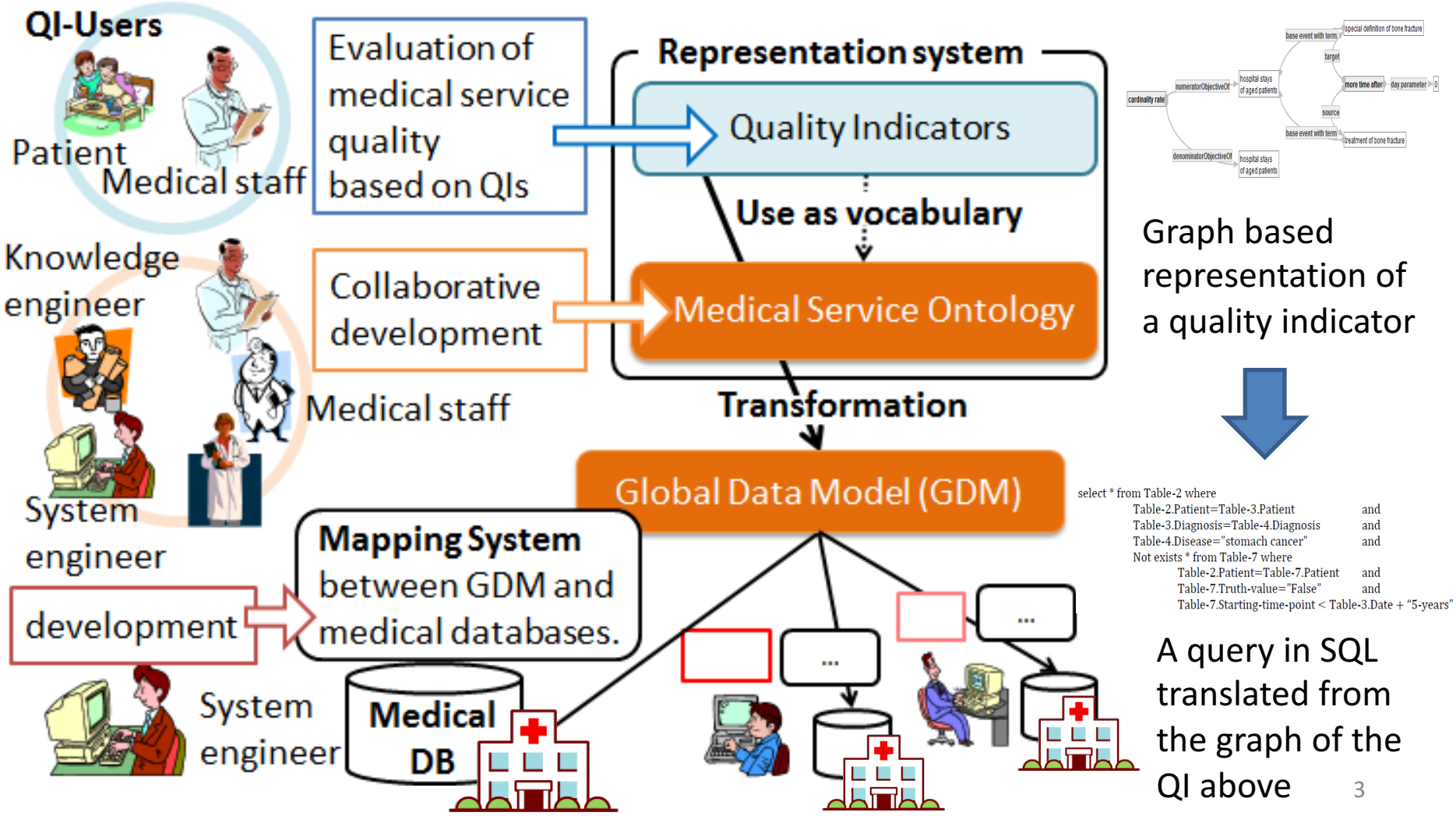
500GB Hard Drive

Ref. http://www.dell.com

QI-framework

- A framework to define quality indicators (QIs) and to calculate QI-values based on medical databases.



Issue on spreading QI-framework in clinical practice

- We have not yet sufficiently spread our framework in clinical practice.

- Value of patients vs. Value of medical staff

The Eighth International Conference on Advances in System Simulation

SIMUL 2016

August 21 - 25, 2016 - Rome, Italy

Panelist: Emilio Luque

High Performance Computing for Efficient Applications and Simulation (HPC4EAS)
Computer Architecture and Operating Systems Department
University Autonoma of Barcelona (UAB), Barcelona, Spain

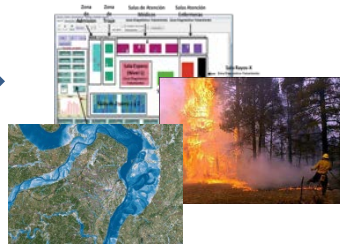
"Simulation as a source of data for unusual and unexpected situations in Health Services"

- The use of data mining techniques, based on real data provided directly by health services, provides new useful knowledge for decision-making but **not always real data are available** for all possible situations,
- Simulation provides parametrizable tools (simulators) allowing us to "replicate/create" any possible situation, becoming then the simulator in a **"sensor" of "virtual-data",** otherwise difficult or impossible to obtain from real systems.
- **"Simulated-data" will expand "real-data"**, allowing us obtaining more reliable models and better predictions.

Our proposal, inclusion of the 5th V: Virtual data (simulation generated)

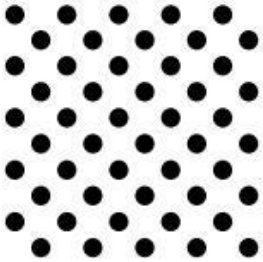
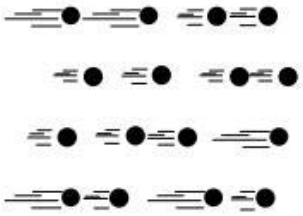
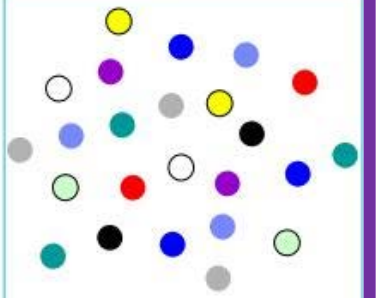
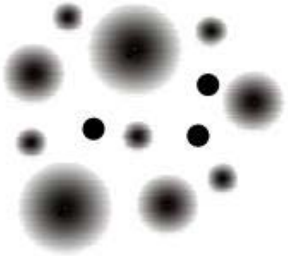
The promise of Big Data

- Data contains information of great value
- If you can extract those insights you can make far better decisions…but is data really that valuable?



The simulator: source of Big Data

*"The **greatest** enemy of knowledge is not ignorance, it is the illusion of knowledge."*

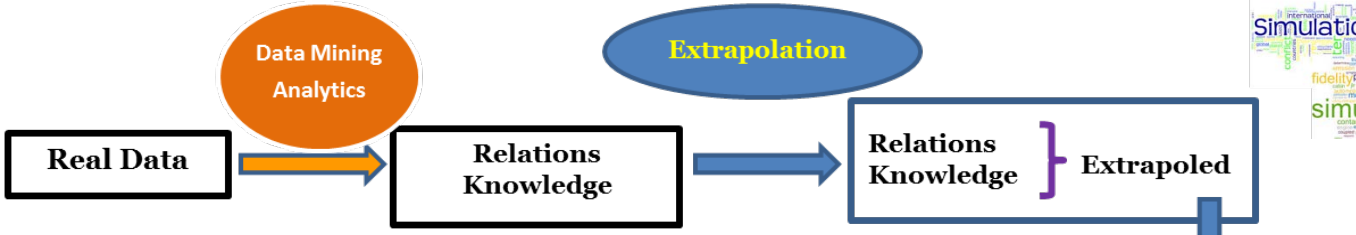
Volume	Velocity	Variety	Veracity*	Virtual
				
