HEART VALVE
PROSTHESIS BEHAVIOUR IN
MICROGRAVITY ENVIRONMENT

Chiara Manzini

Aerospace Engineer

- **Bachelor Degree:**
  Aerospace Engineering
  Politecnico di Milano

- **Master Degree:**
  Systems and control
  (Aerospace Engineering)
  ISAE-Supaero

- **High interest in Biomedical world**

Anisia Lauditi

Biomedical Engineer

- **Bachelor Degree:**
  Biomedical Engineering
  Politecnico di Torino

- **Master Degree:**
  Biomechanics and Biomaterials
  (Biomedical Engineering)
  Politecnico di Milano

- **High interest in Aerospace world**

Outline

1. Context
2. State of the art
3. Objectives
4. Experiment set-up

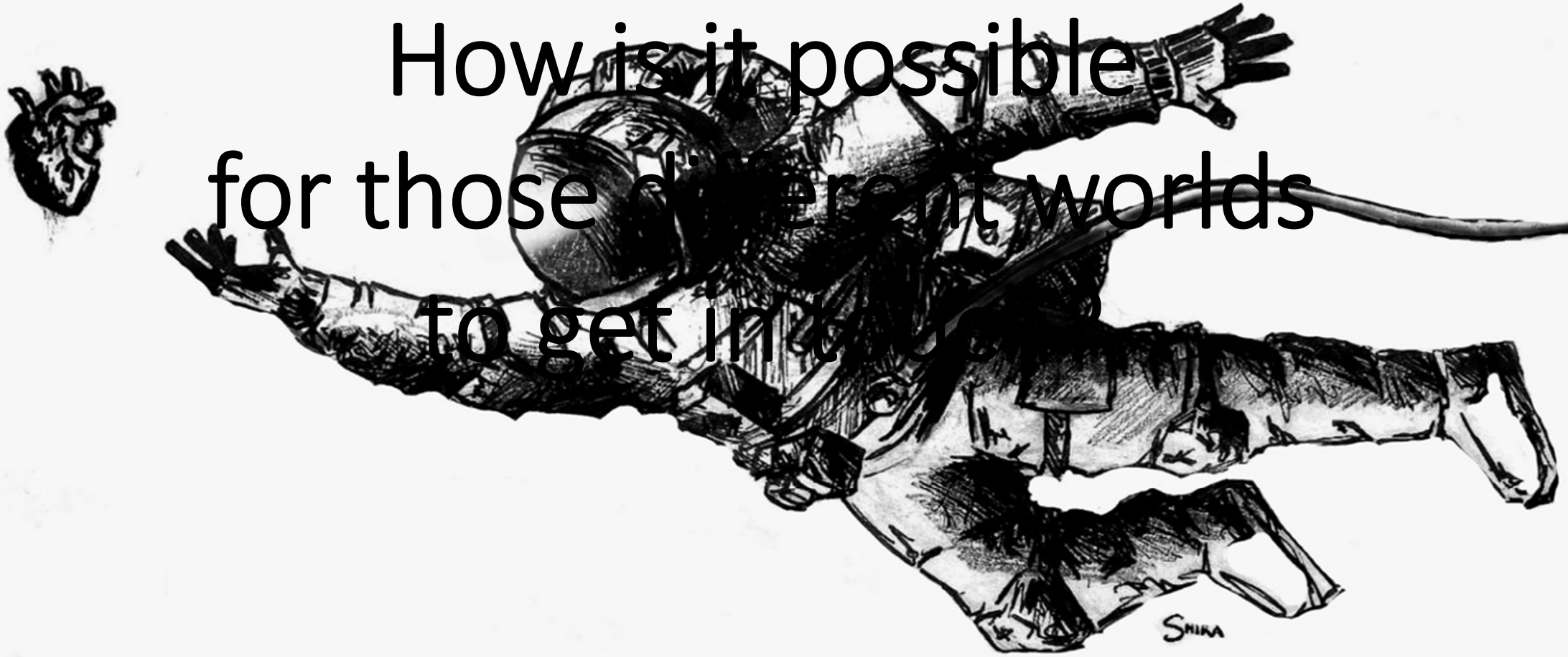
Outline

5 Experiment process

6 Mass and volumes

7 Costs and risk analysis

8 Next steps

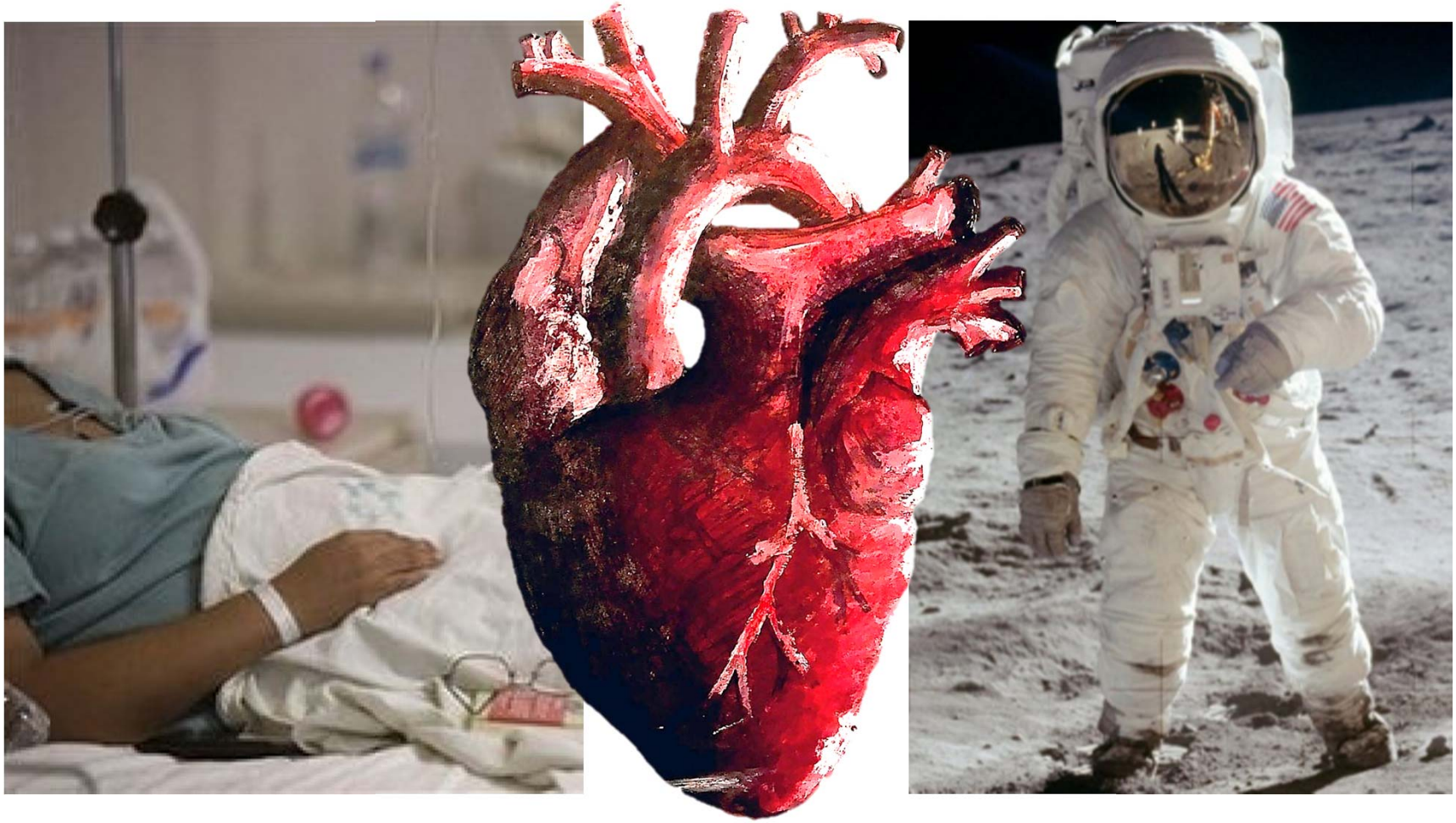


How is it possible
for those different worlds
to get in touch?

Shira H. S.

