

INCIPIT_INTERFACCE POLIMERICHE BIOMIMETICHE E CONDUTTIVE INTEGRATE IN GRADO DI SVOLGERE FUNZIONE DI “PATCH” MICRO - NANOSTUTTURATI PER LA RIGENERAZIONE DEL MIOCARDIO

Caterina Cristallini

CNR-IPCF

PROBLEM

Post-ischemic Heart Failure



Patients worldwide



Heart Failure risk
after a heart attack

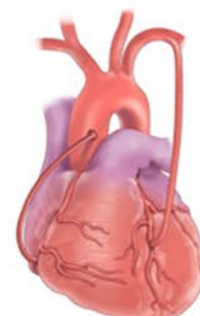
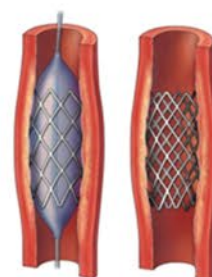


1M + people/year Heart Failure
hospitalisations in US and Europe

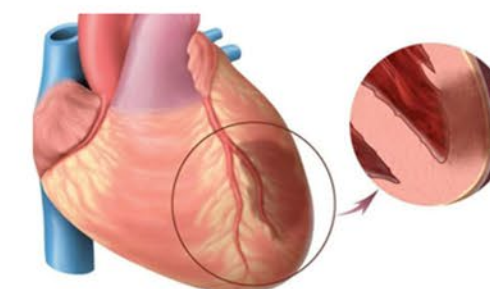


5 years mortality rate

European Heart Journal (2023). DOI: 10.1093/eurheartj/ehab892
American College of Cardiology (2023). DOI: 10.1016/j.jacc.2023



Drugs and surgical procedures
do not recover
cardiac tissue structure and function

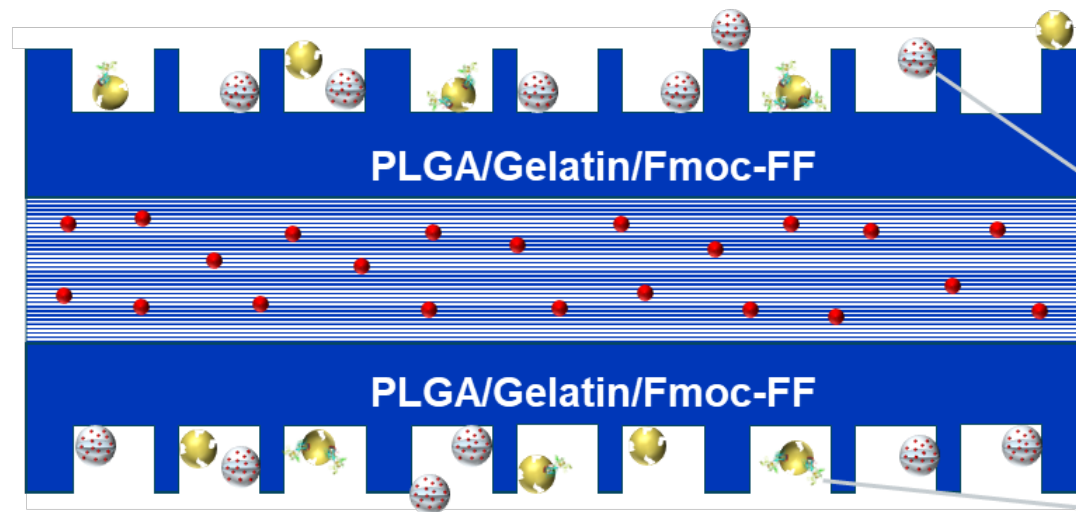


INtegrated Conductive and biomimetic polymeric Interfaces able to serve as micro - nanostructured Patches for myocardial regeneraTion

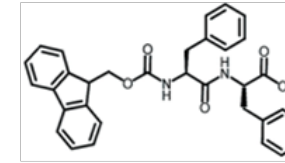
Transnational Research Project



The **promising results** of the project led us to pursue **technological transfer** by **patenting the technology**



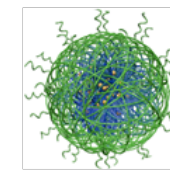
Electroconductive signal: Fmoc-FF peptide



Self-assembling short peptide semiconductor

Pleiotropic drug: Apelin-13

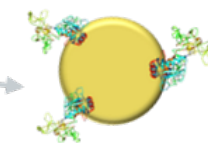
- Regulation of migration and differentiation into contractile cells
- Lowers arterial blood pressure inducing vasodilation
- Cardioprotective effect by reducing infarct size
- Contrasts cardiac dysfunction and pathological remodeling



