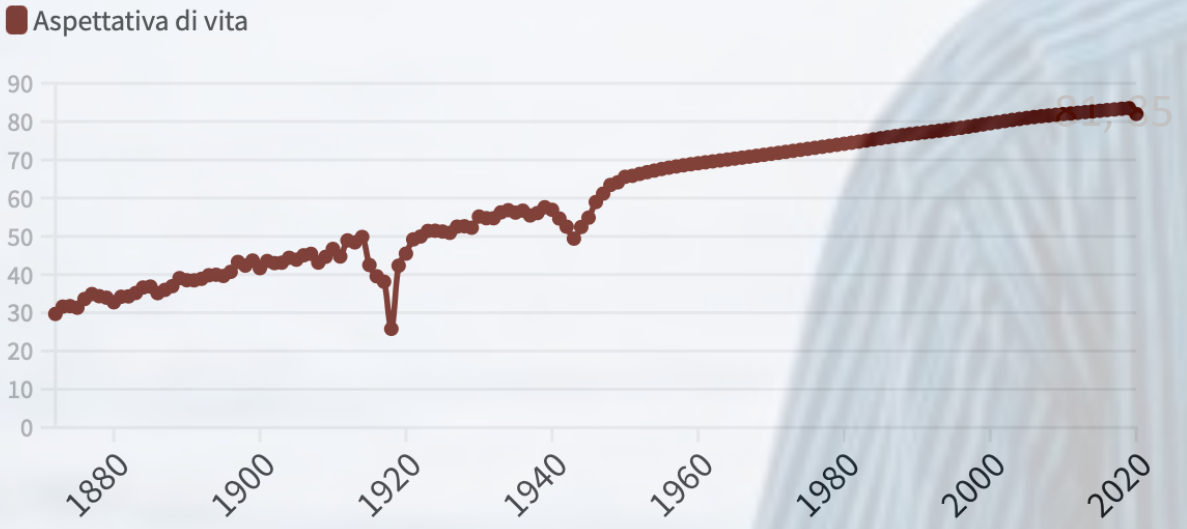
INTRODUZIONE

La rivoluzione dei Medical Device personali e la Medicina 5-P

Gaetano Marrocco
Coordinatore Corso di Studi in Ingegneria Medica
Università Di Roma Tor Vergata

L'aspettativa di vita in Italia dal 1872 al 2020



https://statisticsanddata.org/it/data/aspettativa-vita-italia/

Thanks to:

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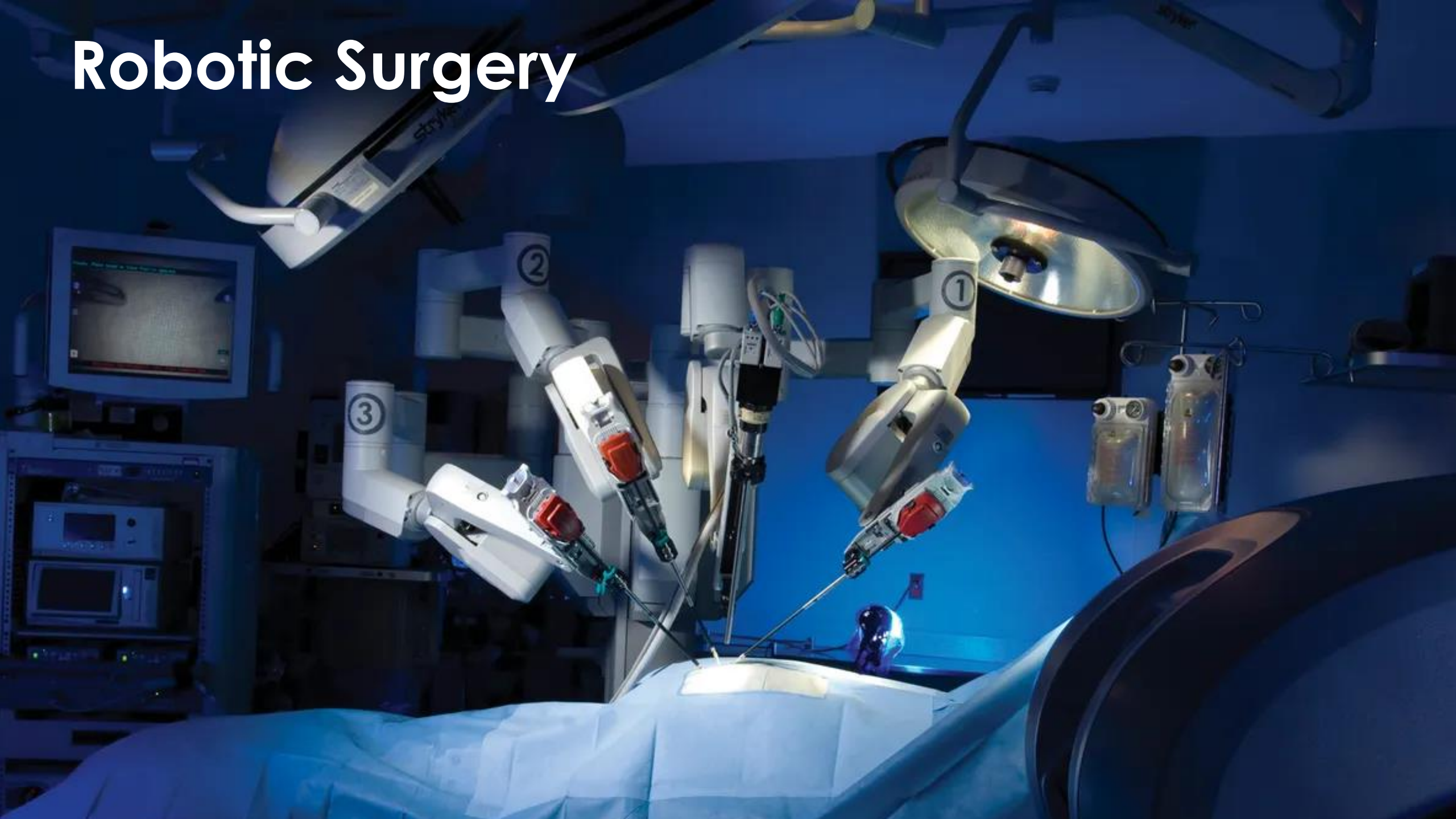
Pharma