Context

Context



Context

17,9 million

people die each day for Cardiovascular disease, an estimated 31% worldwide

300.000

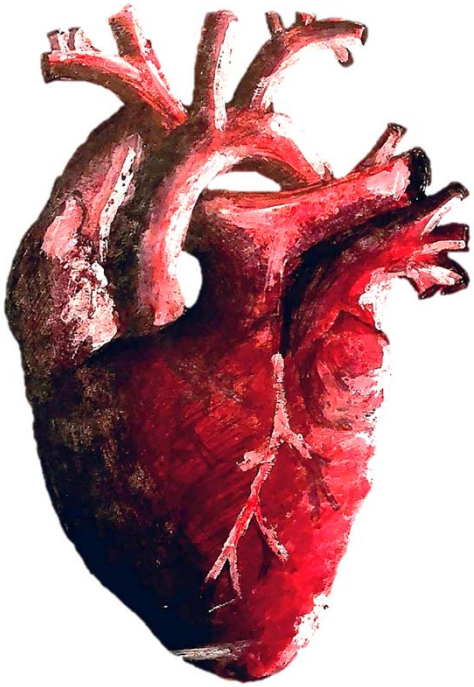
surgical heart valve replacement performed worldwide annually

850.000

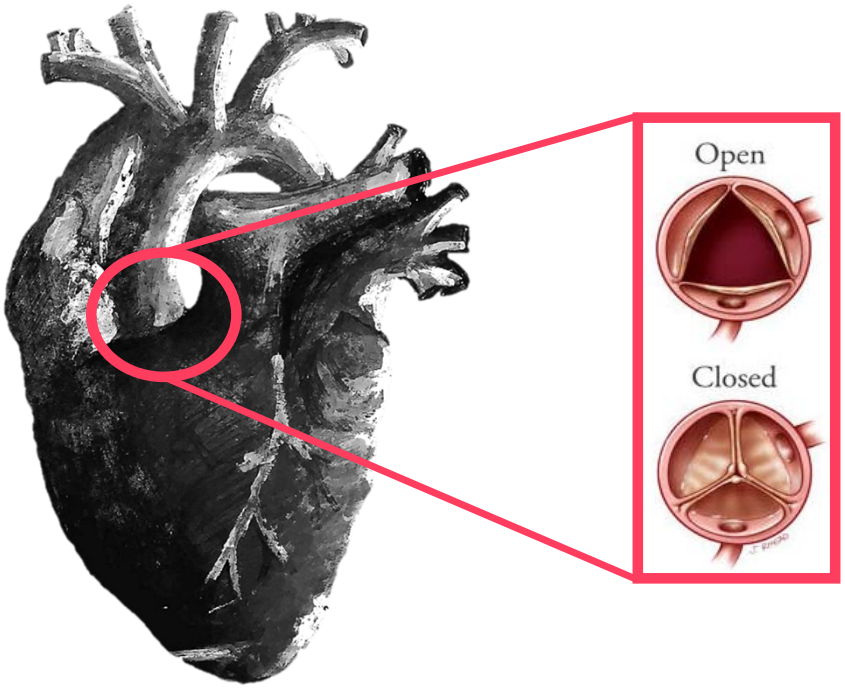
expected demand for interventions in 2050

https://www.who.int/health-topics/cardiovascular-diseases/
https://www.frontiersin.org/articles/10.3389/fcvm.2019.00047/full#B1