Biodegradable drug-delivery nanoparticles

- protect against endogenous proteases
- increase the long-term bioavailability

Prevention of ventricular remodelling



Molecularly imprinted nanoparticles

OUR SOLUTION: AN INNOVATIVE CARDIAC PATCH

Class III
Medical Device

Patents

n.1418910
Italian Patent
GRANTED

2014

n.2943230
European Patent
GRANTED
France, Germany, United Kingdom, Spain, Sweden

2017

 
n.102023000014616
Italian Patent
FILED

2023

 
PCT
Extension

2024



Awards and acceleration programs



4° general STARTCUP 2022 PIEMONTE VALLE D'AOSTA
(1° Life Sciences Project)
Special Mention «Open Innovation/Spin off Industrial»



Finalist PNI: L'Aquila (1-2 Dic2022)



Access to the program #ReadyToStartUp and
mentorship Biondustry Park Silvano Fumero.
Meet In Italy SUB 2022



Unicredit Start-Lab
award winner



UNIONCAMERE



DINTEC
CONSORZIO PER L'INNOVAZIONE
TECNOLOGICA



Tecnopolo
Roma



C S
M T



UNIQUE VALUE PROPOSITION: MYOCARDIAL BIOMIMICRY

Our device: a microstructured and multilayered cardiac patch