Technology

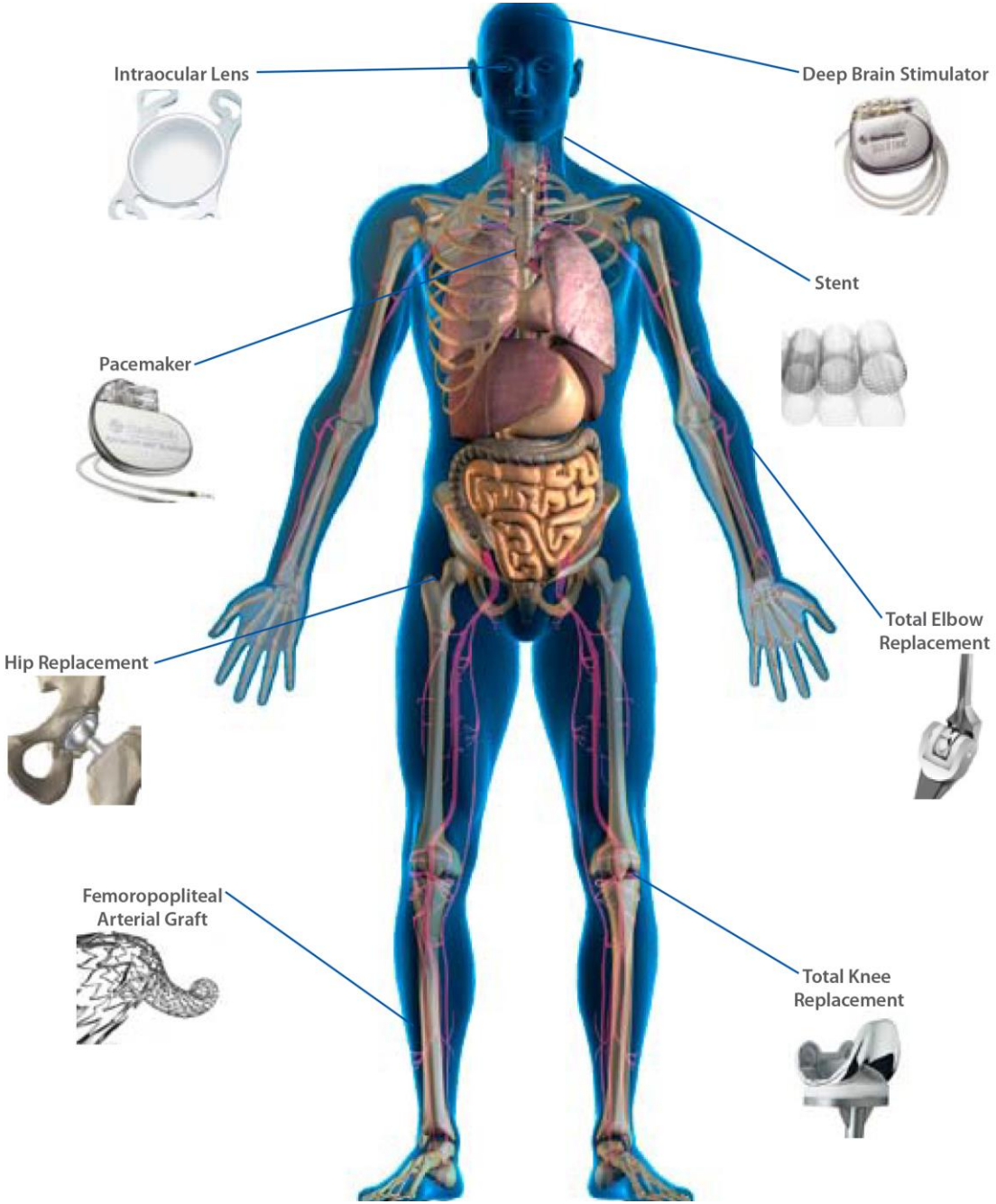
…

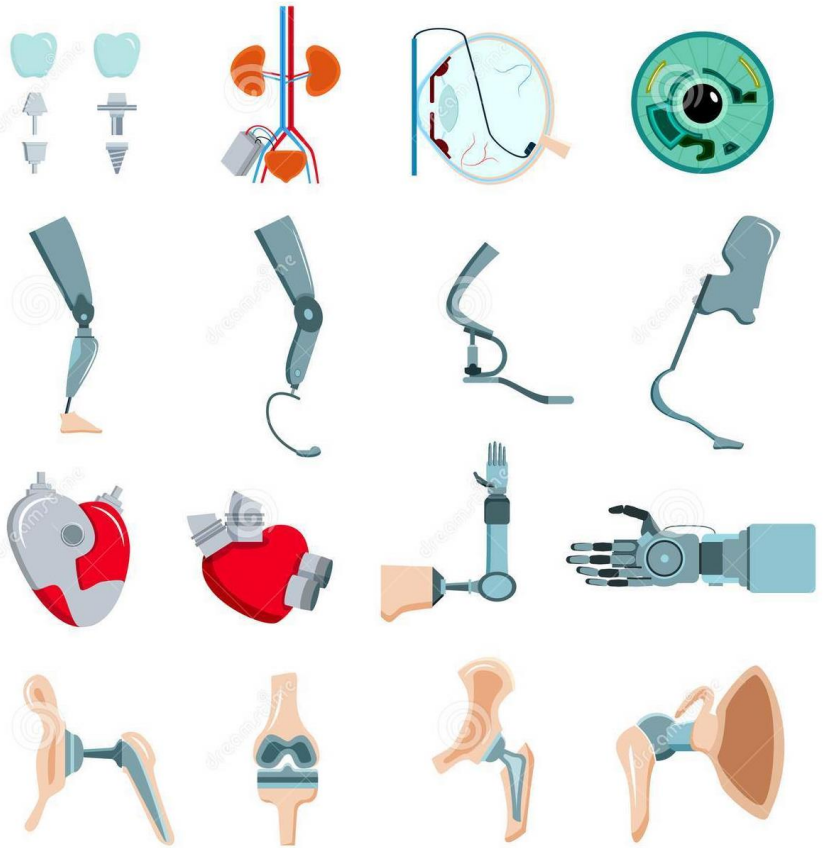
Advanced Diagnostics

Robotic Surgery



Medical Implants (Endo-prosthesis)



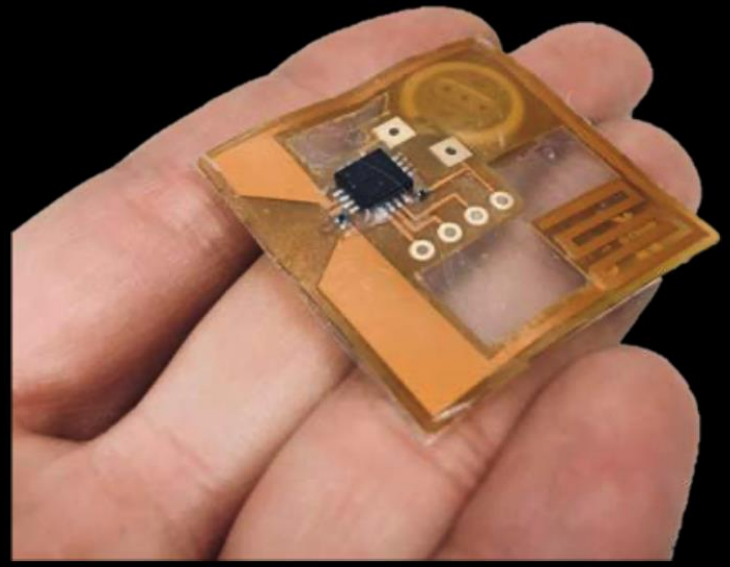


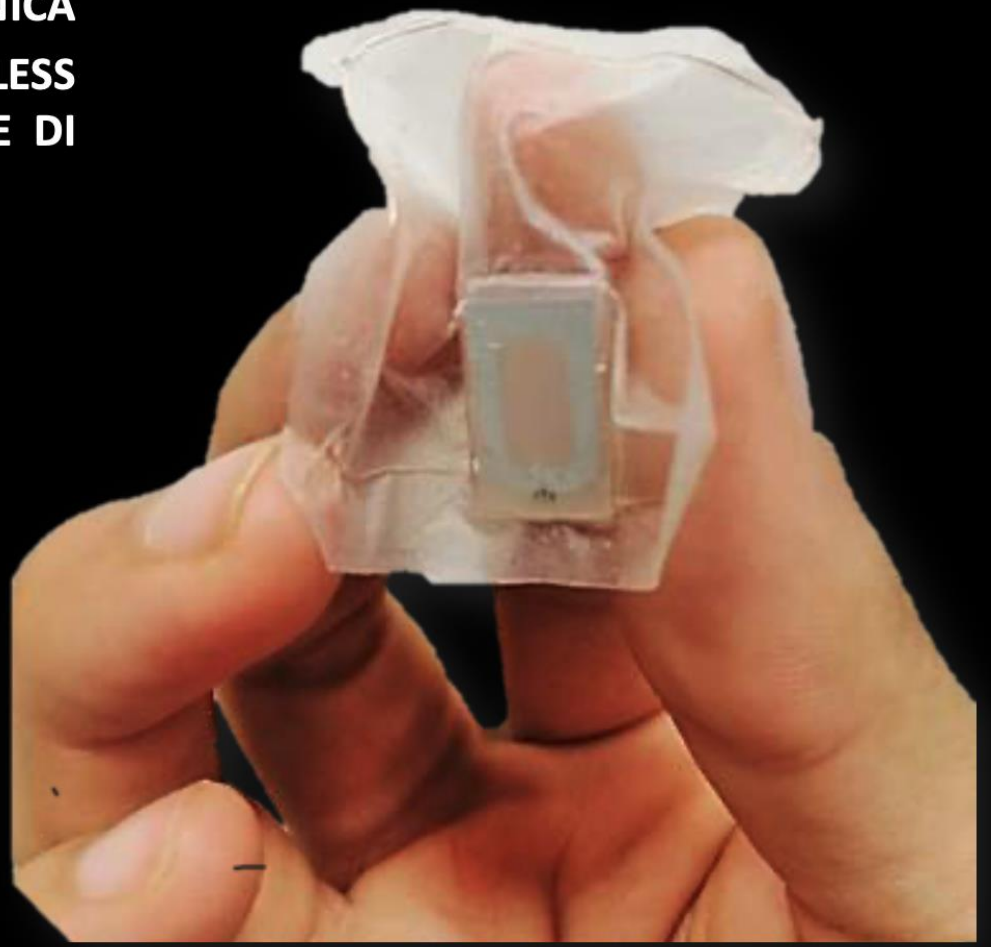
SECOND SKIN

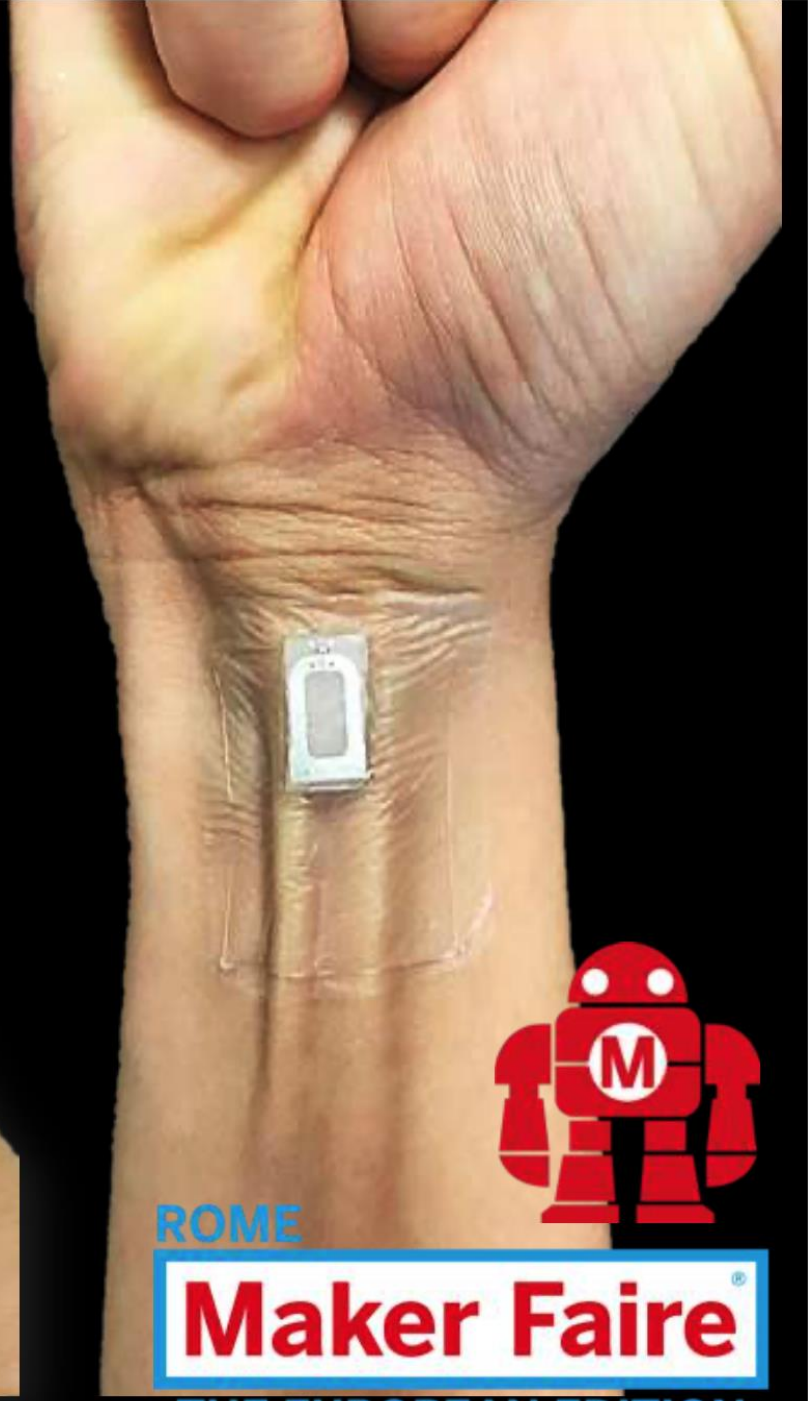
SABATO 19 Ottobre 2019
14:15– 15:15
Pav.6 Stage 6