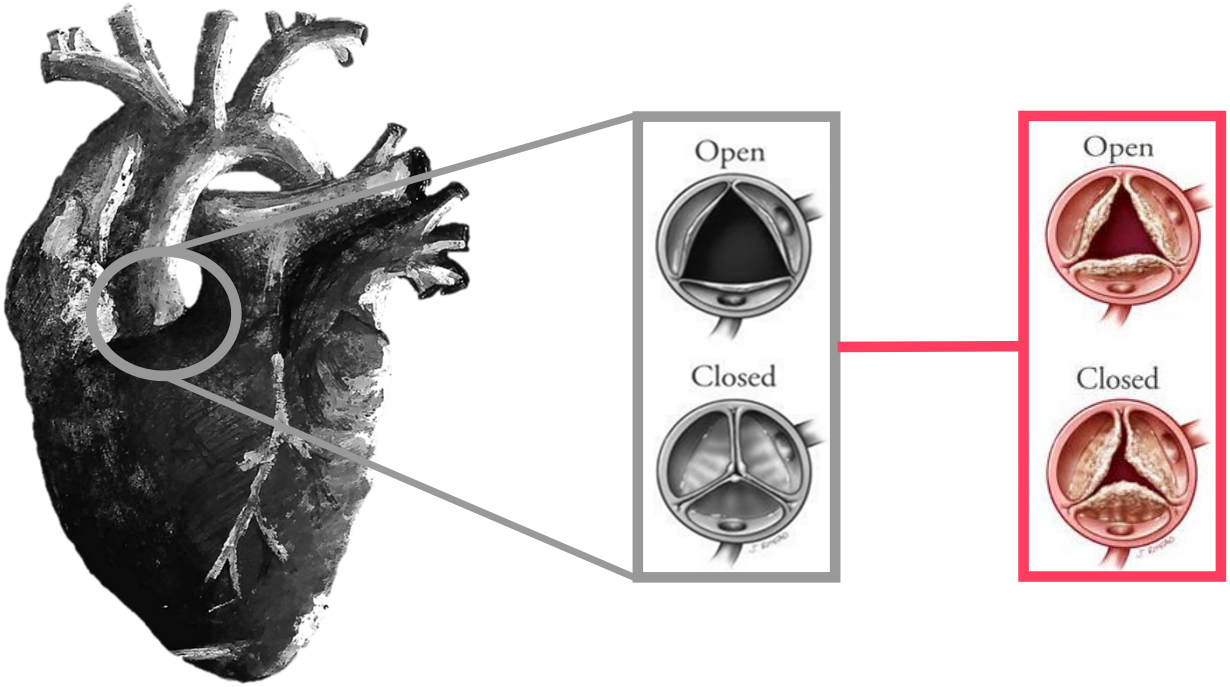
State of the art



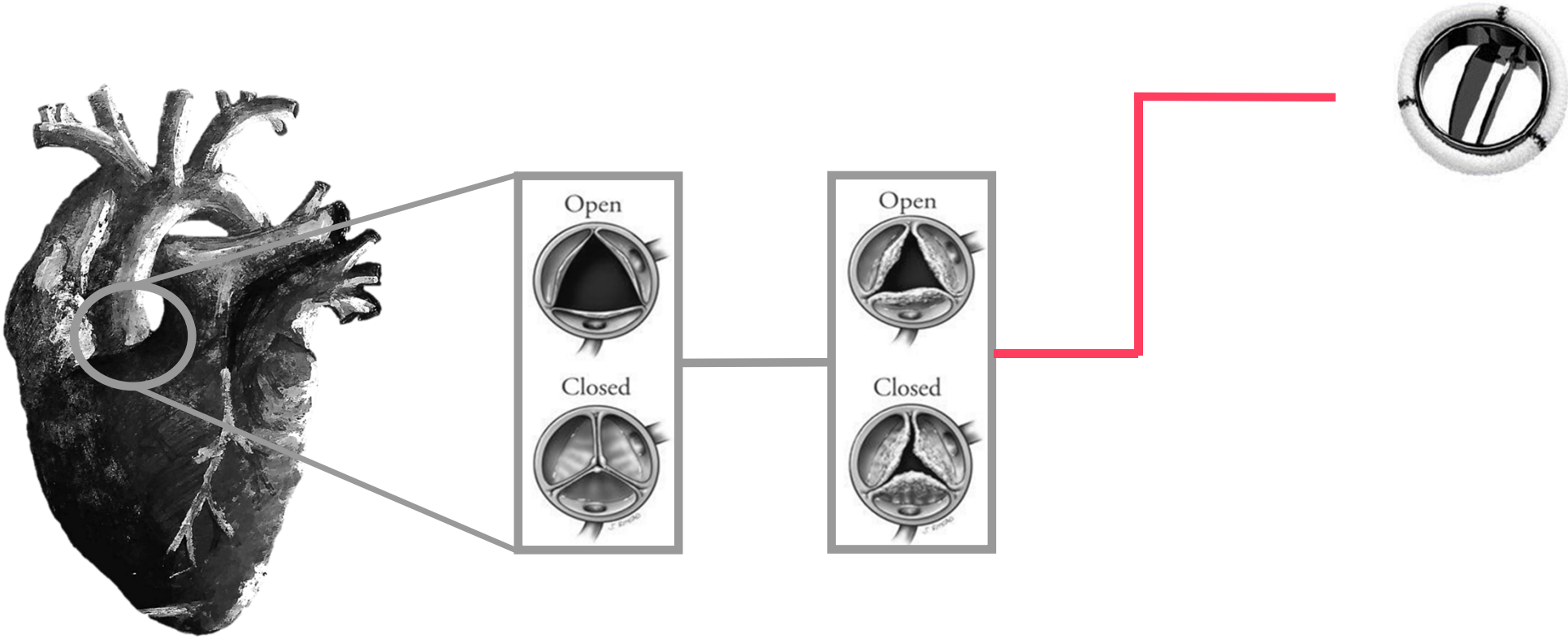
State of the art



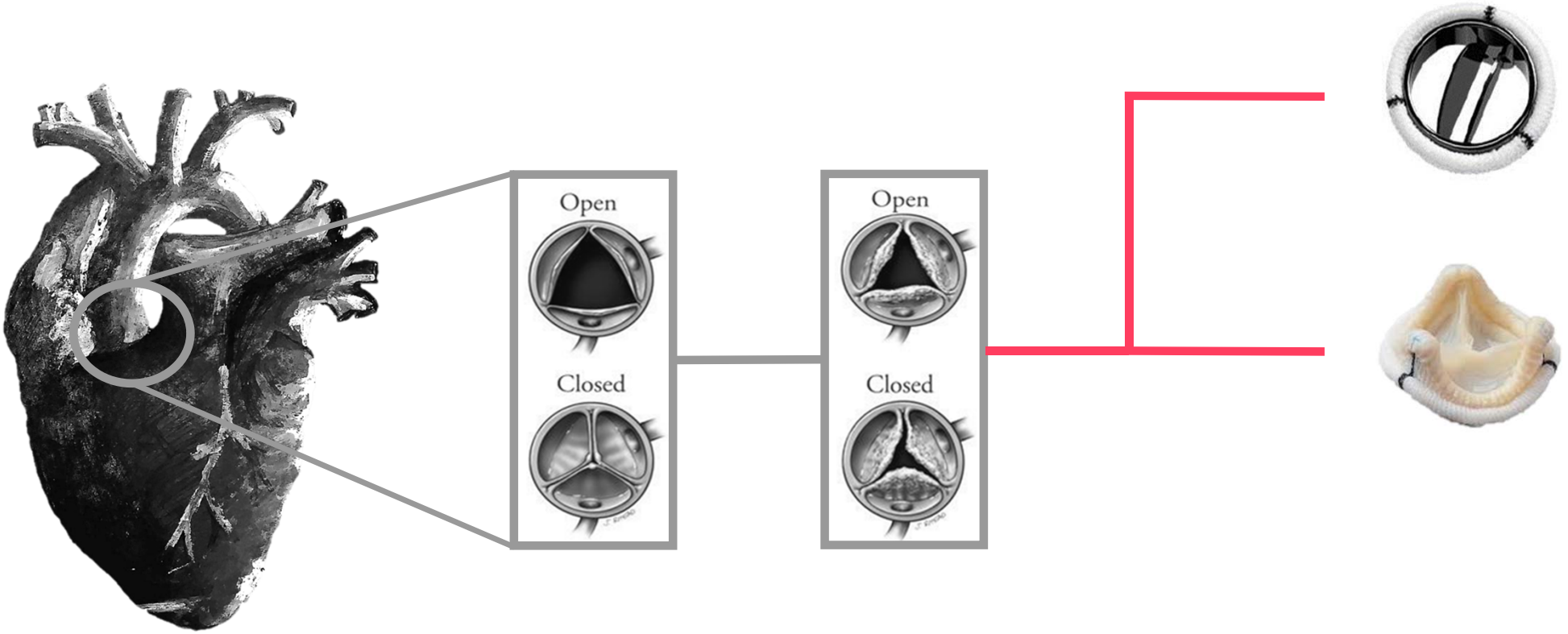
State of the art



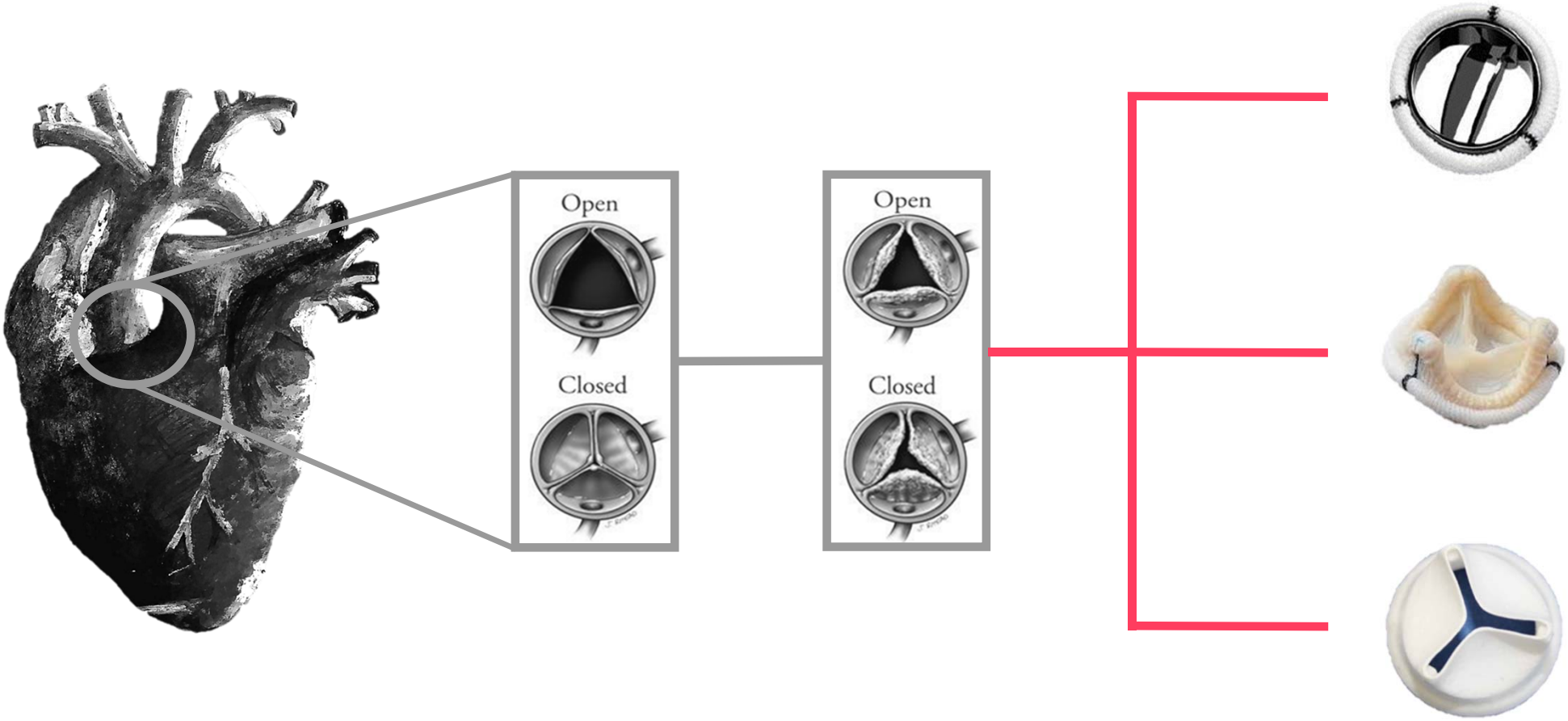
State of the art



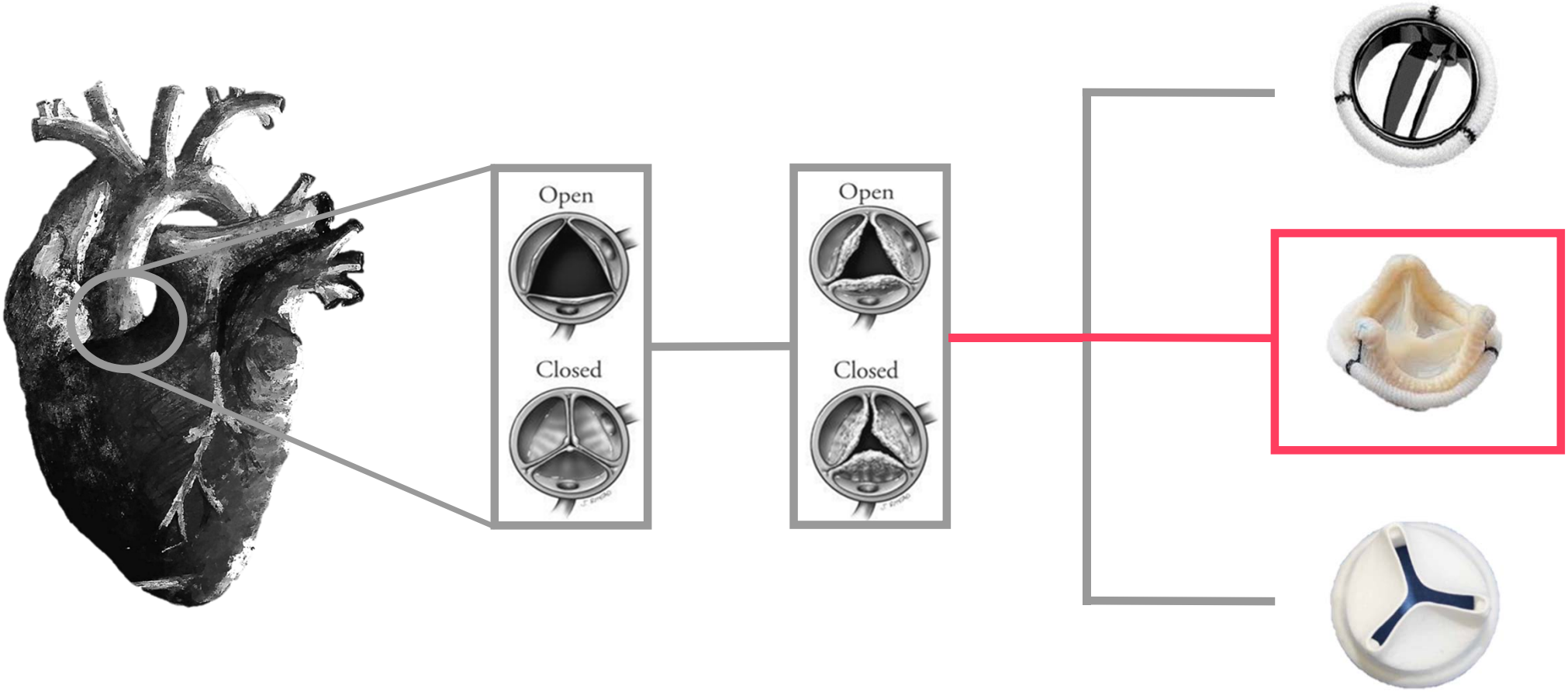
State of the art



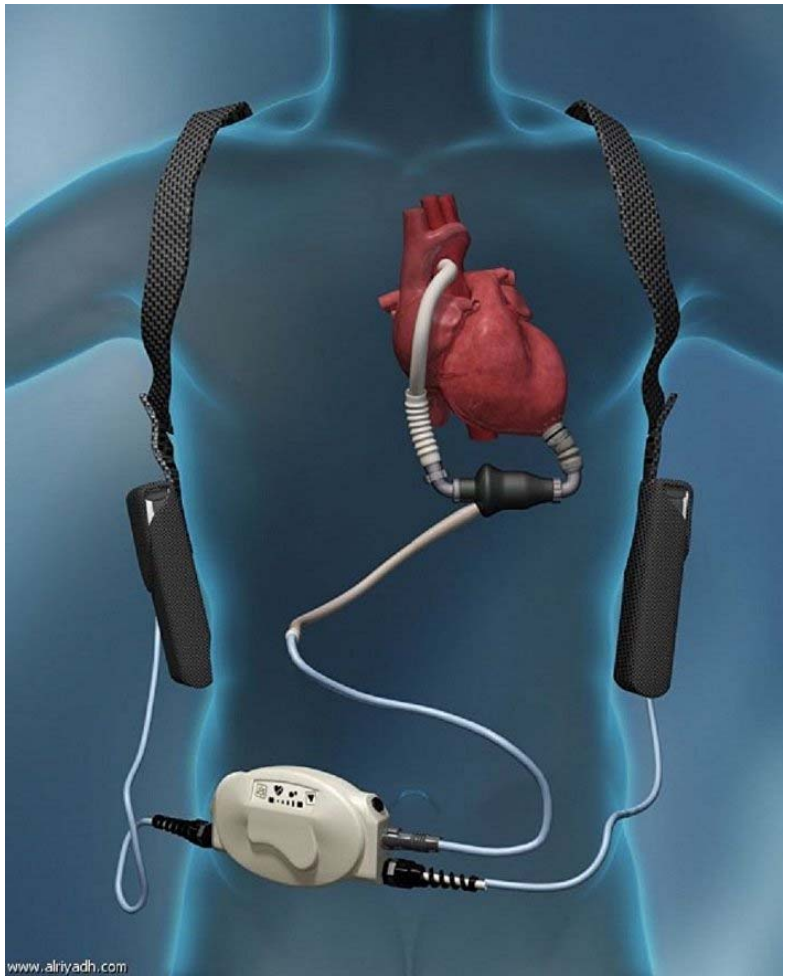
State of the art

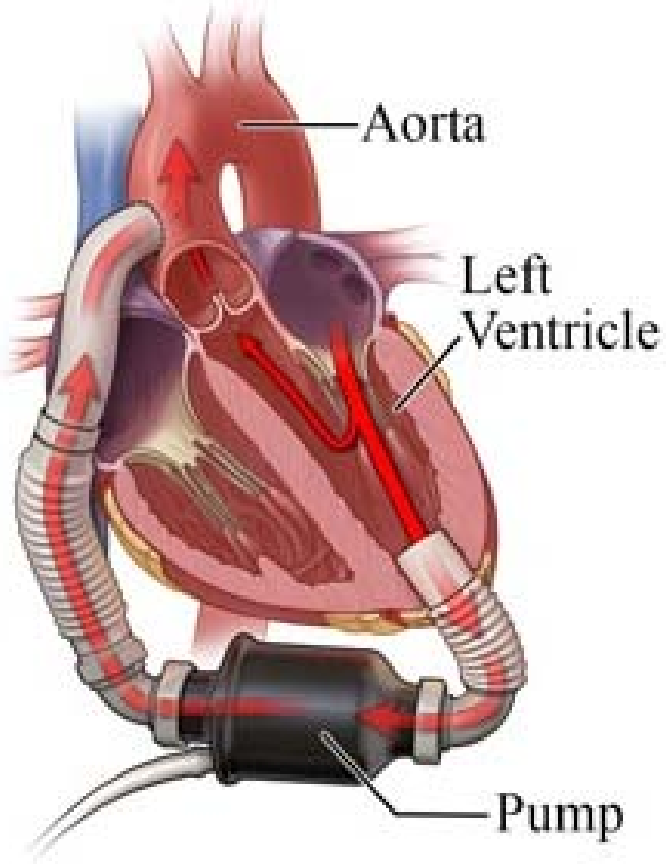


State of the art



State of the art





State of the art

State of the art

Higher calcium concentration

State of the art

Higher calcium concentration

Lower veins and arteries stiffness

State of the art