Data at Rest	Data in Motion	Data in Many Forms	Data in Doubt	Data from "Virtual Worlds"
Terabytes to exabytes of existing data to process	Streaming data, milliseconds to seconds to respond	Structured, unstructured, text, multimedia	Uncertainty due to data inconsistency & incompleteness, ambiguities, latency, deception, model approximations	Simulation as a sensor of the real world

Simulation

INNOVATION

Big Data and Simulation

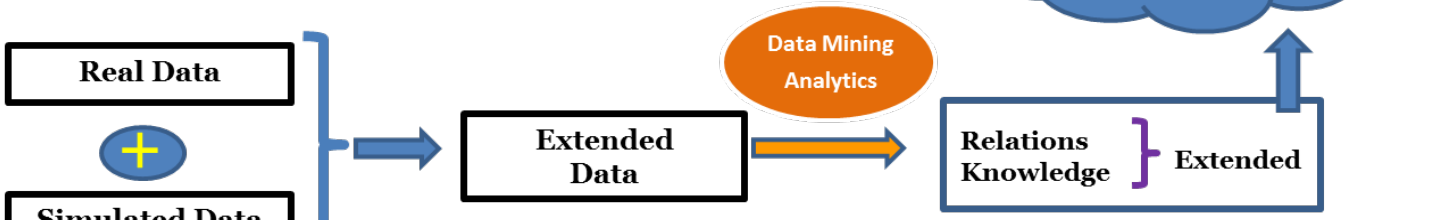
Without simulation



Data obtained directly from the real system will be complemented with data **generated by the simulator.**

What would be more reliable?

Including simulation



The simulator as a sensor of "real data" difficult or impossible to be obtained

"Simulation as a Sensor of Emergency Departments: Providing Data for Knowledge Discovery" (Work-in-Progress Paper) E. Bruballa, M. Taboada, E. Cabrera, D. Rexachs, E. Luque. Procc. *SIMUL 2014 : The Sixth International Conference on Advances in System Simulation pp 209-212. 2014*

"Simulation and Big Data: A Way to Discover Unusual Knowledge in Emergency Departments" (Work-in-Progress Paper) E. Bruballa, M. Taboada, E. Cabrera, D. Rexachs, E. Luque. Procc. *2014 International Conference on Future Internet of Things and Cloud. pp 367-372. 2014*

Emergency Department Simulation

The ED Model (Components)

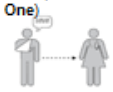
Kinds of agents

1) Active Agents
Patients
Companions of patients
Admission personnel
Sanitarian technicians
Nurses (Triage, Emergency)
Doctors (Emergency, Specialists)

2) Passive Agents
Information system
Loudspeaker system
Pneumatic pipes
Tests services

Communication Model: 3 different types

1 to 1(One-to-One)



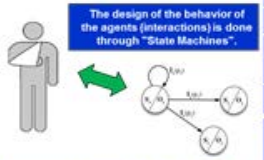
1 to n (Multicast)

1 to Zone: individuals in Zone (Area- Restricted Broadcast)

The ED Model (Individual model)

Agent/Individual Model

The design of the behavior of the agents (interactions) is done through "State Machines".



Current state / Output	Input	Next state / Output
Sx / Ox	Ia (p1)	Sy / Oy
Sx / Ox	Ia (p2)	Sz / Oz
Sx / Ox	Ia (p3)	Sx / Ox

State variables

STATE Variables	Values	Observability
Name/identifier <id>	Unique per agent	I
Personal details	Gender, Medical history (cardiology, pulmonology, neurological,...); Allergies (yes-no); Treatments that received (classified into therapeutic groups: bronchodilators, vasodilators, etc.); Origin (national or immigrant)	I
Location	Entrance, Admissions, Waiting Room, Triage, Treatment Zone.	E
Action	Idle, Requesting information from <id>, Giving information to <id>, Searching, Moving to <location> , Waiting for ambulance.	E
Physical condition	Healthy; Hemodynamic-Constant; Barthel Index (degree of dependence).	E/I/N
Symptoms (patients)	Healthy, Cardiac/respiratory arrest, severe/moderate trauma, headache, vomiting, diarrhea	E/I
Communication skills	Low, Medium, High	E
Level of experience (doctors)	Resident (1 to 5); Junior (5-10); Senior (10 - 15) and Consultant (over 15 years)	E/I
Level of experience (triage nurses)	Low, Medium, High	E/I
Level of experience (emergency nurses)	Low, Medium, High	E/I
Level of experience (admissions)	Low, Medium, High	E/I

All together

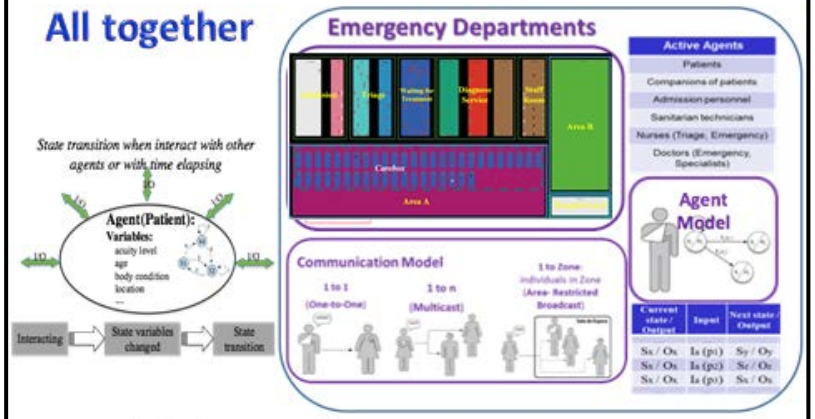
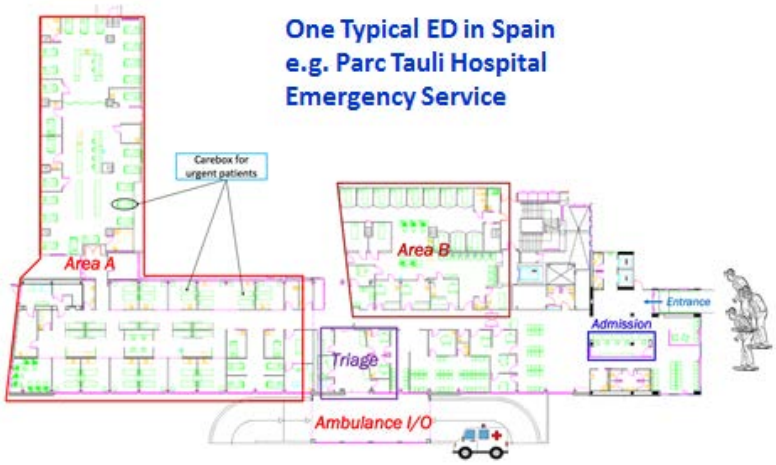


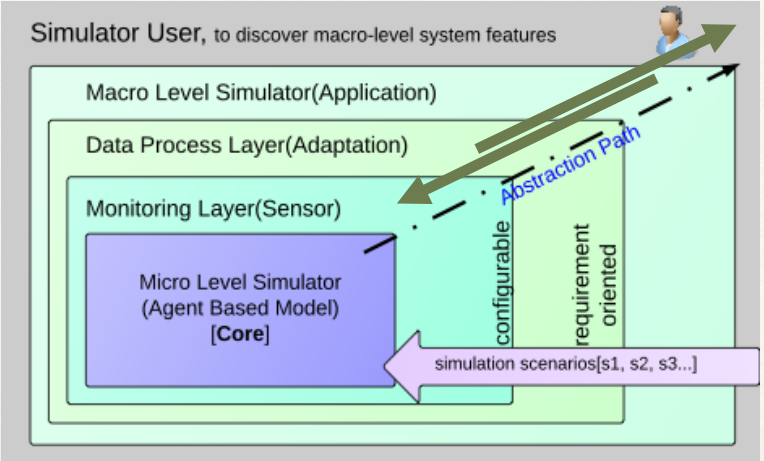
Table 1: A PART OF A NURSE'S STATE TRANSITION.