UNA SECONDA PELLE ELETTRONICA PER IL MONITORAGGIO WIRELESS DELLA SALUTE E LA REALIZZAZIONE DI SENSI BIONICI

Prof. Gaetano Marrocco,
Università di Roma Tor Vergata







ROME
Maker Faire
THE EUROPEAN EDITION

A medical device

is a product used for diagnosis, prevention, monitoring, treatment or alleviation of disease or injury in humans.

Can be :

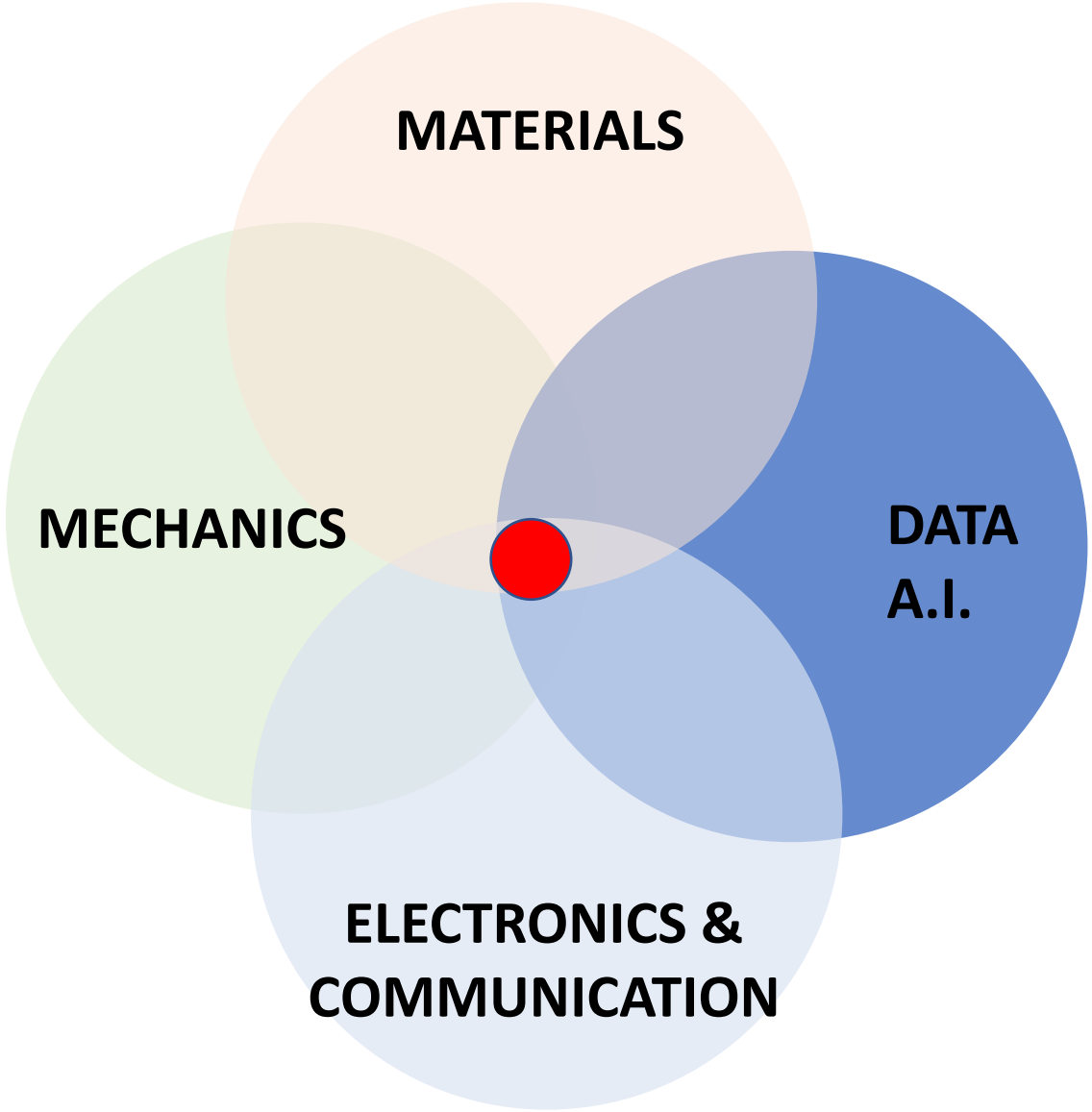
- a physical object
- a software or
- a combination of both.

(https://ec.europa.eu/growth/sectors/medical-devices_it)

MEDICAL DEVICE

physical

Digital



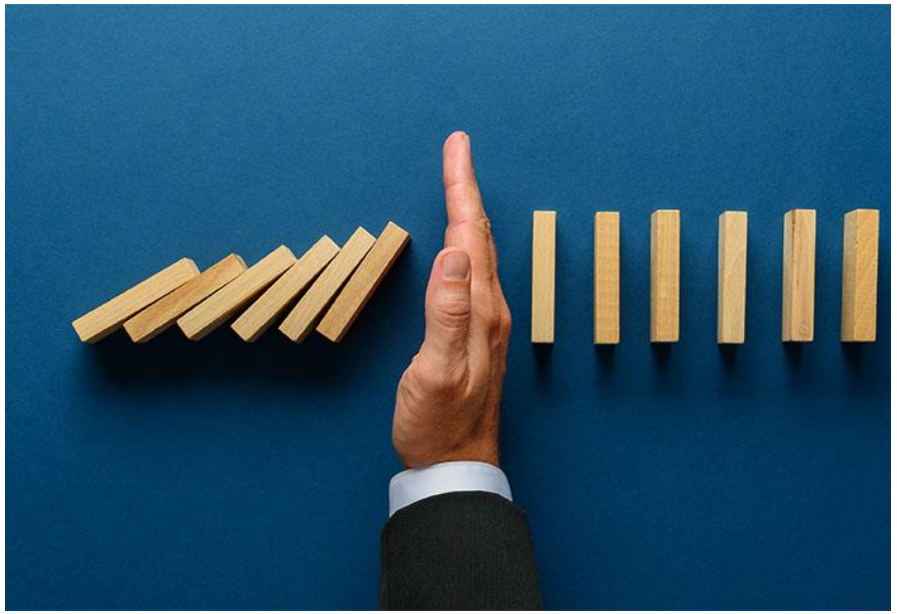
MD originally played a physical action, but the are now becoming generator and repository of very sensitive data.