- Higher calcium concentration
- Lower veins and arteries stiffness
- Hypovolemia and haematocrit increase

State of the art

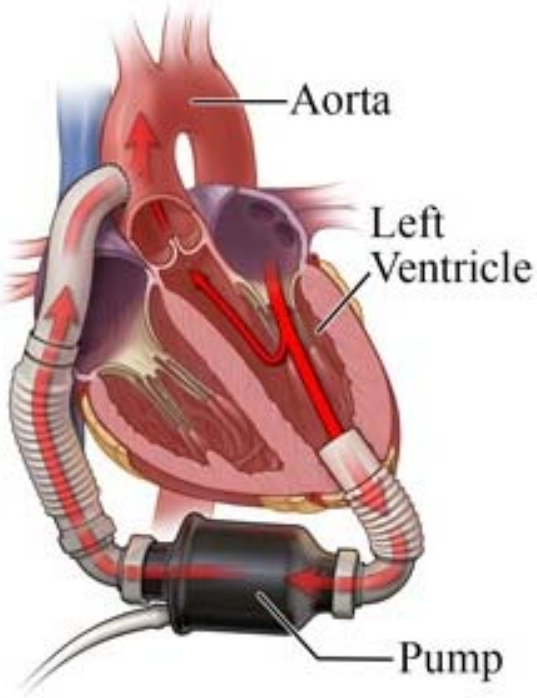
- Higher calcium concentration
- Lower veins and arteries stiffness
- Hypovolemia and haematocrit increase
- Blood shift

State of the art

- Higher calcium concentration
- Lower veins and arteries stiffness
- Hypovolemia and haematocrit increase
- Blood shift
- Stroke volume reduction

State of the art

- Higher calcium concentration
- Lower veins and arteries stiffness
- Hypovolemia and haematocrit increase
- Blood shift
- Stroke volume reduction