State index	Source State	Destination state	Input
...	...	...	...
S_t	Waiting for task.	Meet with patient(take blood sample).	blood test task from IS
S_{t+1}	Meet with patient.	Waiting for task.	sample take finished
S_{t+2}	Waiting for task.	Meet with patient(for treatment)	treatment task from IS.
S_{t+1}	Meet with patient.	Waiting for task.	treatment task finished
S_{t+3}	Waiting for task.	Meet with patient(help discharging)	Discharging task from IS.
...	...	...	...

The ED Model (Layout)

One Typical ED in Spain
e.g. Parc Tauli Hospital
Emergency Service





Emergency Department Simulation Results

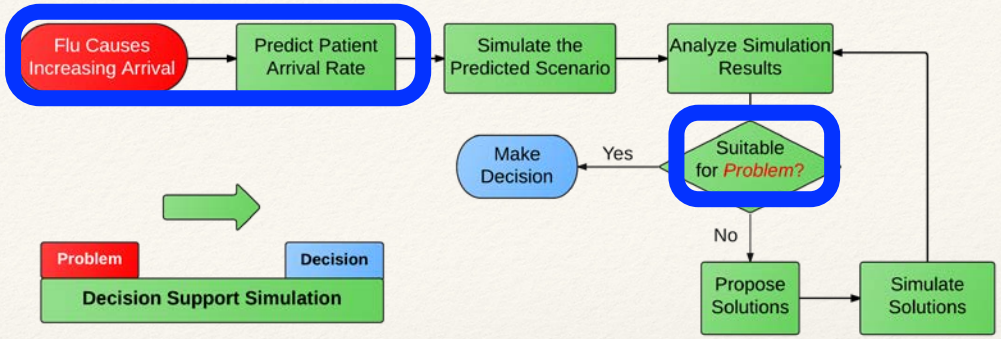


Table 1: LoS and ED resources utilization with increasing arrival patient

Daily arrival	Average LoS by acuity level(hour)					Average utilization of ED resources(%)				
	1	2	3	4	5	Tr_{lab}	N_A	D_A	D_B	N_B
361	10.83	10.30	9.79	3.01	2.81	70.51	40.57	67.94	53.95	43.68
397	10.84	10.90	10.41	3.43	3.81	81.39	46.31	78.29	62.05	50.27
416	11.66	11.28	10.69	3.59	4.12	83.64	48.01	80.59	64.23	52.16
436	11.87	11.73	11.31	3.78	5.28	86.75	50.01	84.50	66.84	54.17
456	11.71	12.09	11.85	3.98	**8.94**	**91.32**	51.85	87.19	69.80	56.27

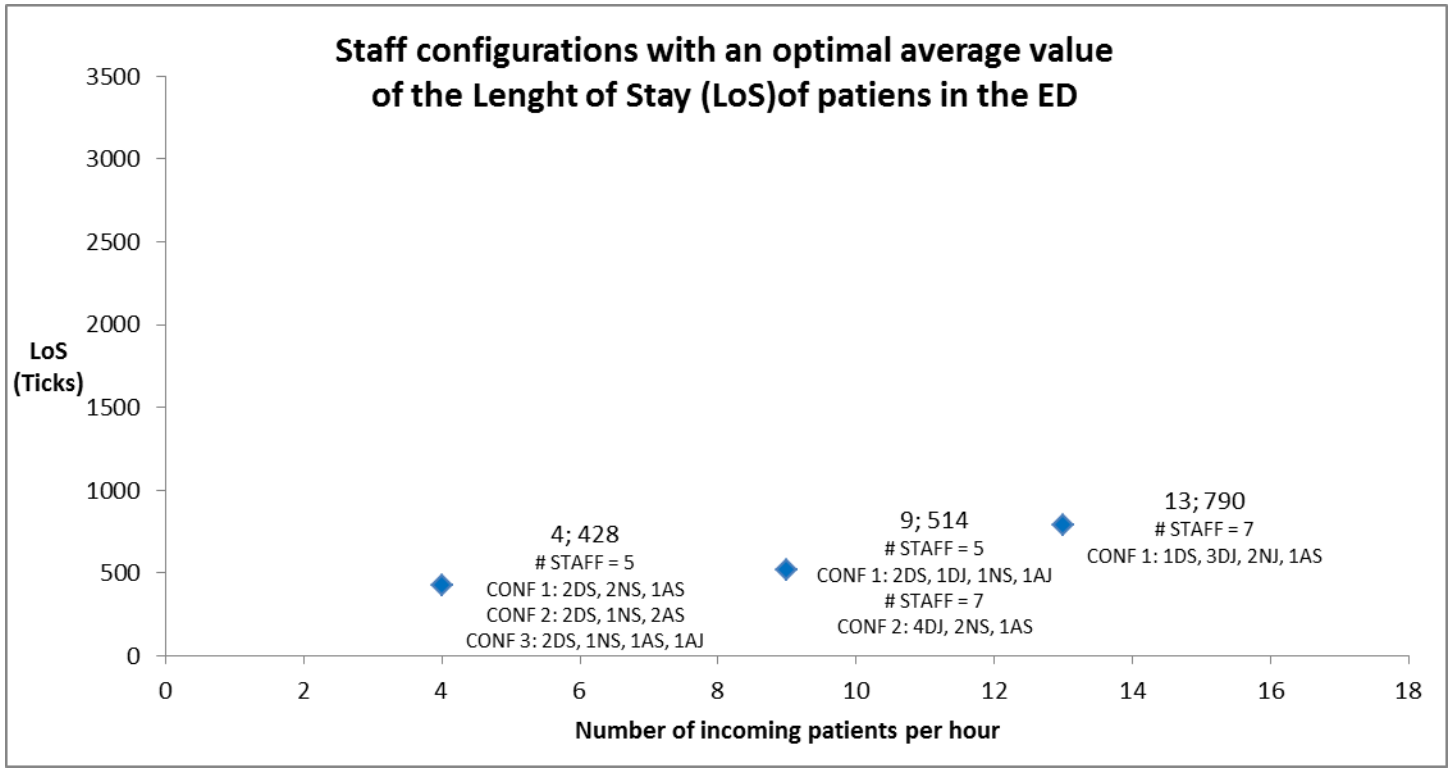
Add two more technicians to laboratory room

Daily arrival	Average LoS by acuity level(hour)					Average utilization of ED resources(%)				
	1	2	3	4	5	Tr_{lab}	N_A	D_A	D_B	N_B
456	11.58	11.90	11.70	3.65	**3.17**	**60.67**	51.99	87.19	69.47	56.65
476	12.54	12.70	14.33	3.80	3.57	64.19	55.04	92.30	73.01	59.42
496	13.23	12.90	**33.93**	4.02	4.16	66.37	56.90	**96.06**	76.32	62.25