Cure is not enough anymore

We do not want to get sick at all

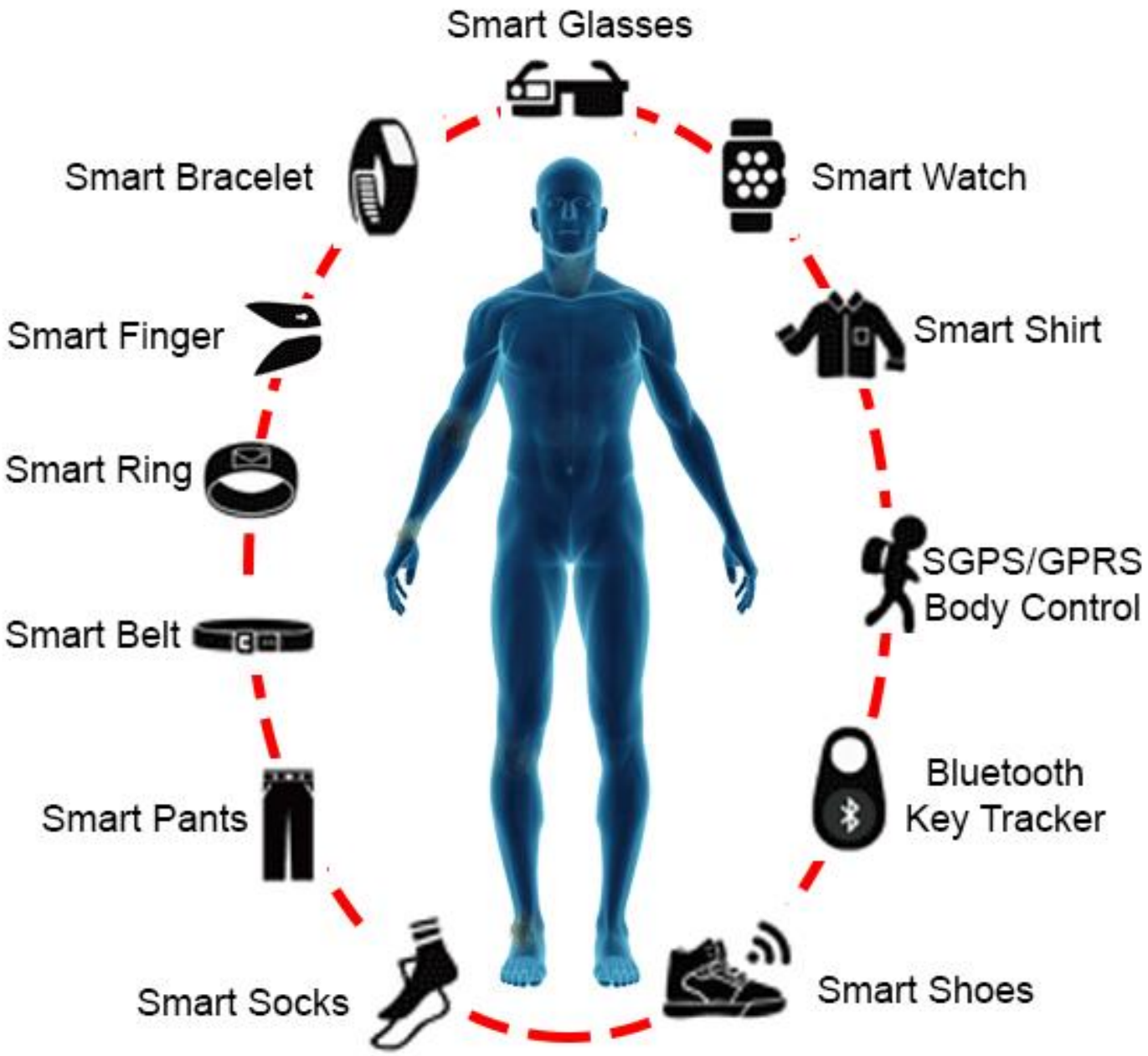
From cure to Prevention

Cure: Chemistry
Surgery



Prevention: Electronics
Internet
A.I.

Wearable connected Devices



Biophysical information generated by the body exterior

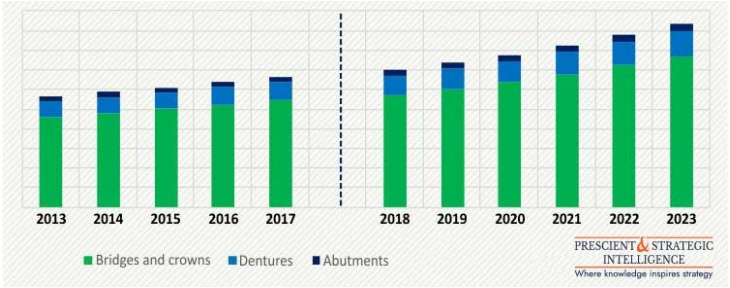
How probing from the inside ?

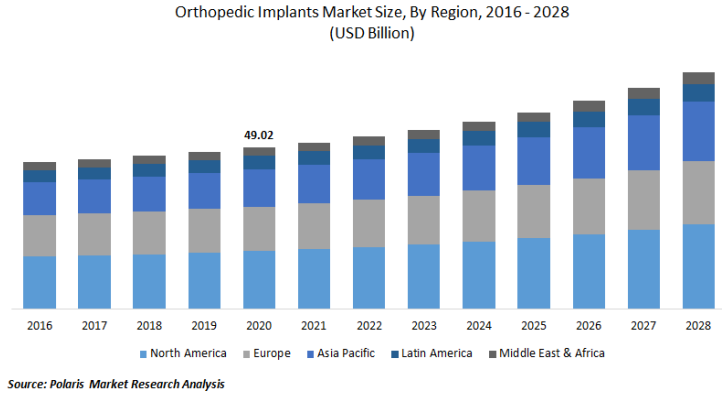
Prosthesis Statistics

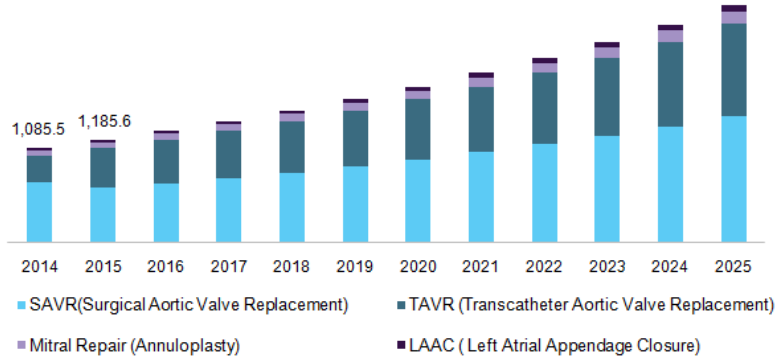
Tooth implants

Orthopedic Implants

Cardiovasc. Implants





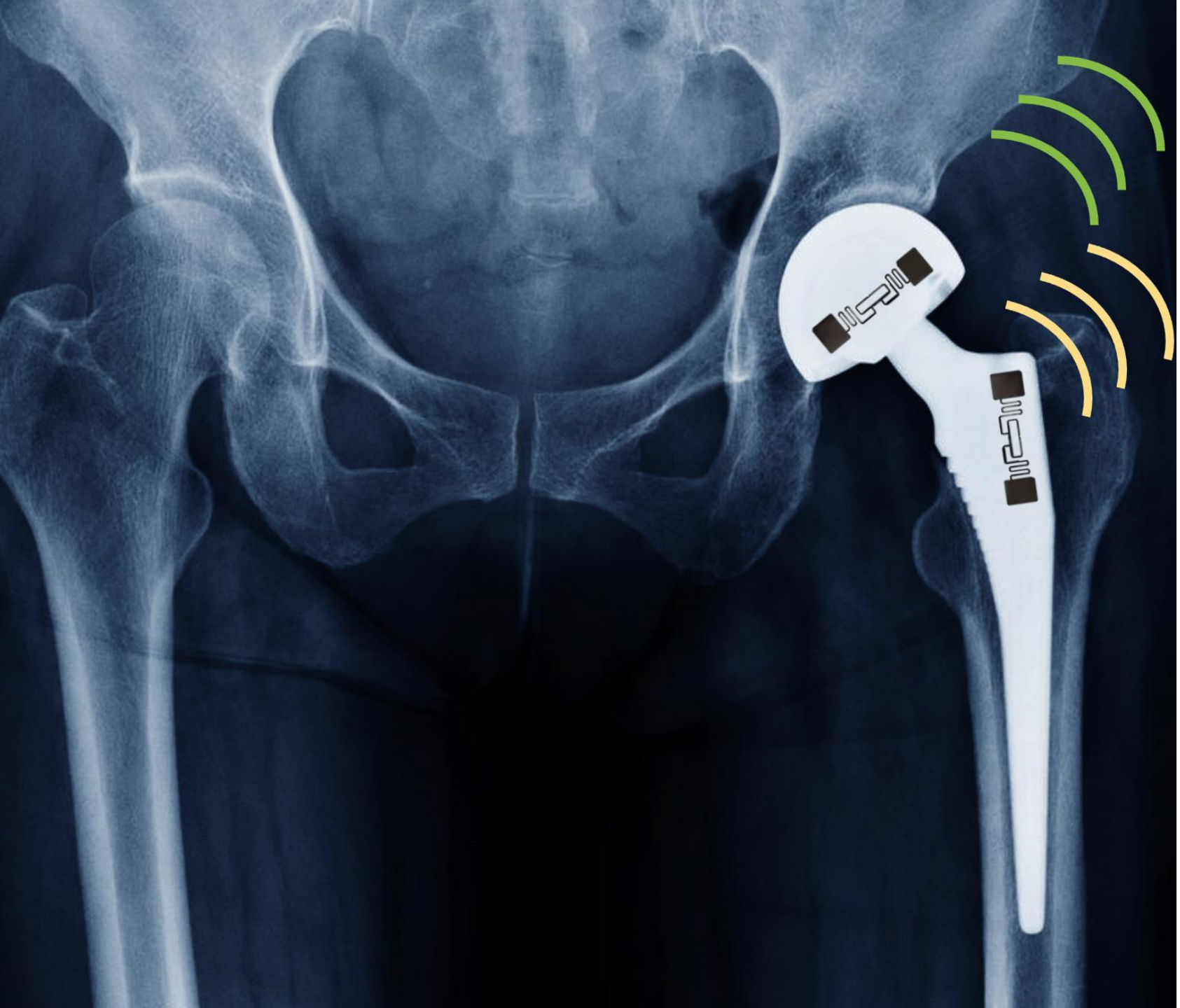


(Grans View Research 2017)

Implantation opens a channel toward the body inside

Implants can stay inside for years

We can augment prosthesis to make it working as wireless sensors



Cyber Prostheses

Physical endo-implants augmented with data generation capability

The revolution of cyber-implants

Local storage of:

- device ID,
- manufacturer and model
- patient issue
- recent screening

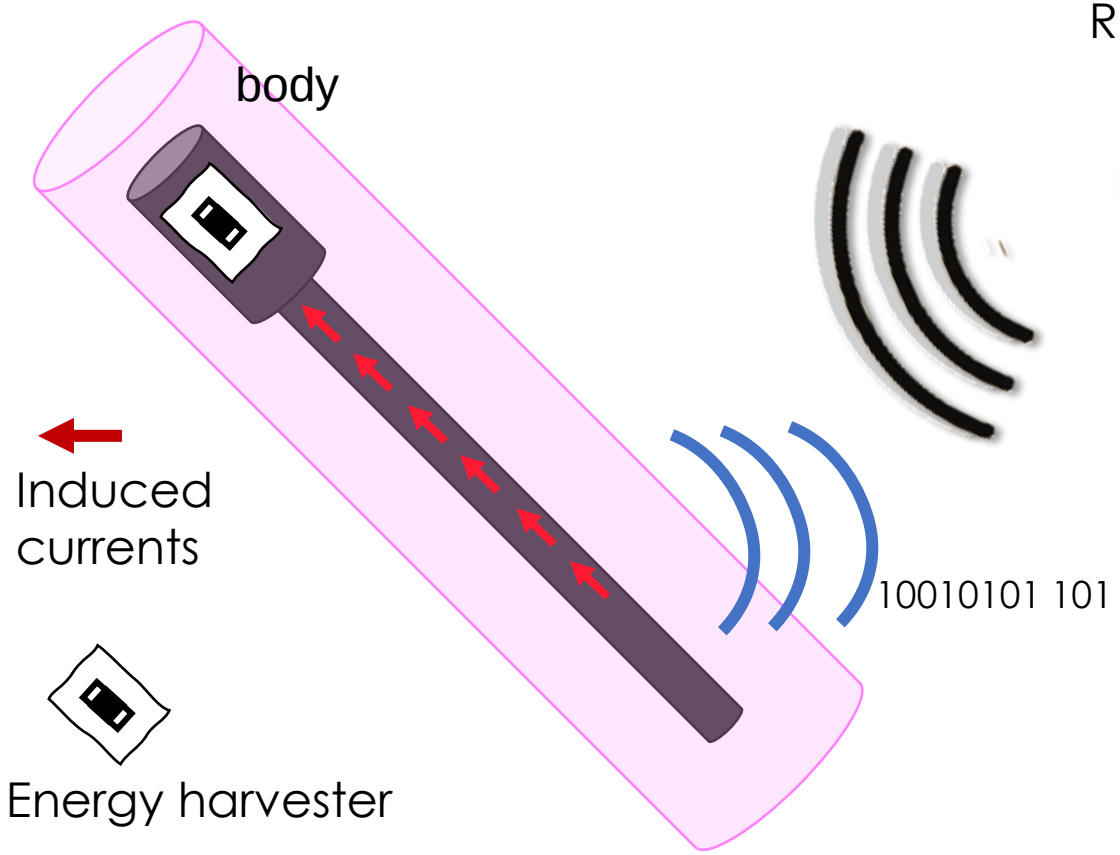
Measurement of

- temperature
- pH
- bacteria levels
- enzymes
- deformation
- pressure
- motions

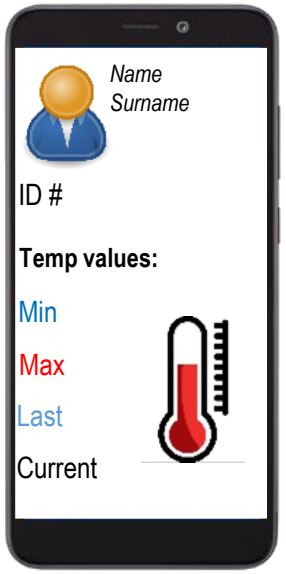
Applications

- Early detection of health problems
- Monitoring of the device health status
- Proactive and preventive management of potential failures
- Post surgery monitoring
- Identification of exceptions
- Optimization of the ad-hoc drug delivery (precision medicine)