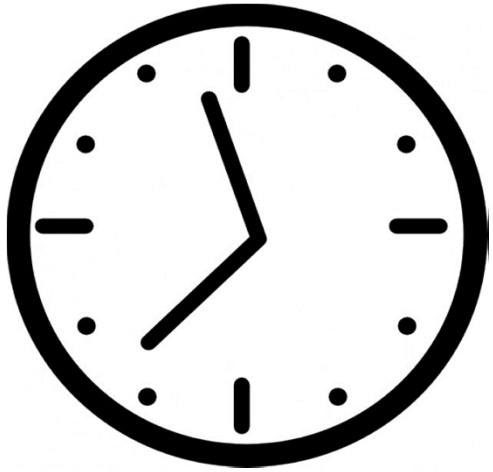


State of the art

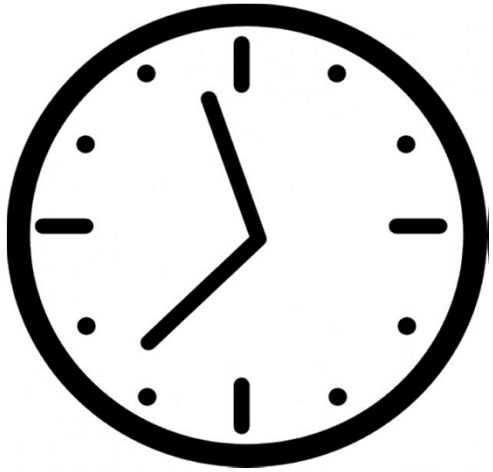
State of the art

State of the art

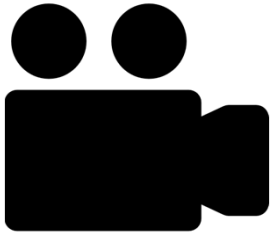
State of the art



State of the art

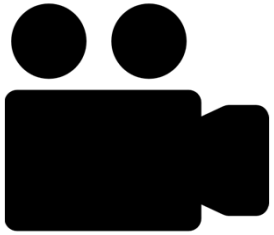


Objectives



Basal

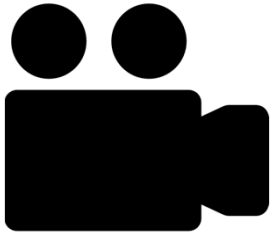
Objectives



Basal

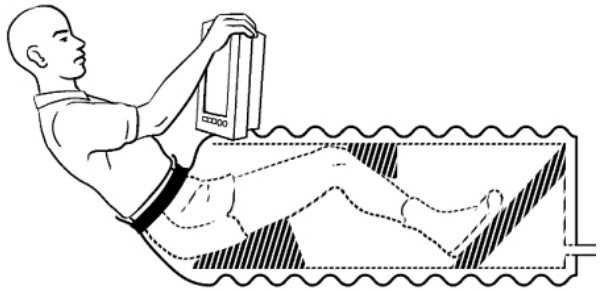
Calcification

Objectives



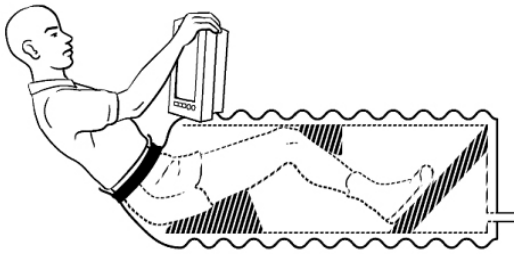
Basal

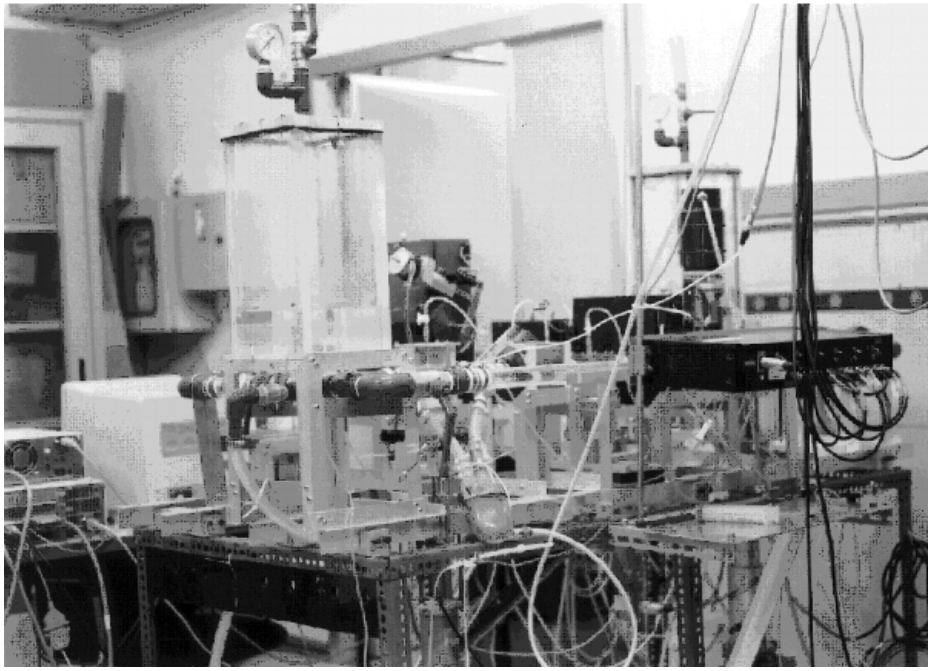