Table 1: Two more doctors added to area A

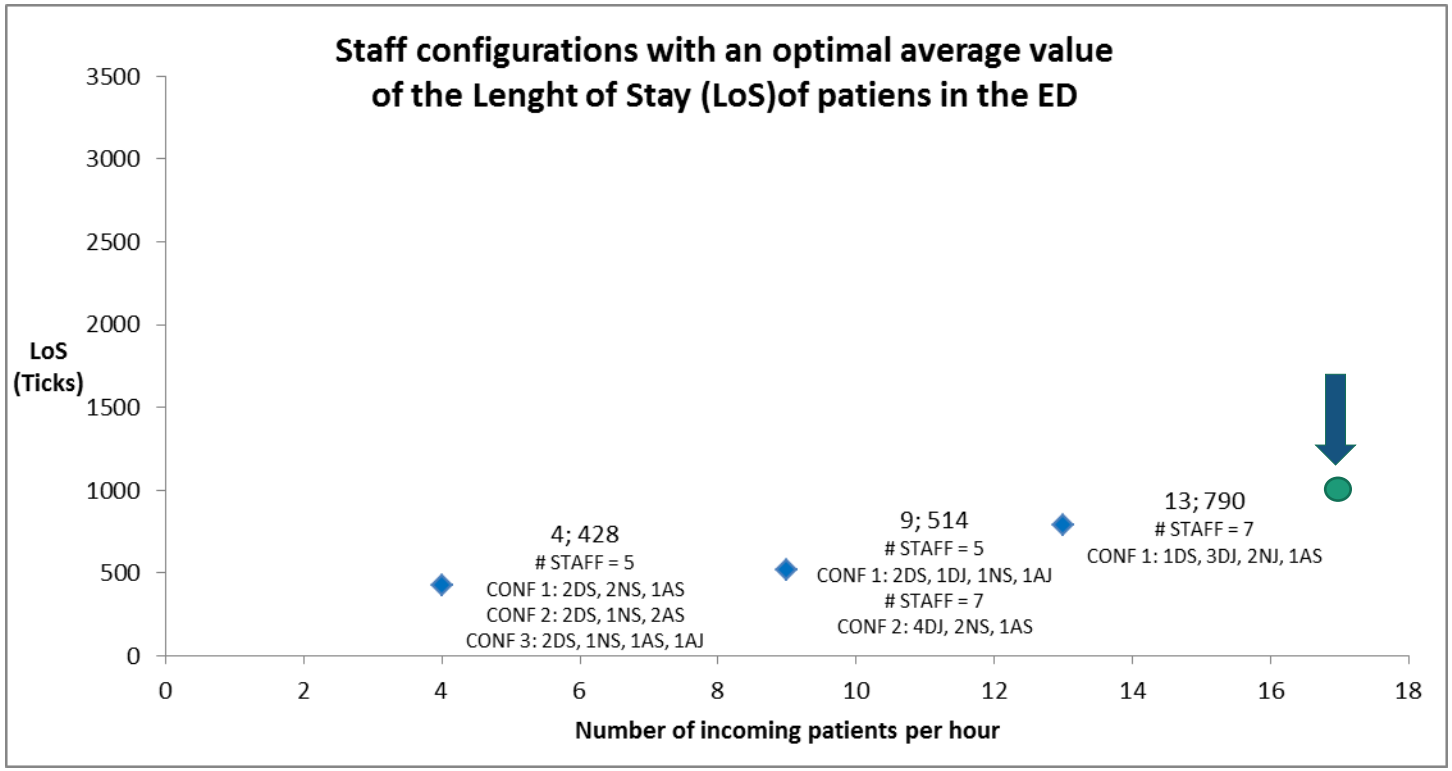
Daily arrival	Average LoS by acuity level(hour)					Average utilization of ED resources(%)				
	1	2	3	4	5	Tr_{lab}	N_A	D_A	D_B	N_B
496	10.89	11.01	**11.07**	3.98	4.15	66.73	57.50	**71.84**	75.79	61.58
516	11.12	10.86	11.20	4.13	4.79	68.75	58.67	72.99	78.80	64.30
535	11.26	11.31	12.54	4.36	5.82	71.39	60.65	76.00	82.52	67.14

Data provided by simulation: Justification



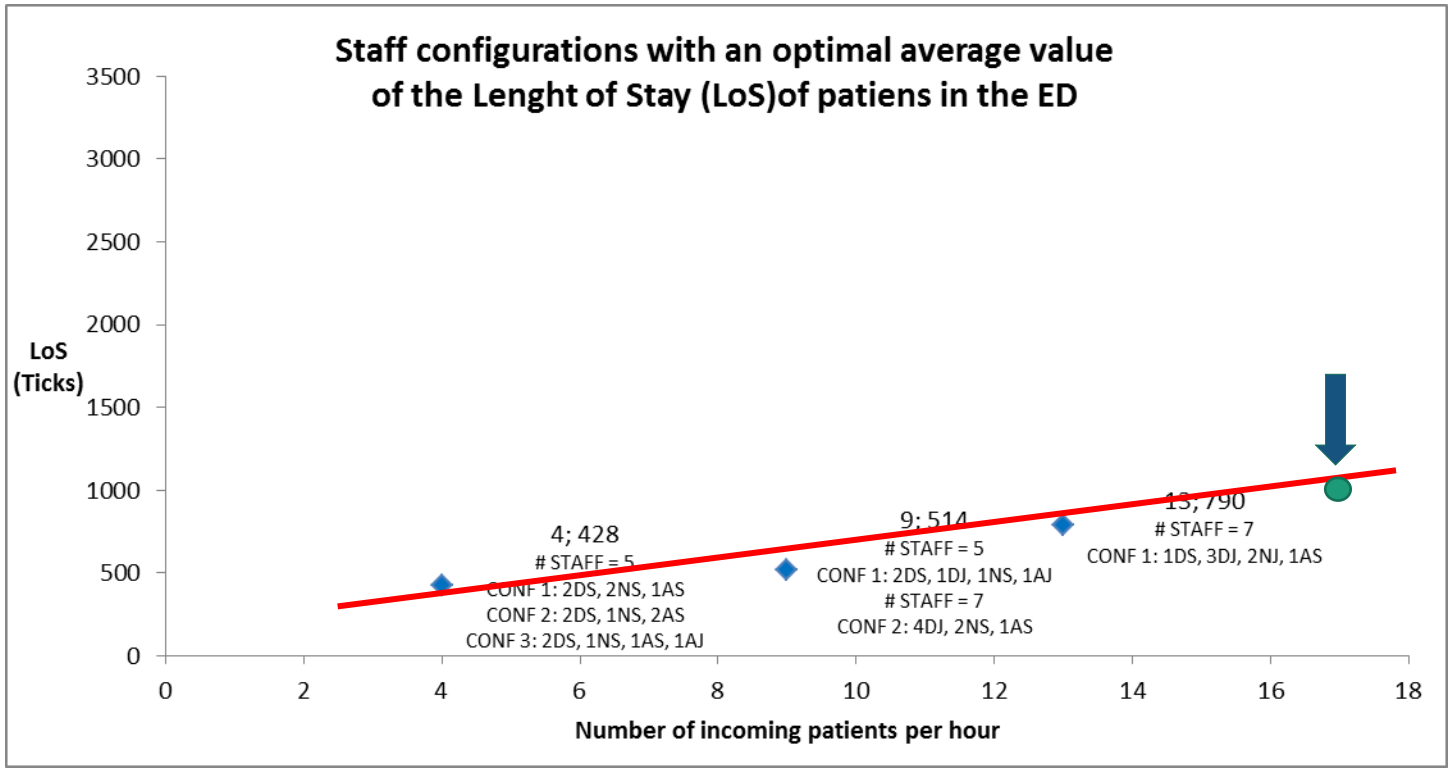
Incoming Patients	4 pat/h 9 pat/h 13 pat/h 17 pat/h