Antennification of the prostheses



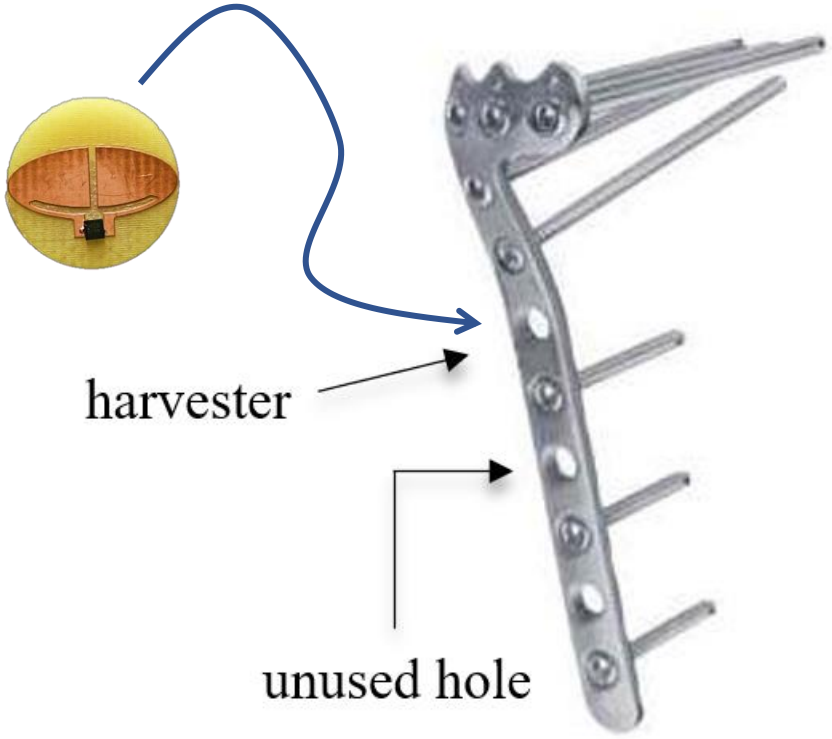
Reader

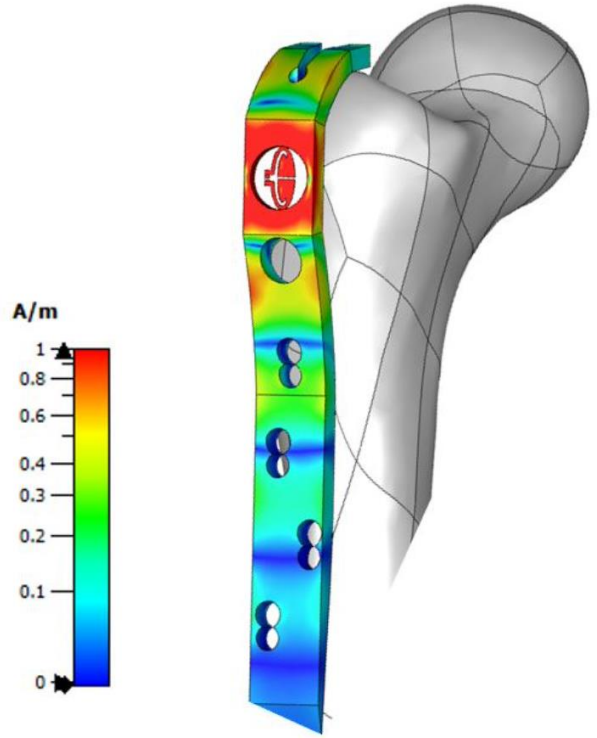


Visualization interface

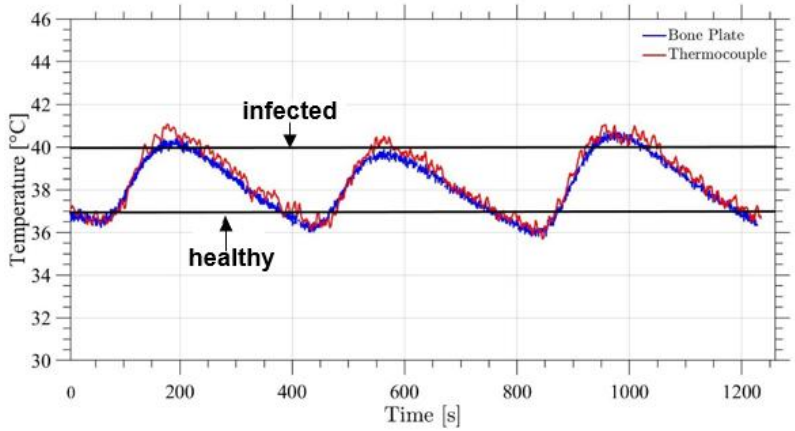
Bone Fixing-Plate

Monitoring of Infections



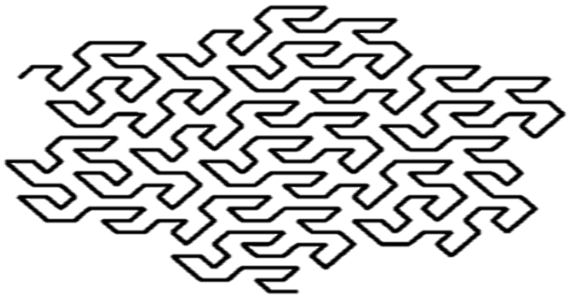


➔ **Un-used holes can host energy coupler and sensors**

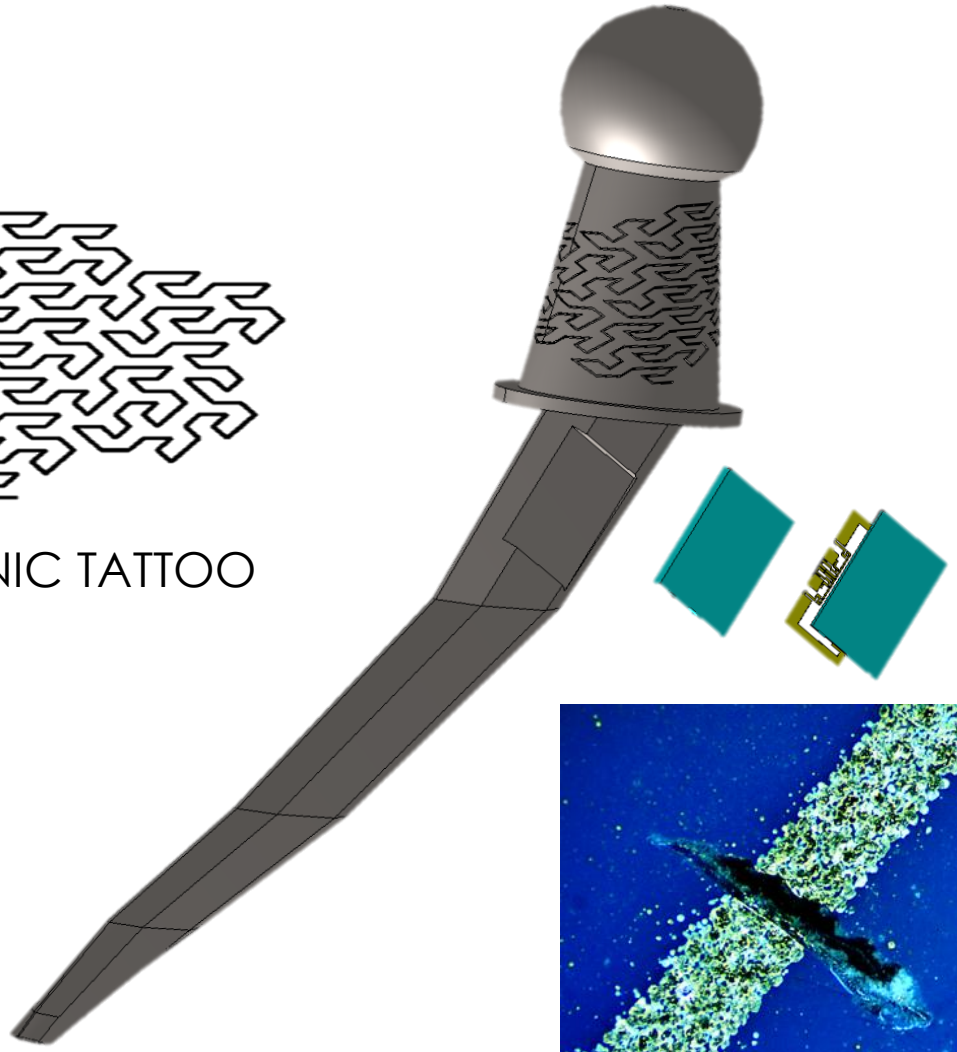


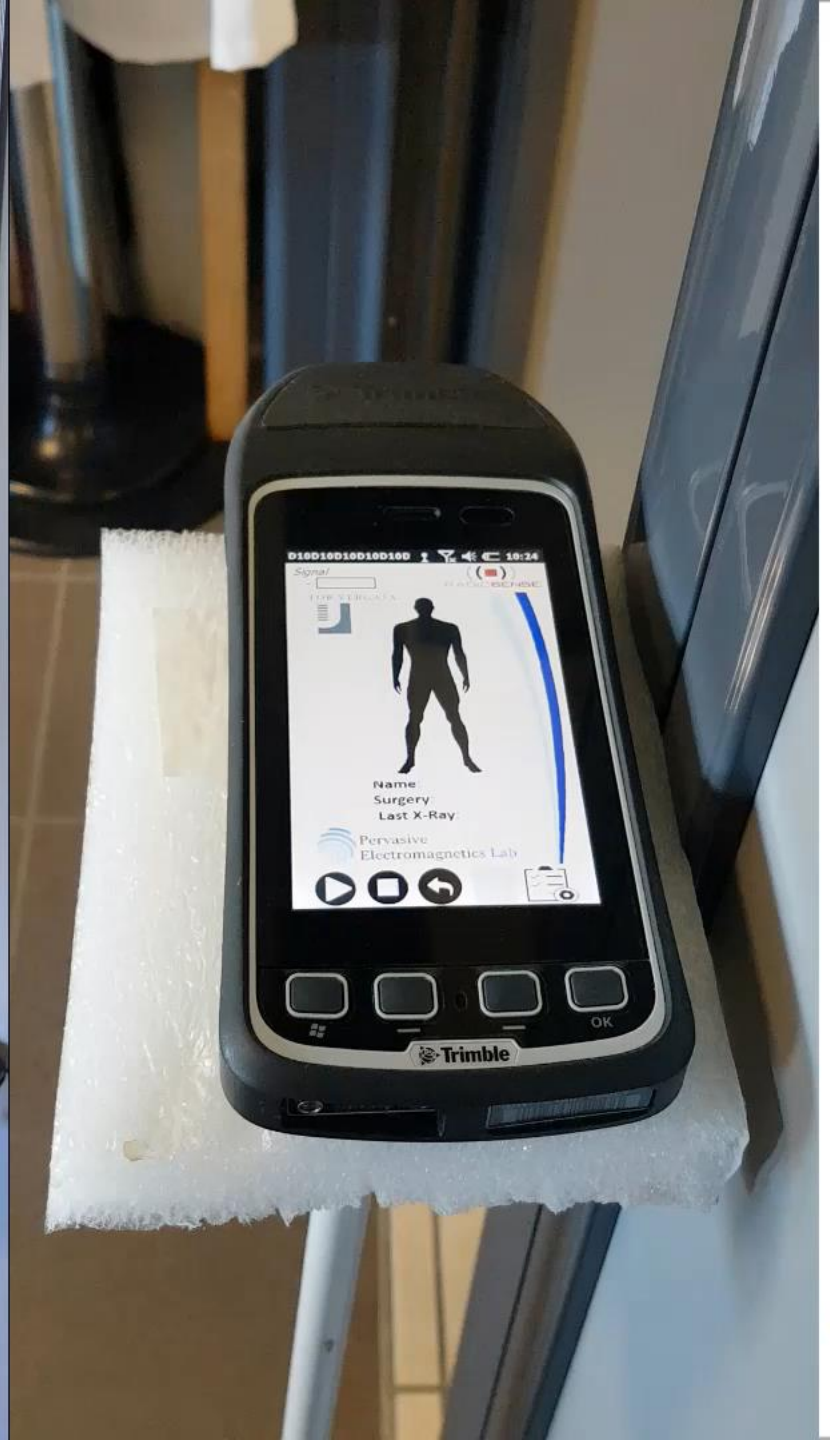
Hip Prosthesis

Early detection of Microcracks



ELECTRONIC TATTOO





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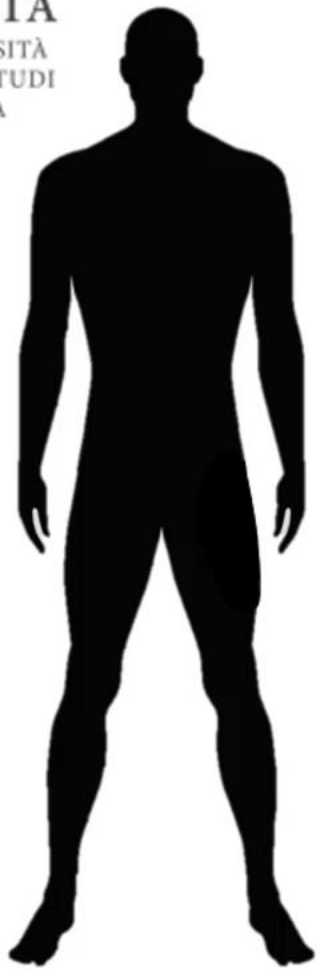
DI ROMA



Name:

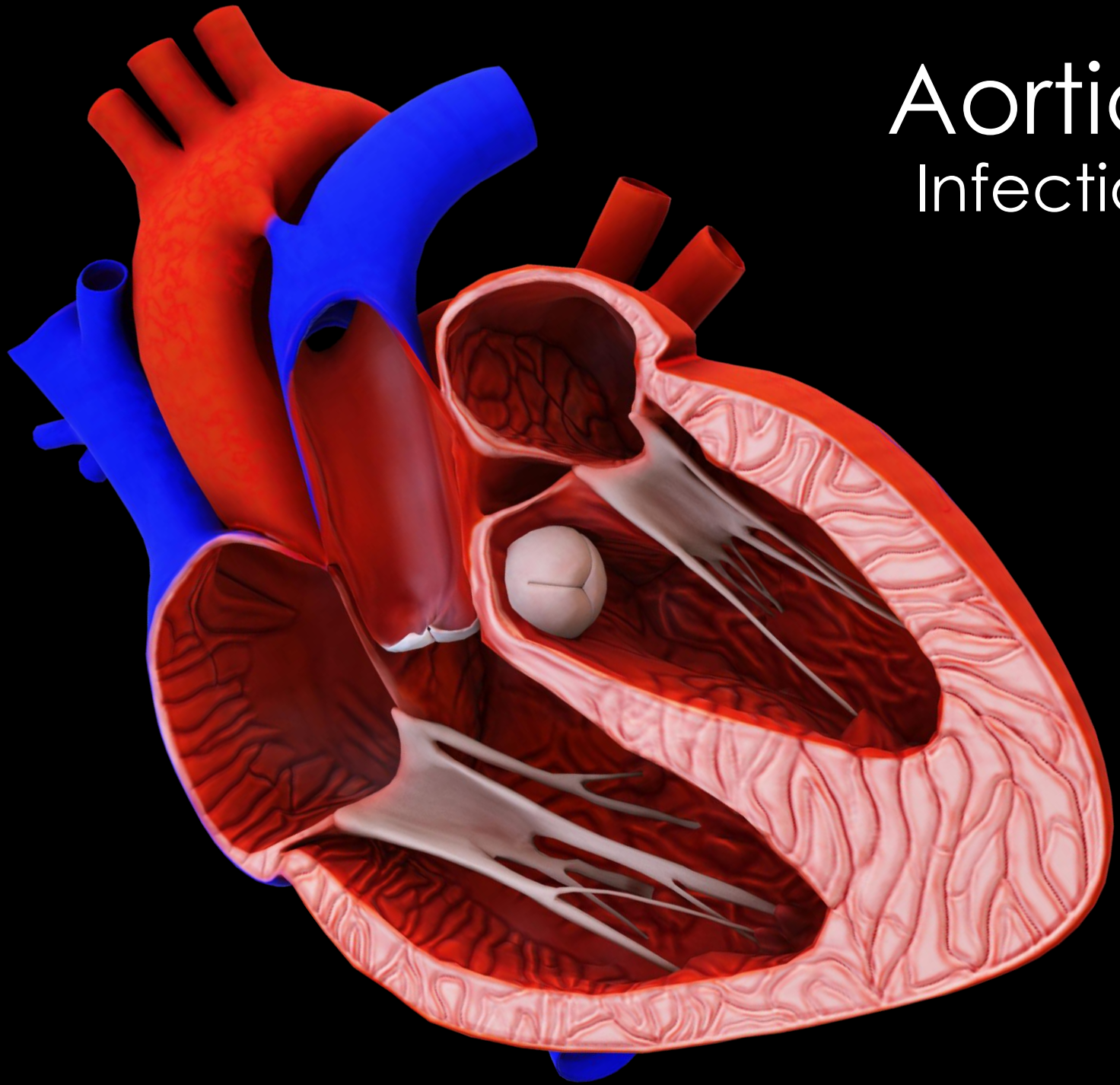
Surgery:

Last X-Ray:

Pervasive
Electromagnetics Lab

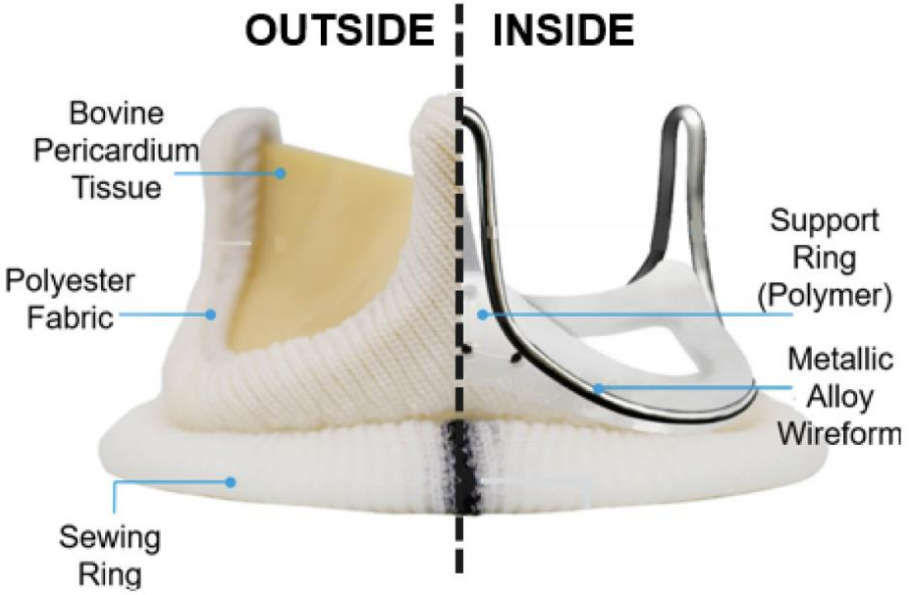
Aortic Valve

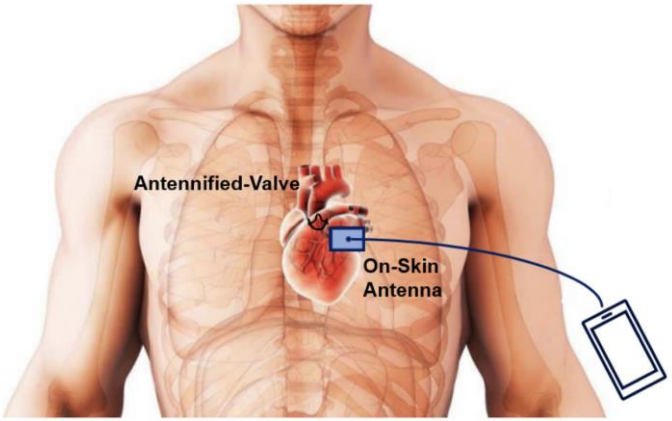
Infections, stress,..

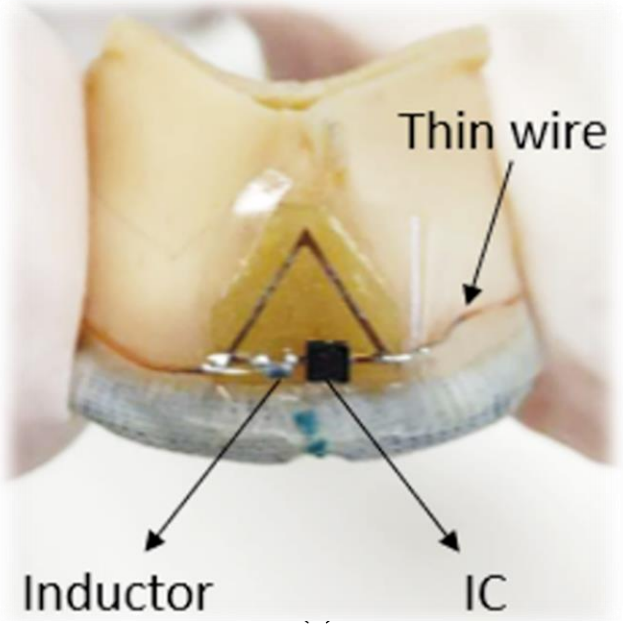


Aortic Valve

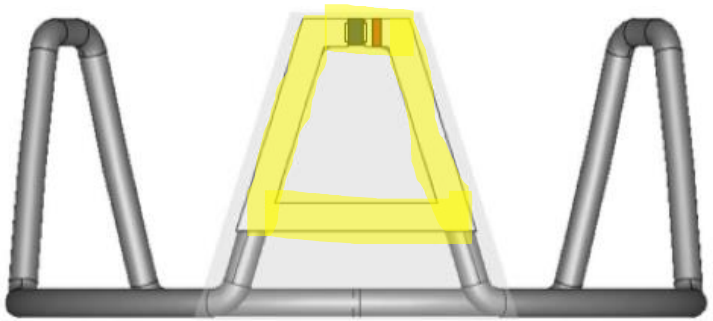
Infections, stress,..