Calcification



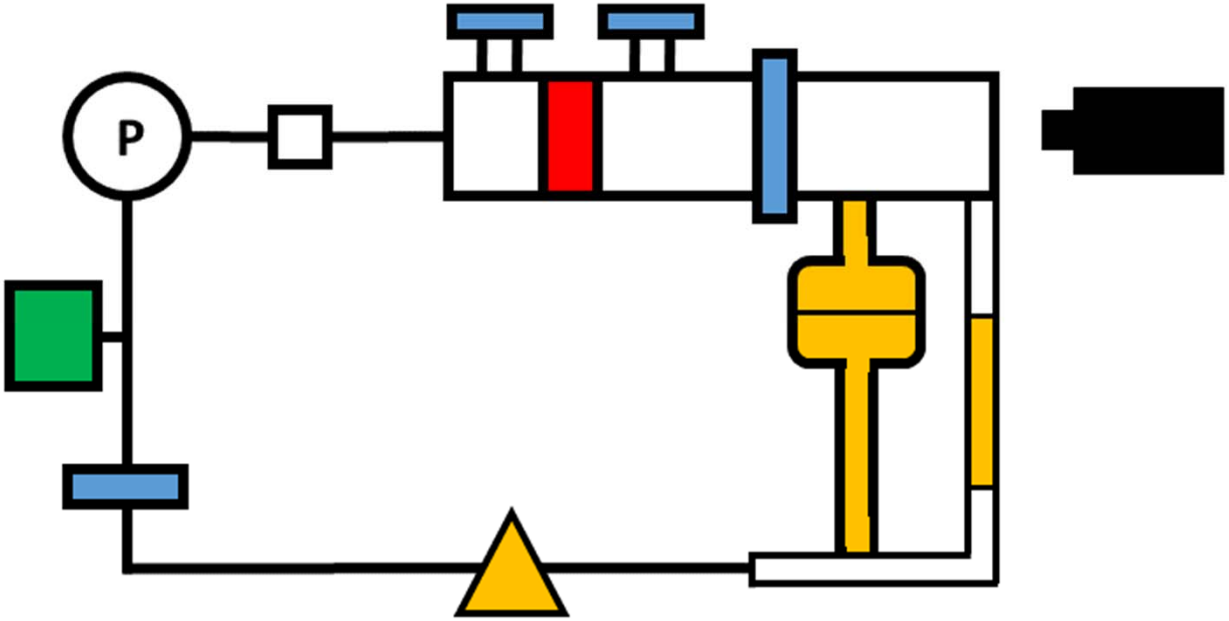
LBNP

Experiment set-up

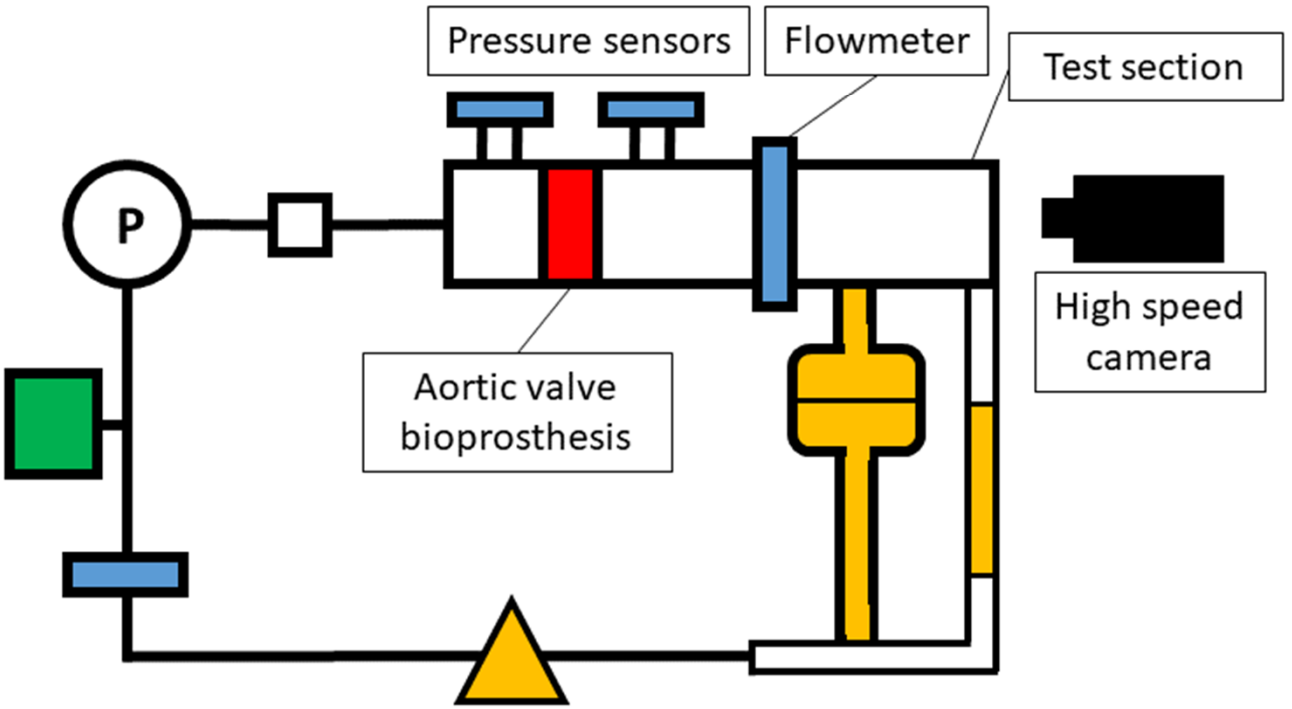




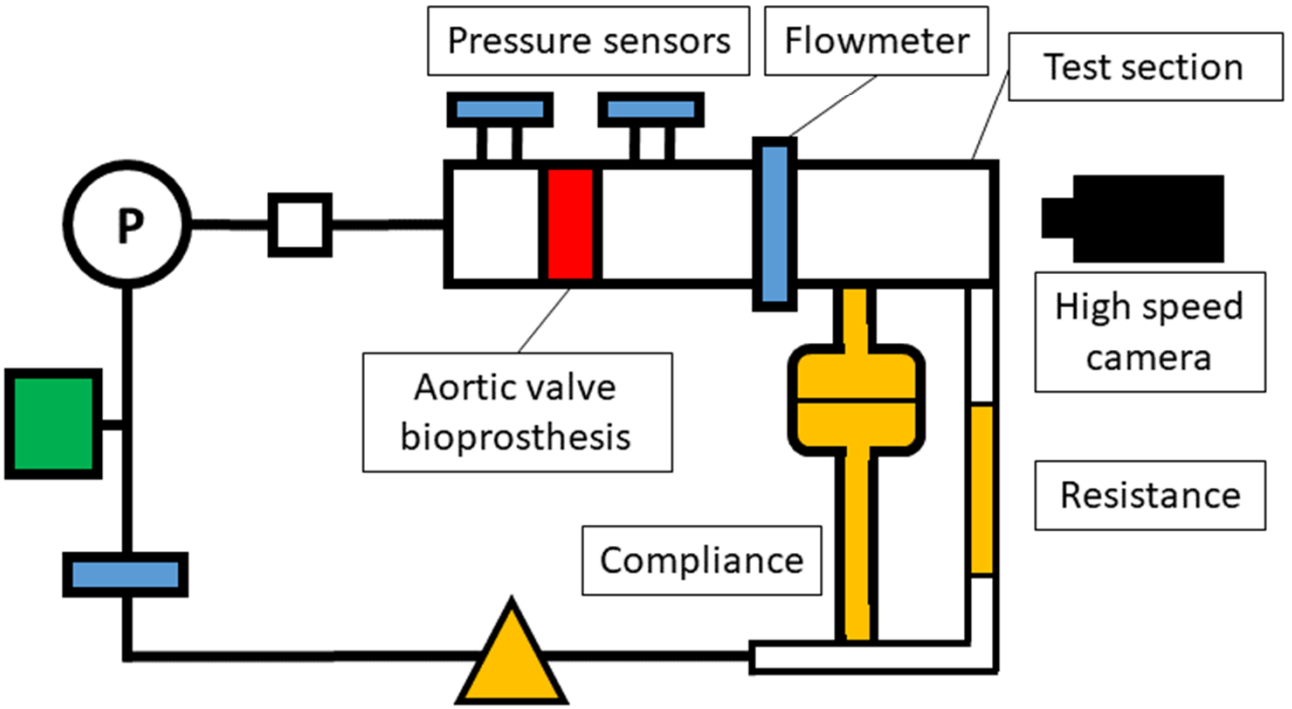
Experiment set-up



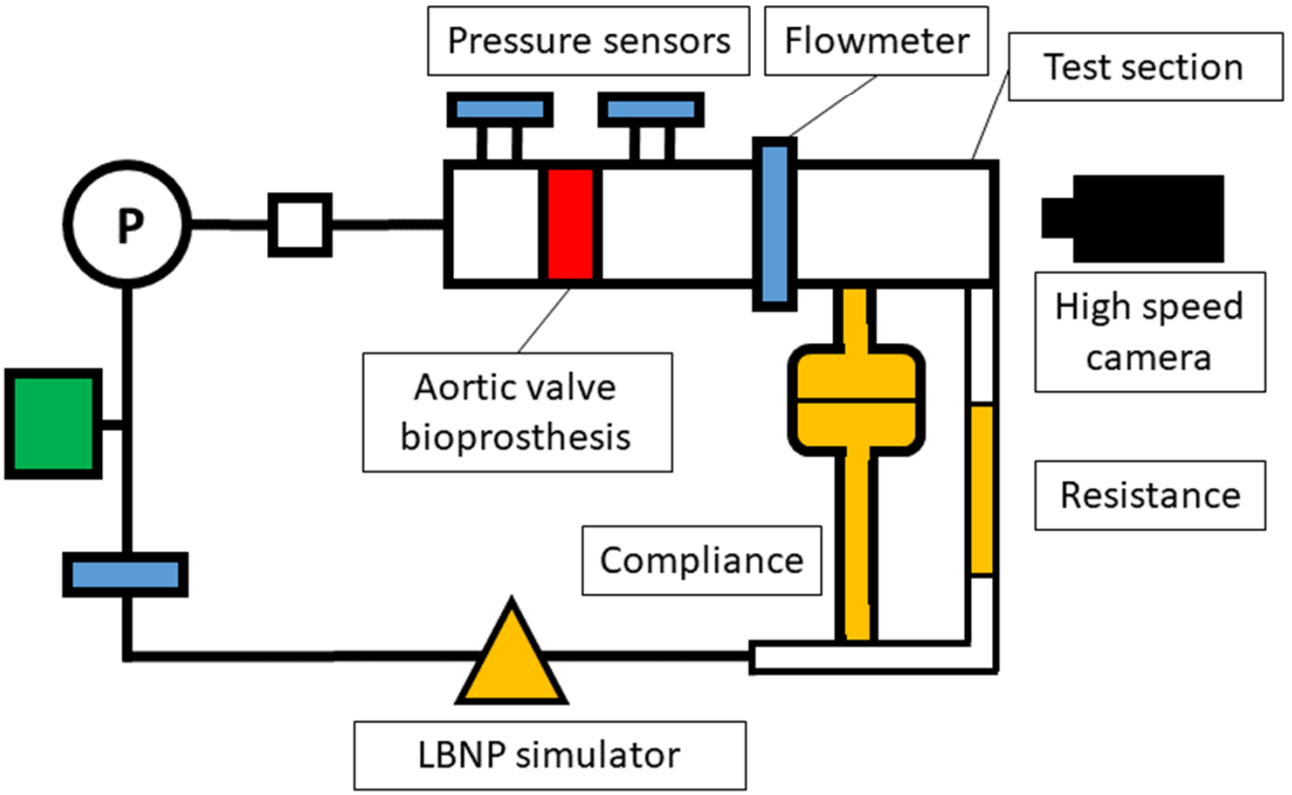
Experiment set-up



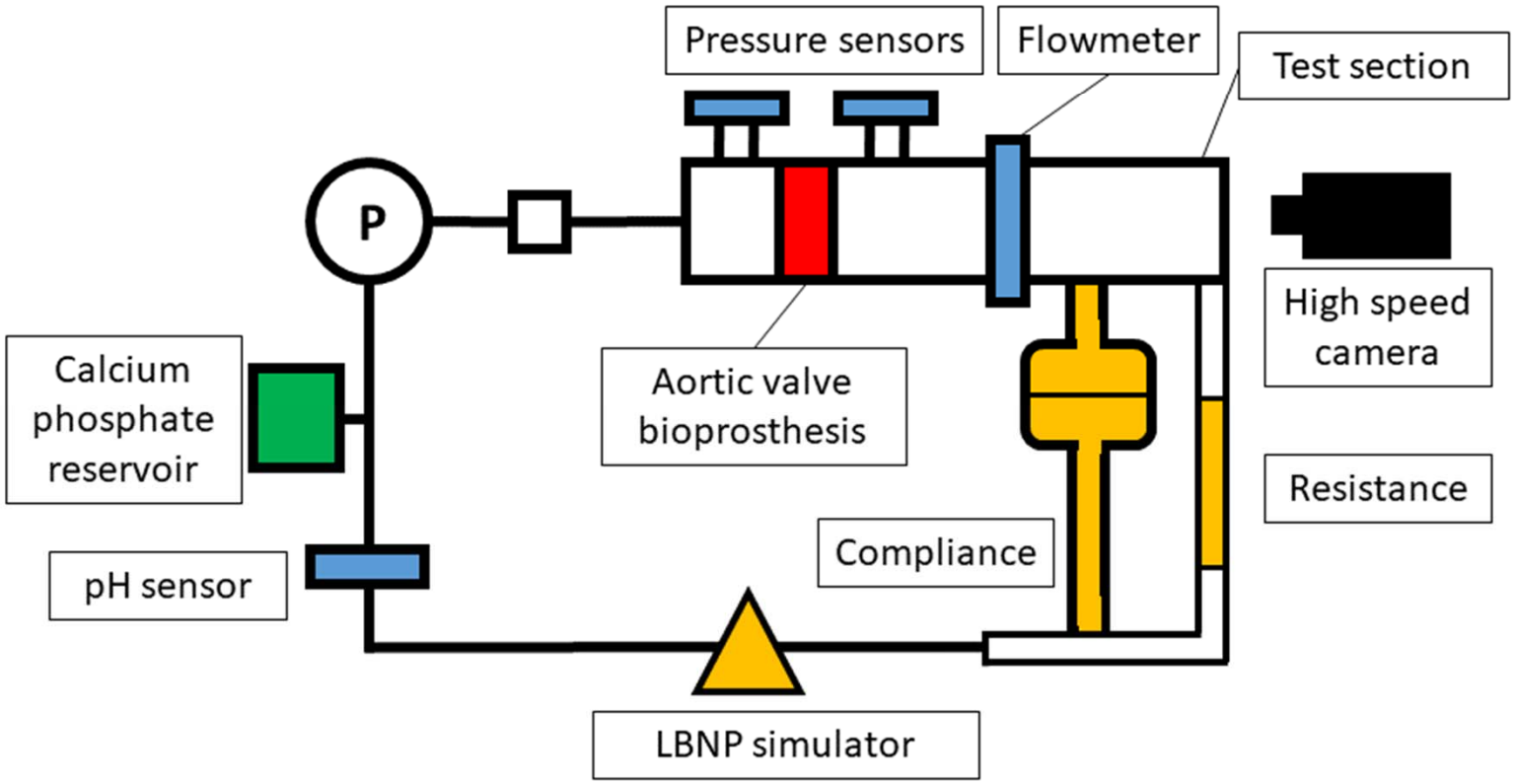
Experiment set-up



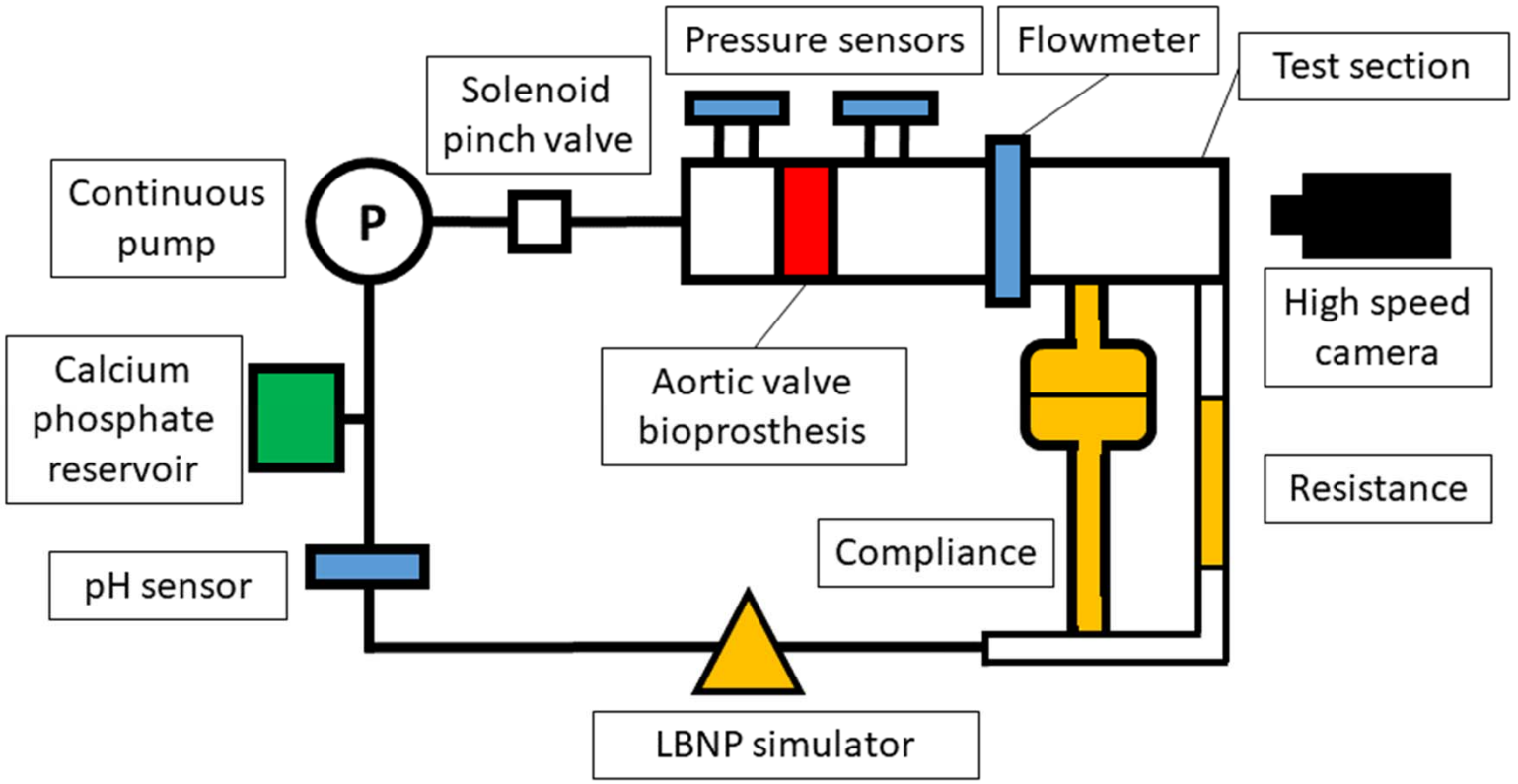
Experiment set-up



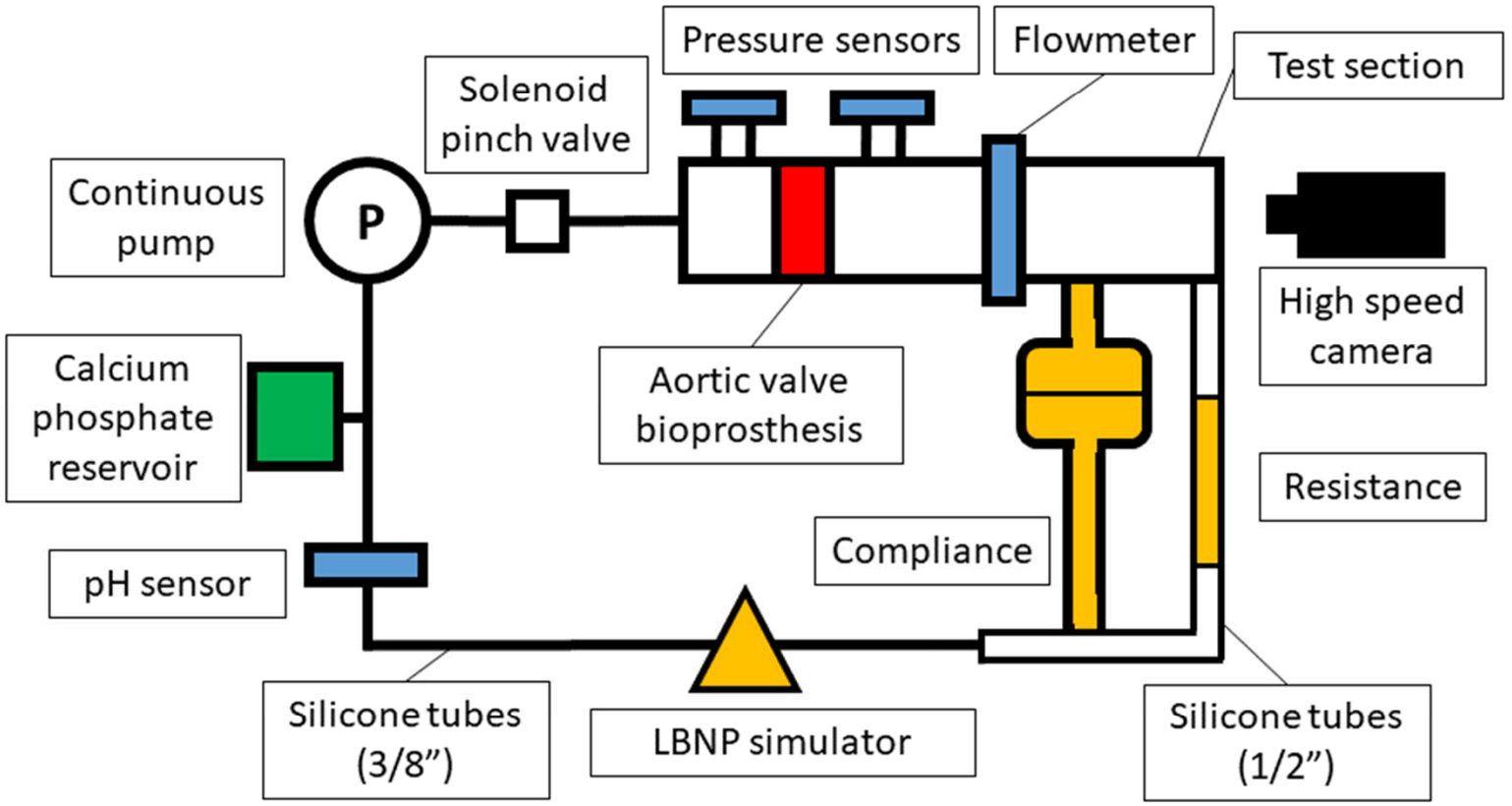
Experiment set-up



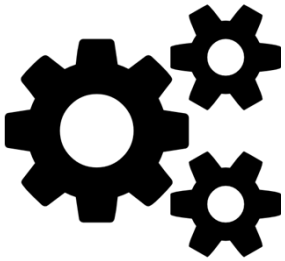
Experiment set-up