Data provided by simulation: Justification



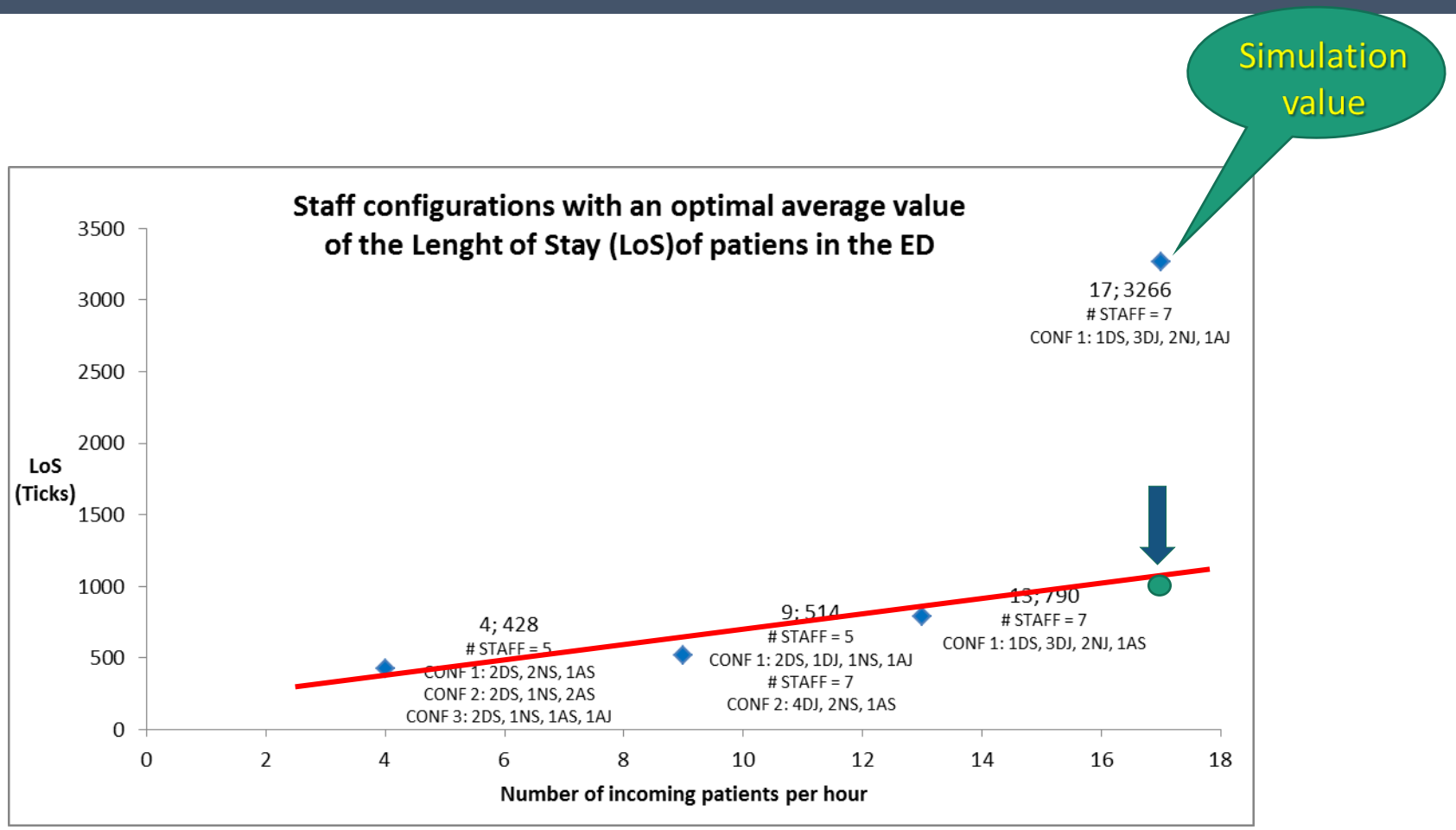
Incoming Patients	4 pat/h 9 pat/h 13 pat/h 17 pat/h

Data provided by simulation: Justification



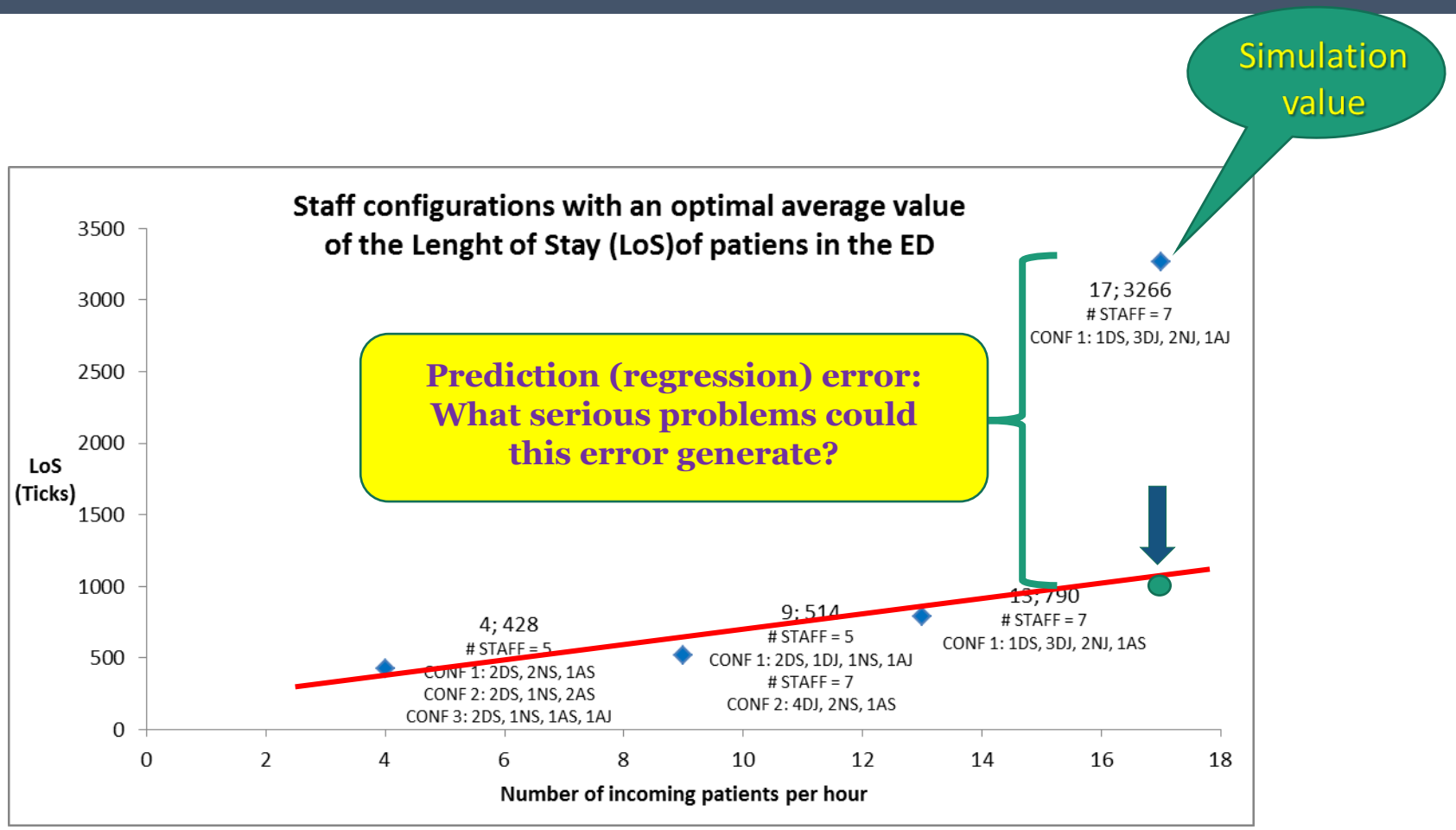
Incoming Patients	4 pat/h 9 pat/h 13 pat/h 17 pat/h

Data provided by simulation: Justification



Incoming Patients	4 pat/h 9 pat/h 13 pat/h 17 pat/h

Data provided by simulation: Justification



Data generated by simulation can be a more reliable source for predicting the behavior of the **real system**.

Incoming Patients	4 pat/h 9 pat/h 13 pat/h 17 pat/h

UAB Universitat Autònoma de Barcelona

HPC4EAS Research Group

Influence of Ambulance Service for Departure

✓ (one way to relieve overcrowding in real situation);

Table 6: Influence of ambulance response time to LoS.

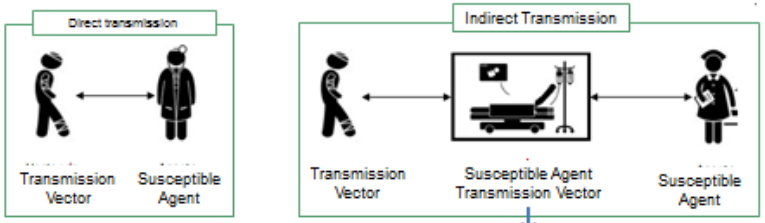
Ambulance response time model	Average LoS by acuity level(hour)				
	1	2	3	4	5
current actual delay(*mean*=63 minutes)	13.23	12.90	**33.93**	4.02	4.16
50% of actual delay(*mean*=31 minutes)	12.70	12.60	**17.96**	3.94	4.03
without delay	12.04	12.51	**15.53**	3.86	3.86

Simulation of the MRSA propagation in the Emergency Department

Modelization: Transmission forms

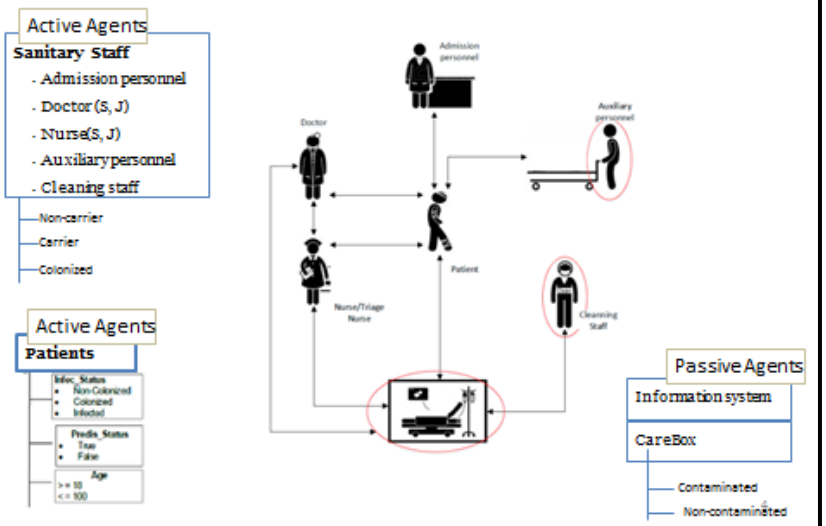
Physical contact.