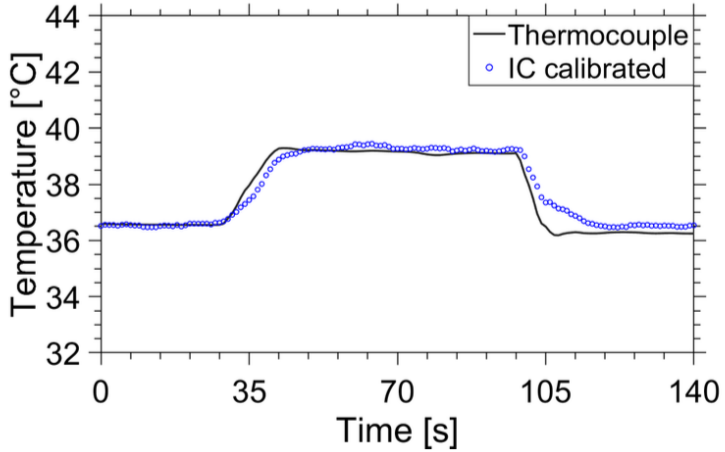


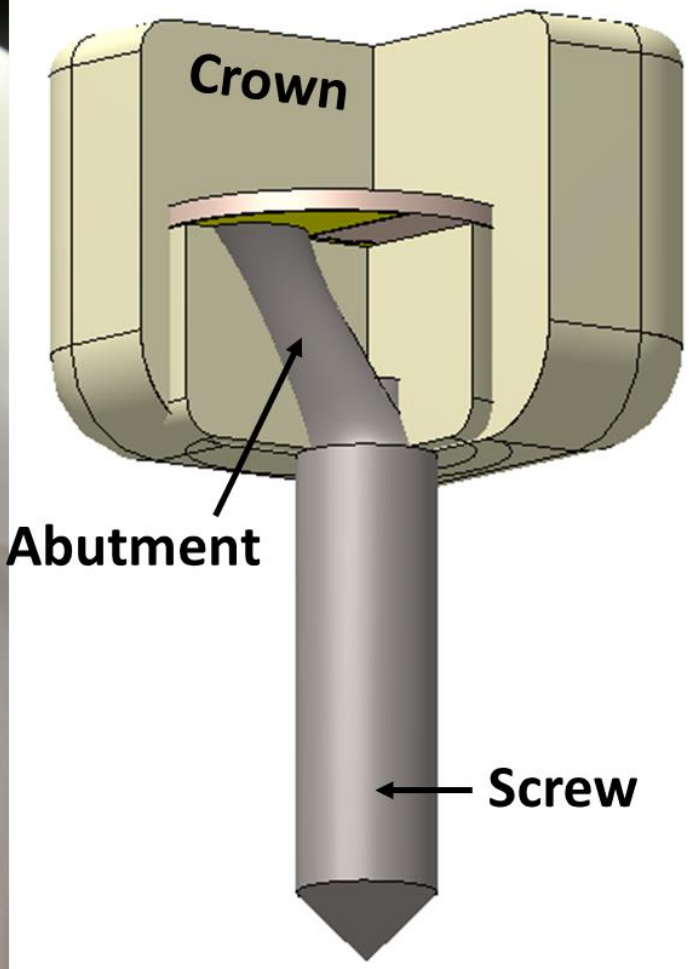




Energy harvester
& sensors



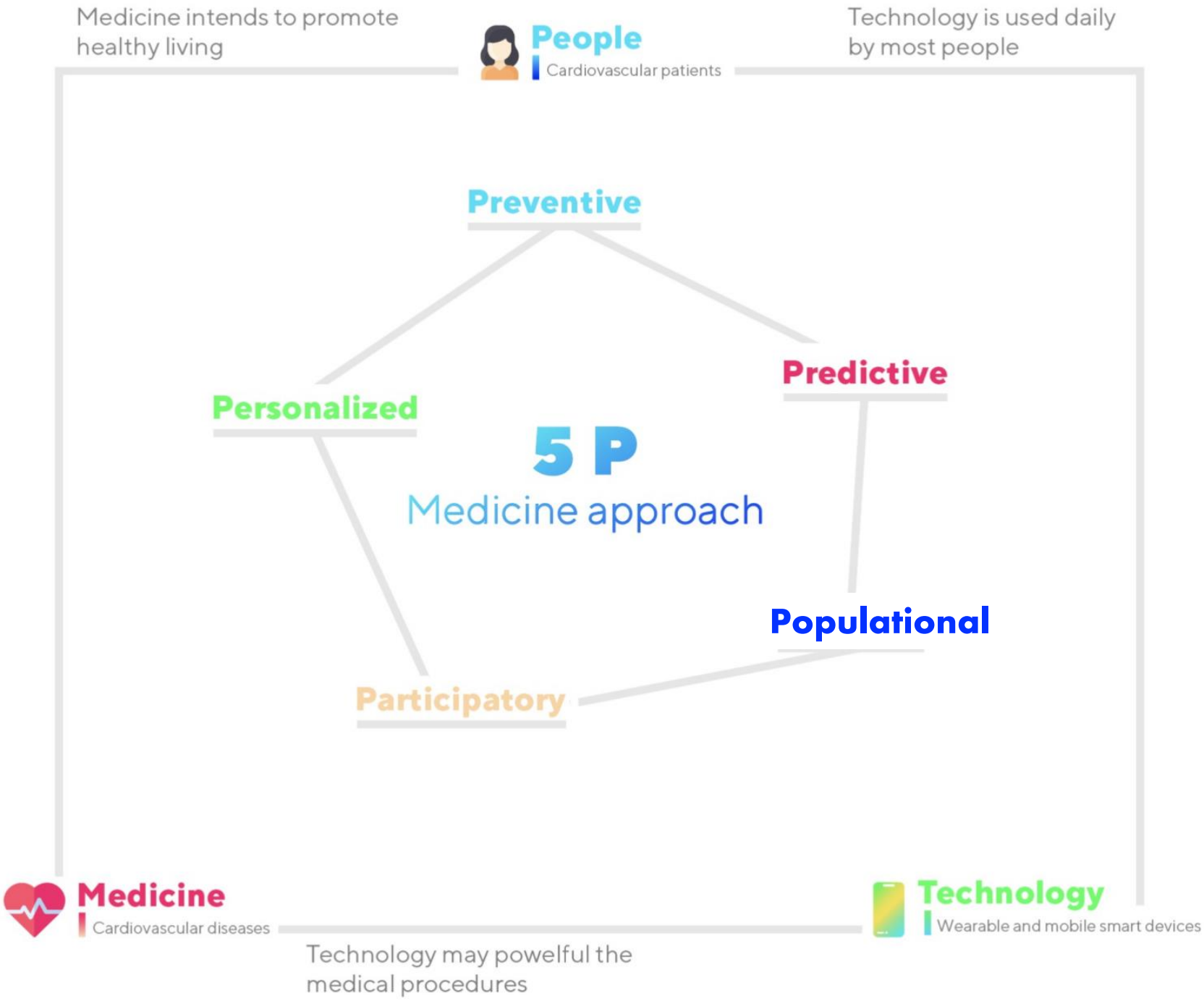




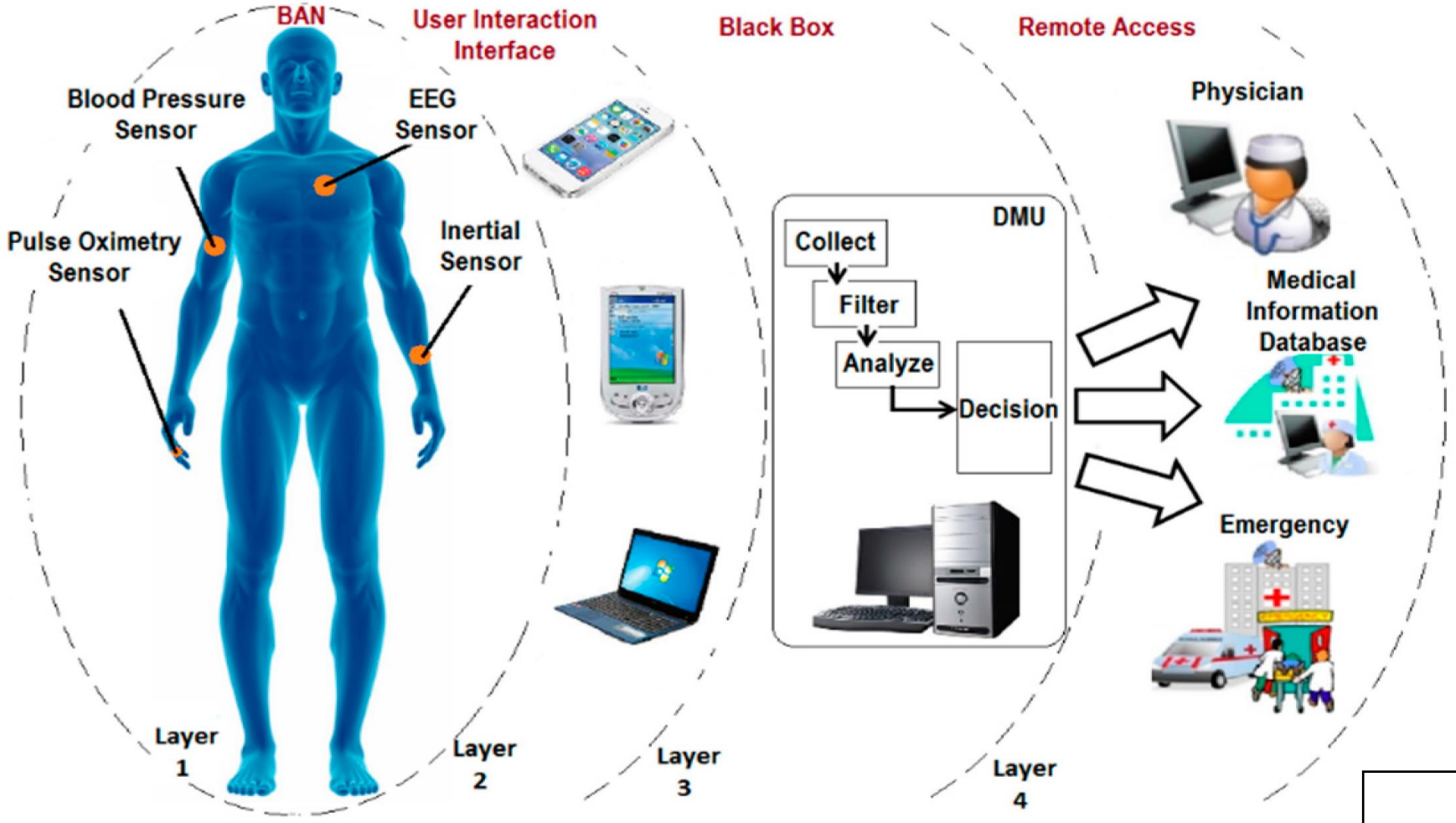
Dental Capsule

Infections, mechanical parameters

- ➔ P5-Medicine
- ➔ Hospital-home continuity
- ➔ DIGITAL TWINS



Wireless Connectivity



- Configuration & SW upgrade
- Data retrieval
- Actuation

Potential Non-authorized Interactions

Take-home messages

Medical device of the near future:

- Bio-integrated
- Pervasive
- Physical /Digital
- Wireless Interconnected

Needs:

- **Understand** source of Vulnerabilties
- **Correlate** their impacts with the Safety and the Privacy of the User/Patient

Security ⇔ Safety ⇨ **Cyber4Health** Obs.

Thanks for listening !

Gaetano@marrocco@uniroma2.it
www.pervasive.ing.uniroma2.it

CYBER4 HEALTH

Pervasive Electromagnetics Lab