Experiment set-up

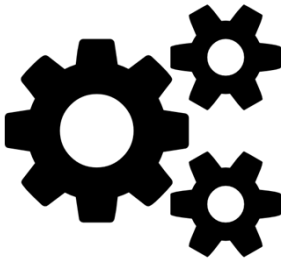


Experiment process



Configuration

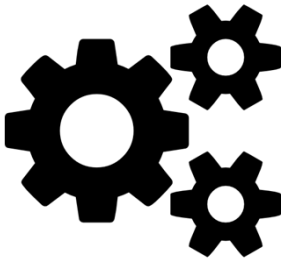
Experiment process



Configuration

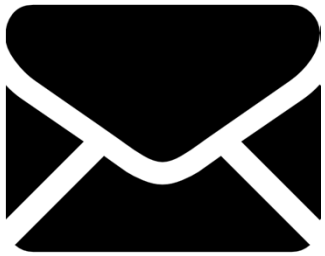
Acquisition

Experiment process



Configuration

Acquisition



Transmission

Mass and volume

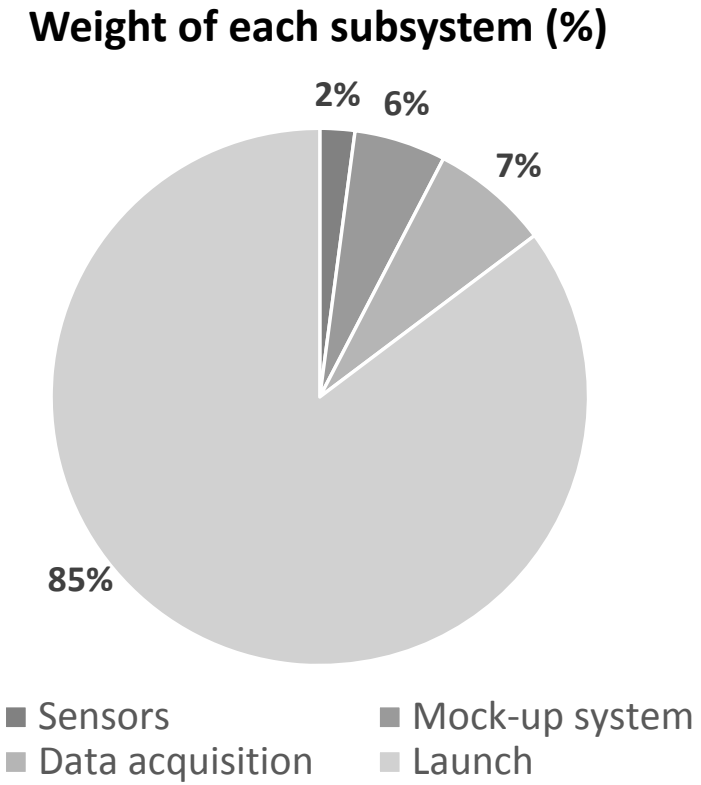
Component	Mass [g]	Volume [mm^3]
Pump	400	34 x 37 x 64
High resolution camera	300	64 x 64 x 66
Pinch solenoid valve	250	61 x 42 x 99
pH sensor	50	12 (d) x 120