- **Direct transmission** => Active agent – Active agent
- **Indirect transmission** => Active agent – Passive agent– Active agent

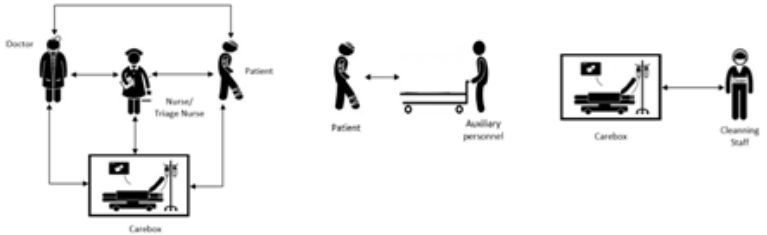


MRSA Time life on dead surfaces: 90 days

Contact Propagation Model: Agents



Contact Propagation Model: HealthCare Staff



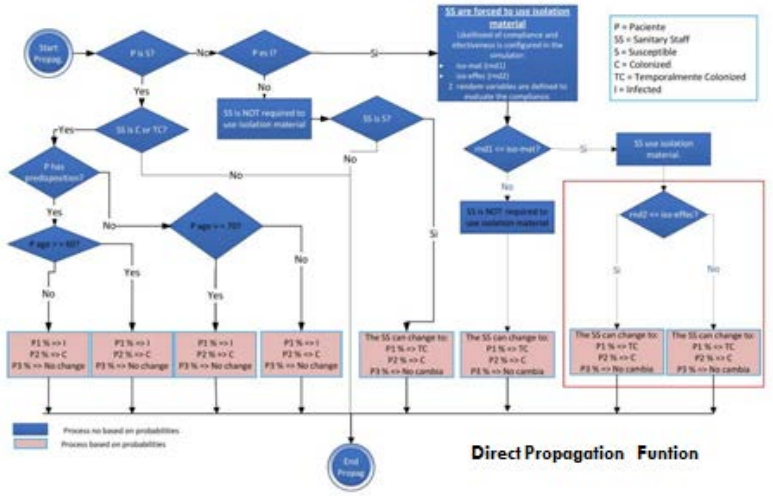
Prevention policies of the healthcare staff

The accomplishment level of the healthcare staff agents with the prevention policies is measured by the accomplishment factor (AF).

The three prevention actions that are evaluated in this research are:

- Handwashing
- Sanitizing hand
- Use of isolation material

Contact Transmission Model: How the MRSA propagates



Simulation: Case Study A

Objetive: To identify the influence of hand washing on the number of infected and colonized patients considering different values of effectiveness.

Parameters of Execution:

Description	Variable	Value
Simulation Time	Simul_Time	1440 hours
Average patient arrive per day*	Averag_Pat	398
Percentage transmission vector that arrive ED	Percen_TV	2%
Percentage of patient with predisposition to acquire MRSA	Percen_Predis	20%
Hand wash probability	HandW_Prob	100%

*The flow of patients has a probability distribution per hour, considering hospital data.

Output dates:

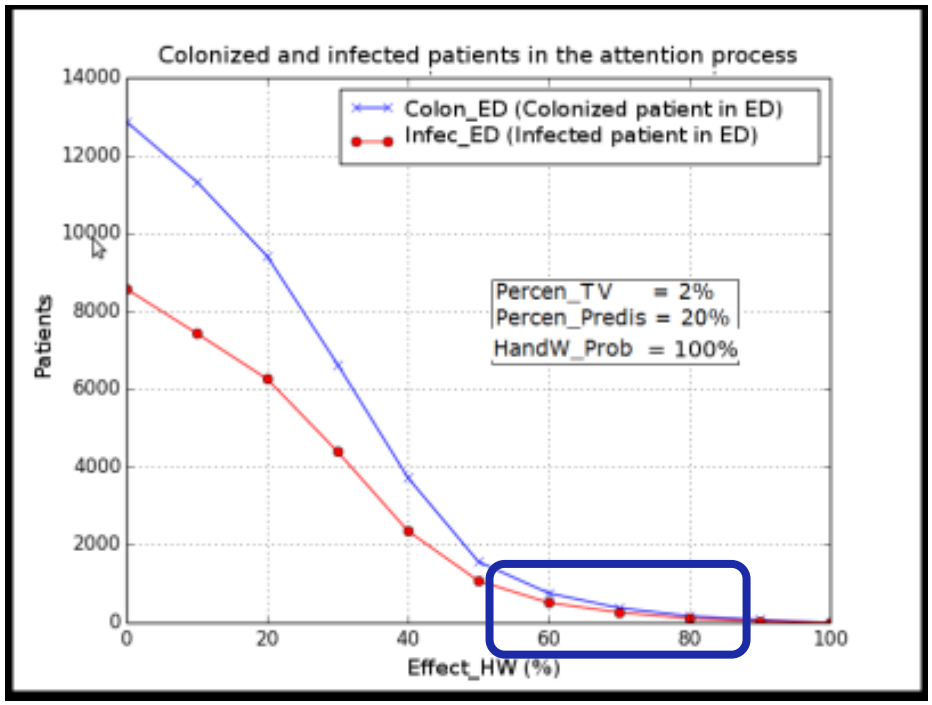
Table : Handwash Probability = 100%

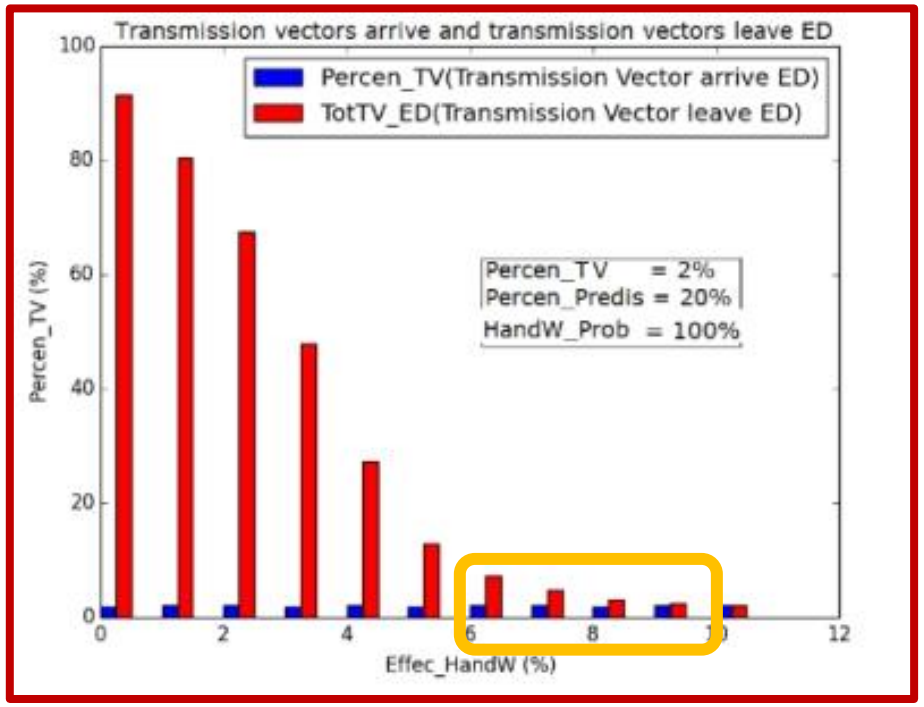
Effec_HandW	0	10	20	30	40	50	60	70	80	90	100
Colon_arrive	222	246	240	252	247	259	241	259	229	255	265
Infec_arrive	242	244	248	220	235	207	238	227	228	231	234
NonCol_arrive	23491	23467	23468	23483	23474	23490	23476	23469	23498	23471	23458
TotPat_arrive	23955	23957	23956	23955	23956	23956	23955	23955	23955	23957	23957
Percen_TV(%)	1,94	2,05	2,04	1,97	2,01	1,95	2,00	2,03	1,91	2,03	2,08
Colon_ED	12868	11326	9411	6634	3723	1568	757	379	169	74	0
Infec_ED	8573	7431	6258	4393	2355	1074	513	263	107	40	0
TotTV_ED(%)	91,44	80,34	67,44	48,00	27,38	12,97	7,30	4,71	3,06	2,50	2,08