PLGA
Poly(lactic-co-glycolic) acid

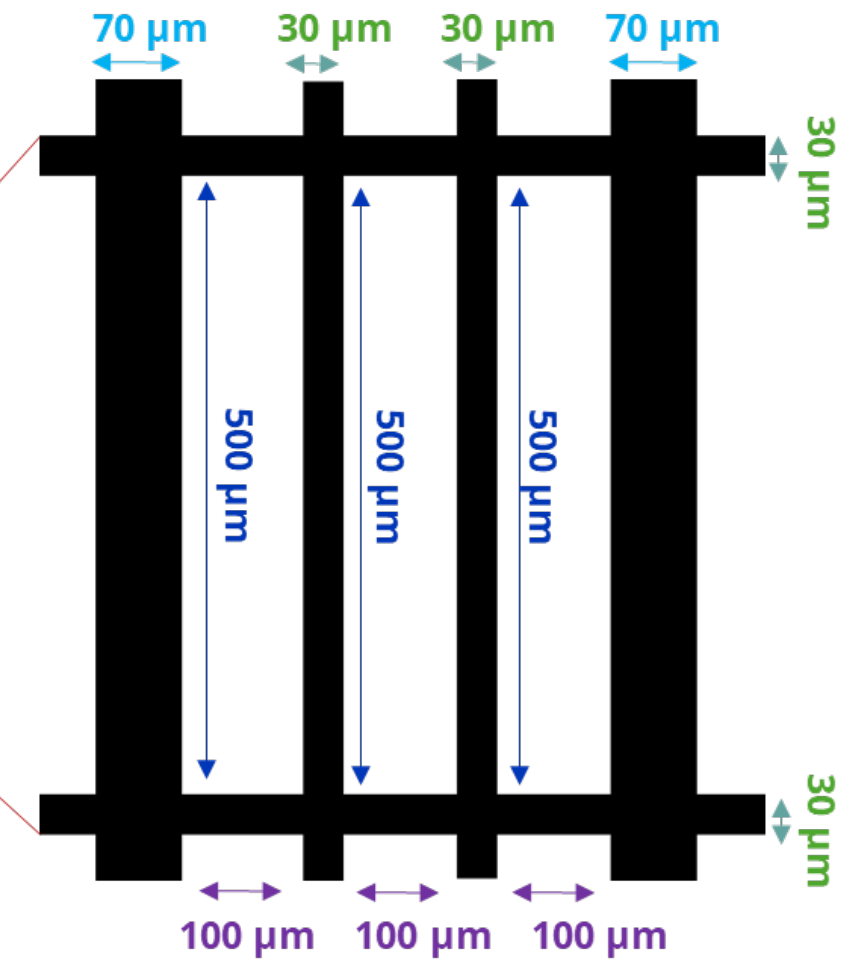
Gelatin



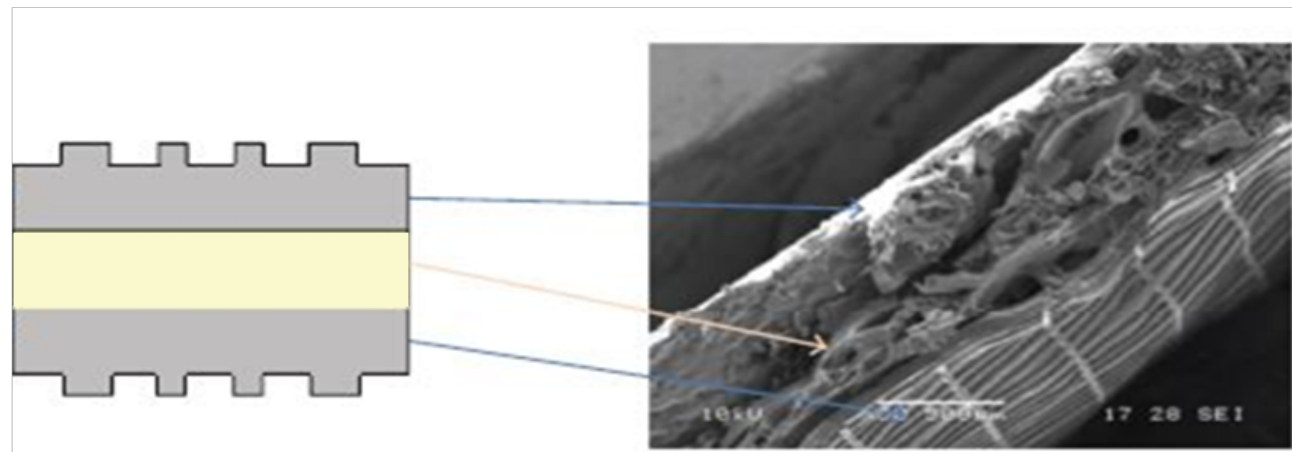
Our unique combination



- Chemical composition
- Processing method
- Micro-patterning



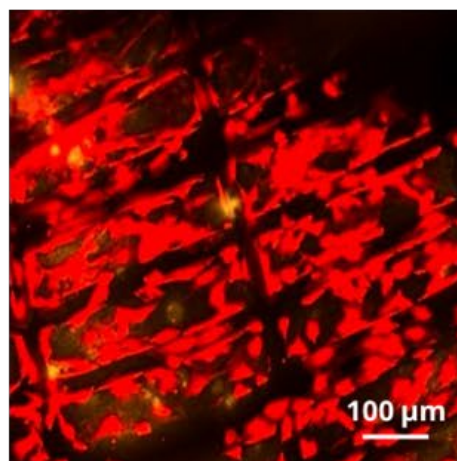
Micro-patterning to reproduce cardiac tissue architecture
→ anisotropy



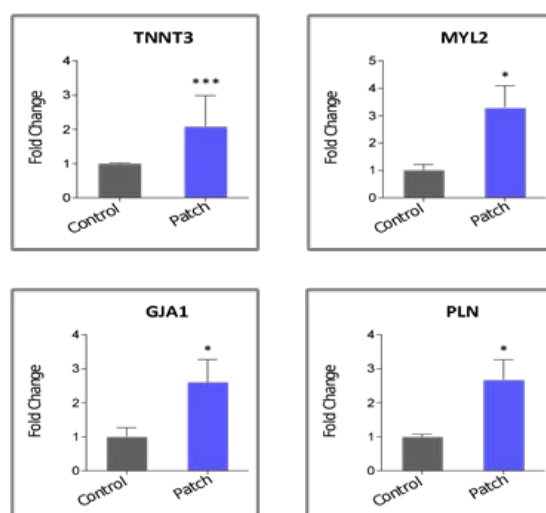
Advantages due to the absence of an *in vitro* culture phase:

- Use of biomaterials **regardless of the patient's individuality**
- **Immediate applicability** of the device (no delay related to cell culture)

Cardioinductivity *in vitro*



Alignment and elongation
of cardiac cells

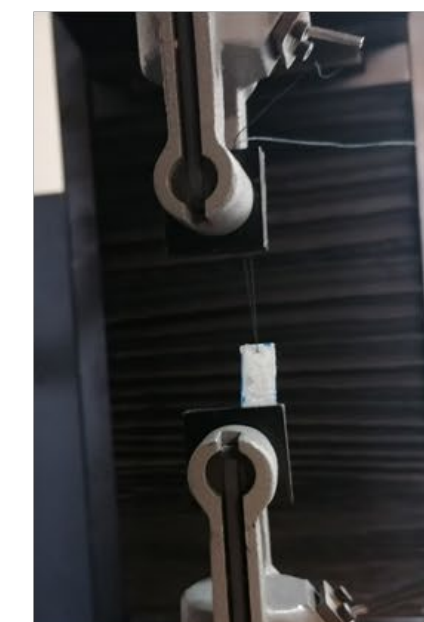


Cardiac differentiation
genes upregulation

Mechanical compliance *in vitro*

**Mechanical tests following ISO 7198-2016
and 17137-2011 for cardiovascular implants**

Tensile strength tests (static and dynamic: visco-elasticity,
anisotropy, flexibility, compliance): similar to cardiac tissue