Total estimated encumbrance: **3U x 4U**

Costs

Sub-section	Costs (€)	Critical element
Sensors	2.100	Flow meter
Mock-up system	5.500	Pump and Bioprosthesis
Data acquisition	7.100	High speed camera
Launch	85.000	Weight (≈ 1.5 kg)

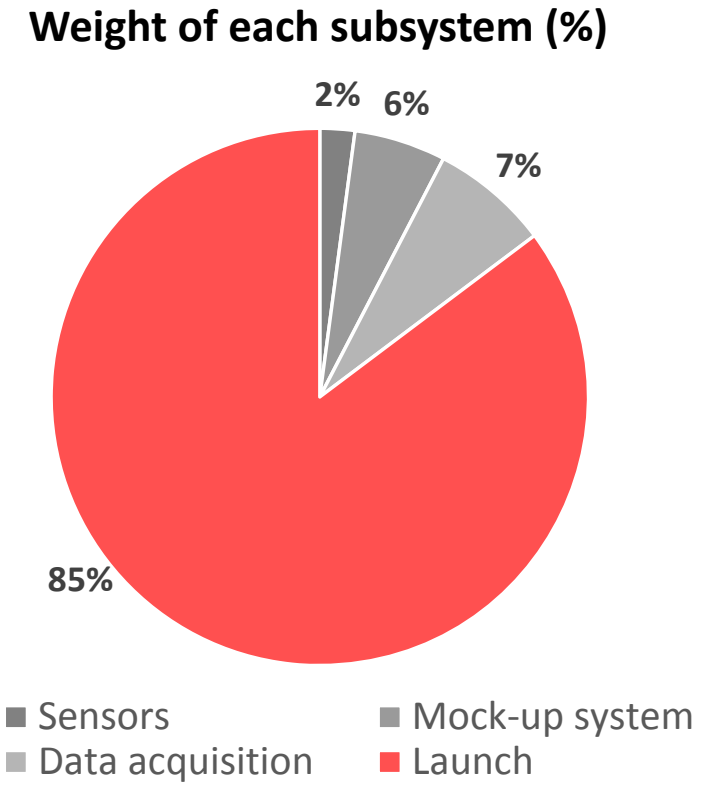
Total estimated cost: **99.700 €**



Costs

Sub-section	Costs (€)	Critical element
Sensors	2.100	Flow meter
Mock-up system	5.500	Pump and Bioprosthesis
Data acquisition	7.100	High speed camera
Launch	85.000	Weight (≈ 1.5 kg)

Total estimated cost: **99.700 €**



Risk analysis

- **Breaking or failure of components**

Risk analysis

- **Breaking or failure of components**
- Accuracy of calibration of the sensors

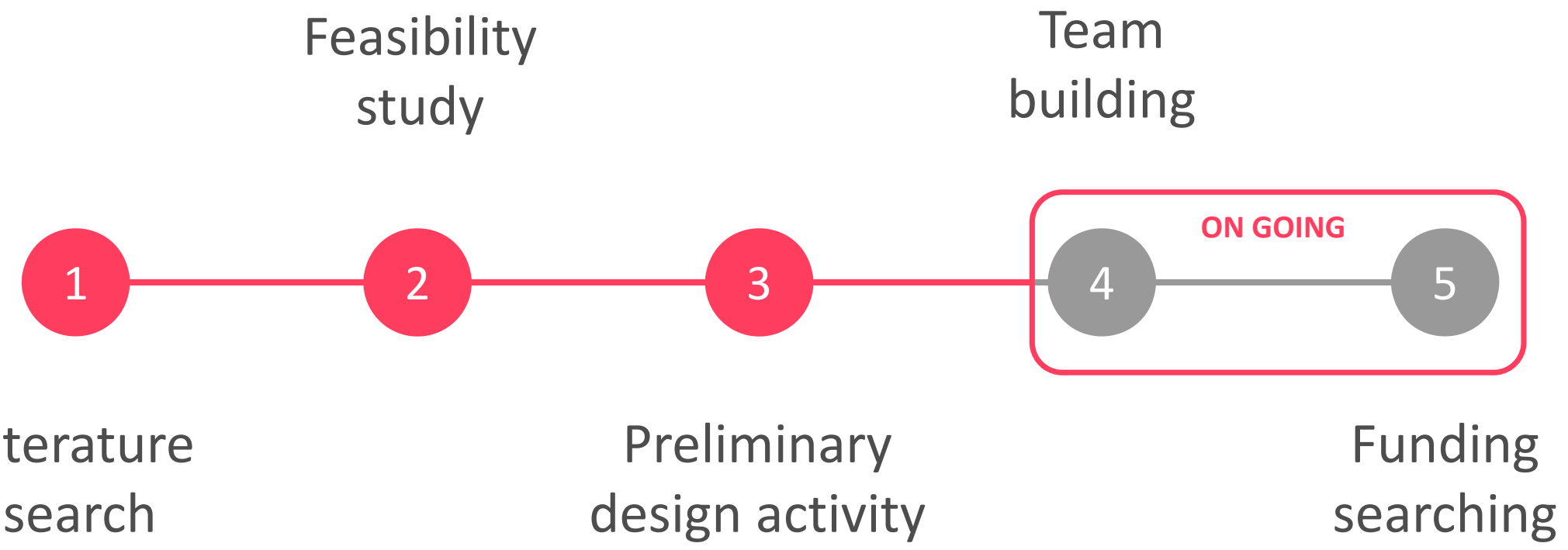
Risk analysis

- **Breaking or failure of components**
- Accuracy of calibration of the sensors
- Bad illumination

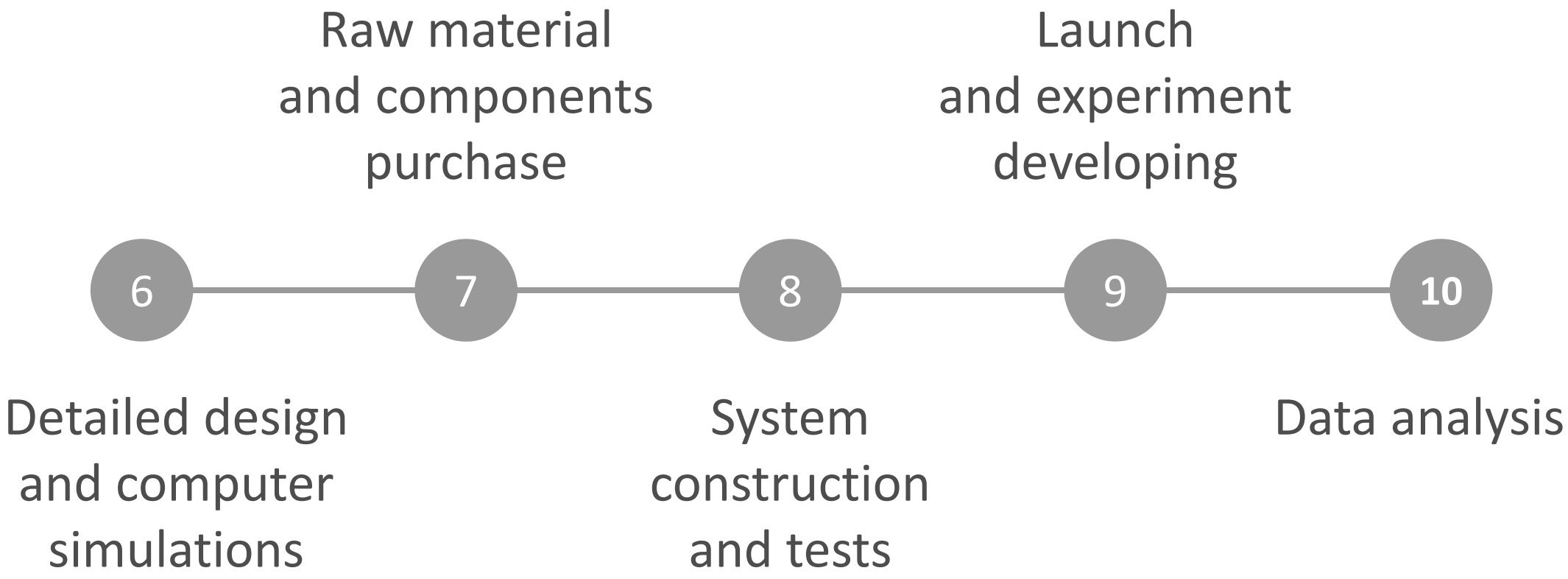
Risk analysis

- **Breaking or failure of components**
- Accuracy of calibration of the sensors
- Bad illumination
- Supersaturation of the fluid

Next steps


Feasibility study
Team building
ON GOING
1
2
3
4
5
Literature search
Preliminary design activity
Funding searching

Next steps


Raw material and components purchase
Launch and experiment developing
6
7
8
9
10
Detailed design and computer simulations
System construction and tests
Data analysis

Chiara Manzini

Aerospace Engineer

Anisia Lauditi

Biomedical Engineer

Thank you for the attention!

Q & A

Chiara Manzini

Aerospace Engineer

Anisia Lauditi

Biomedical Engineer