Simulation: Results Case Study A

Efficiency

Output dates:



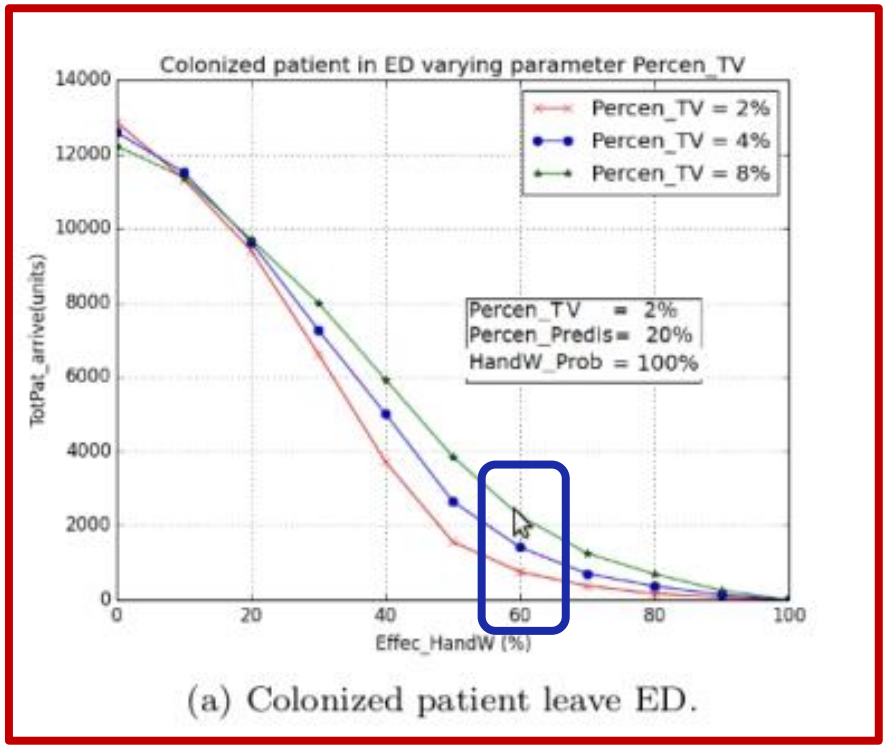


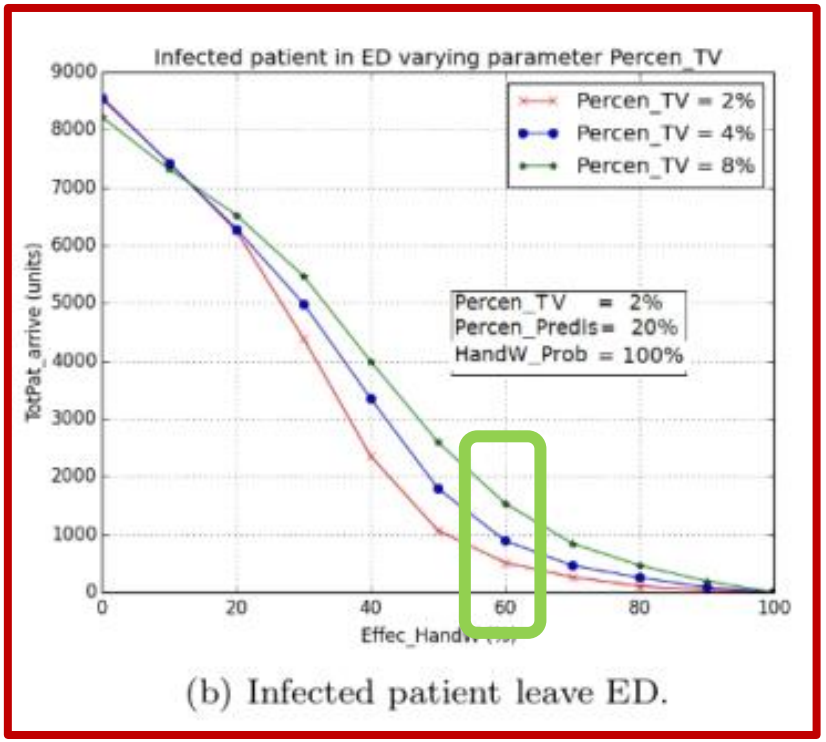
Colonized and Infected Patients with a hand wash accomplishment of 100% and differents values of effectiveness.

Simulation: Resultas Case Study A

Outputs dates:

Sensitiviy to "Percent_TV"
(Transmission Vector)





Influence of hand wash (HW) effectiveness in the number of colonized and infected patient with MRSA during the attention process at ED.

The First International Conference on Informatics and Assistive Technologies for Health-Care, Medical Support and Wellbeing

HEALTHINFO 2016
August 21 - 25, 2016 - Rome, Italy

UDEM

Citizen-oriented health systems and services

Panelist: Dr. Jorge de Jesús Lozoya Santos

Date: August 22, 2016

Rome, Italy

UNIVERSIDAD DE MONTERREY
HOMO HOMINIS IN MINISTERIO PERFICITUR

Health System and services– Citizen-oriented

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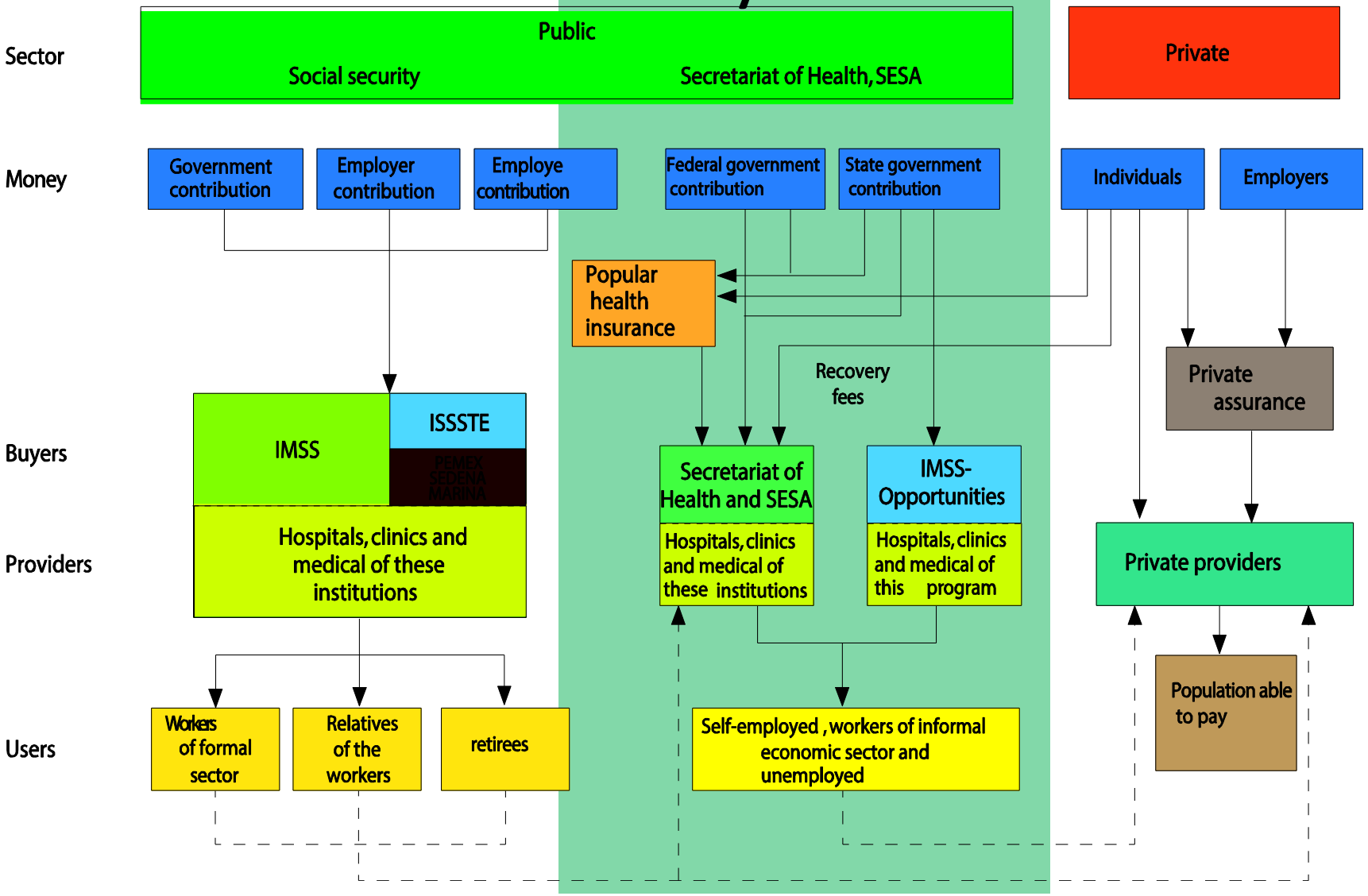
- The right to be attended in any hospital on time and quality
- Health services
  - The right to be attended under any condition atempting against health
  - The right to choose the medical equipment
- Social services
  - The right to have and choose the kindergarten for the children of women with a job.
  - The right to have a retire assurance
  - The right to receive government support under dispaired situation for life
  - The right to have free medicine

Citizen-oriented Health System

UDEM



Dantés, Octavio Gómez, Sesma, Sergio, Becerril, Victor M., Knaul, Felicia M., Arreola, Héctor, & Frenk, Julio. (2011). ***Sistema de salud de México***. *Salud Pública de México*,*53*(Supl. 2), s220-s232. Recuperado en 22 de agosto de 2016, de http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0036-36342011000800017&lng=es&tlng=es.

Mexico Public Health System and services– Institution-oriented

UDEM

- The right to be attended in an economic-status-based hospital
- Health services
  - According to the employment status
  - Expensive and low responsive treatments for most of the people
  - Medicine availability according to the institution and the provider relationship (do not care about people needs and urgency)
- Social services
  - The right to have a kindergarten for the care of childrens for those women with a job (not always available).
  - The right to have a retire assurance (not enough)
  - Etc…

Current arrangements are failing to meet Mexicans's health needs

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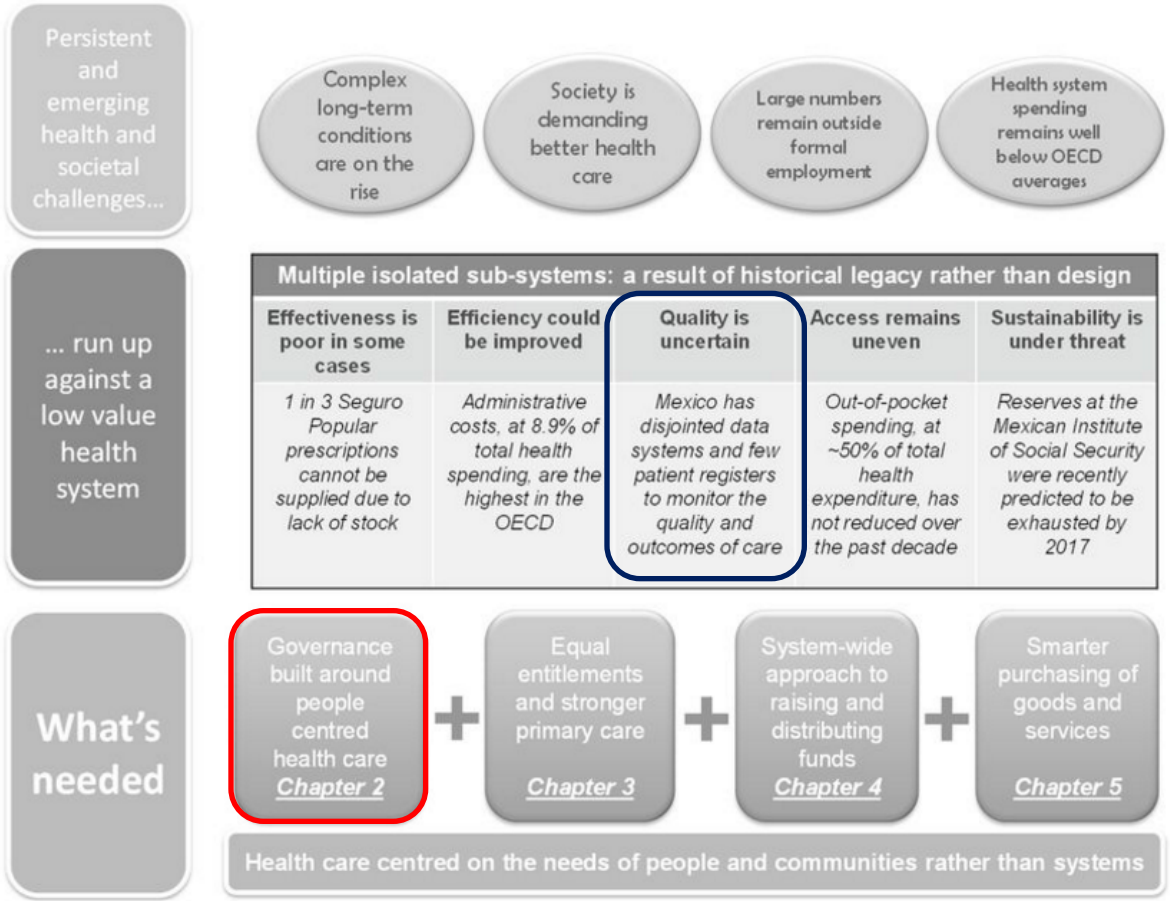

OECD (2016), "Assessment and recommendations", in *OECD Reviews of Health Systems: Mexico 2016*, OECD Publishing, Paris.
DOI: http://dx.doi.org/10.1787/9789264230491-4-en

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Finally

- **Expansion of service-exchange agreements** (or *convenios*) to let affiliates from one system use services from another.
- **Enforcement of information systems that monitor health care quality and that drive improvements across the health system**. This is to ensure that the new *convenios* become living and active agreements, rather than remaining dormant and unused.
- **Creation of a new *Comisión* to work across health insurance schemes and harmonise their care pathways, prices, information systems and administrative practices** Without deliberate and carefully planned equalization of the benefits offered by each insurance scheme, Mexico will not achieve the fairer and more efficient health care system that the country needs.

OECD (2016), "Assessment and recommendations", in *OECD Reviews of Health Systems: Mexico 2016*, OECD Publishing, Paris.
DOI: http://dx.doi.org/10.1787/9789264230491-4-en

Suggestions

- Development of a national standard of quality of service for Health System and Services
- Development of a national system of information for each person in the country

▸ Health of individuals requires more than health care, but also essential daily living functions.
▸ Social care informatics support is not yet well developed.
▸ A cross-disciplinary international group of experts could agree a common vision.

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http://dx.doi.org/10.1016/j.ijmedinf.2011.06.001.