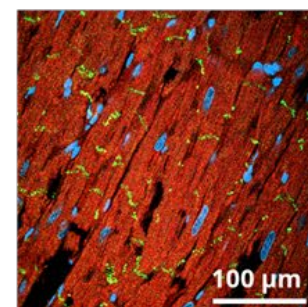
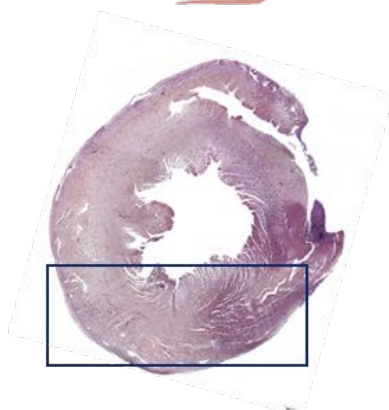


DYNAMIC EPICARDIAL REPAIR *IN VIVO*

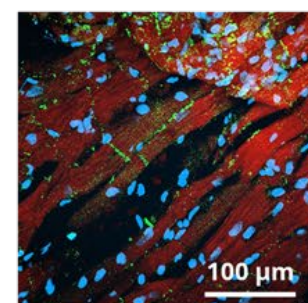
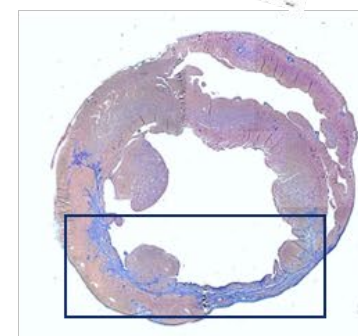


Small animals

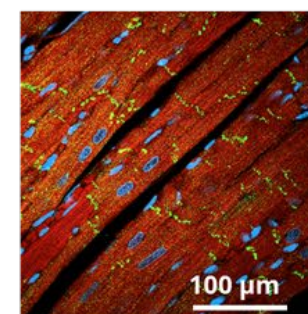
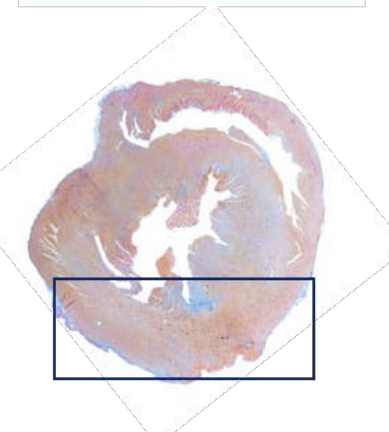
Healthy



Heart attack



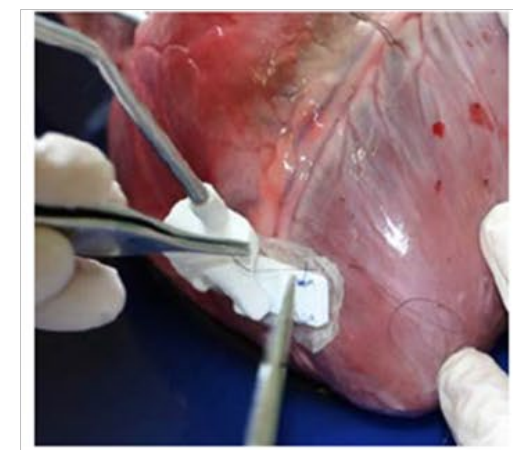
Heart attack + patch



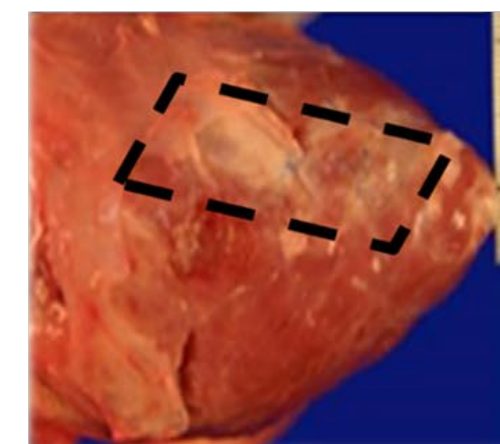
Tissue preservation Correct restoration of cardiac proteins



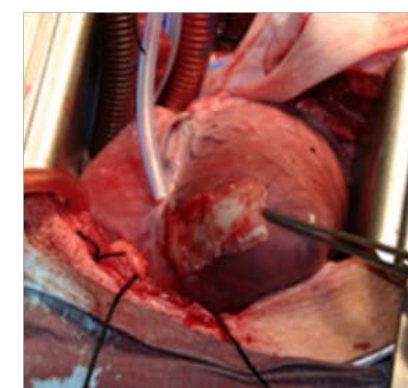
Large animals



Biosafety
Biodegradability



Versatility of implant application



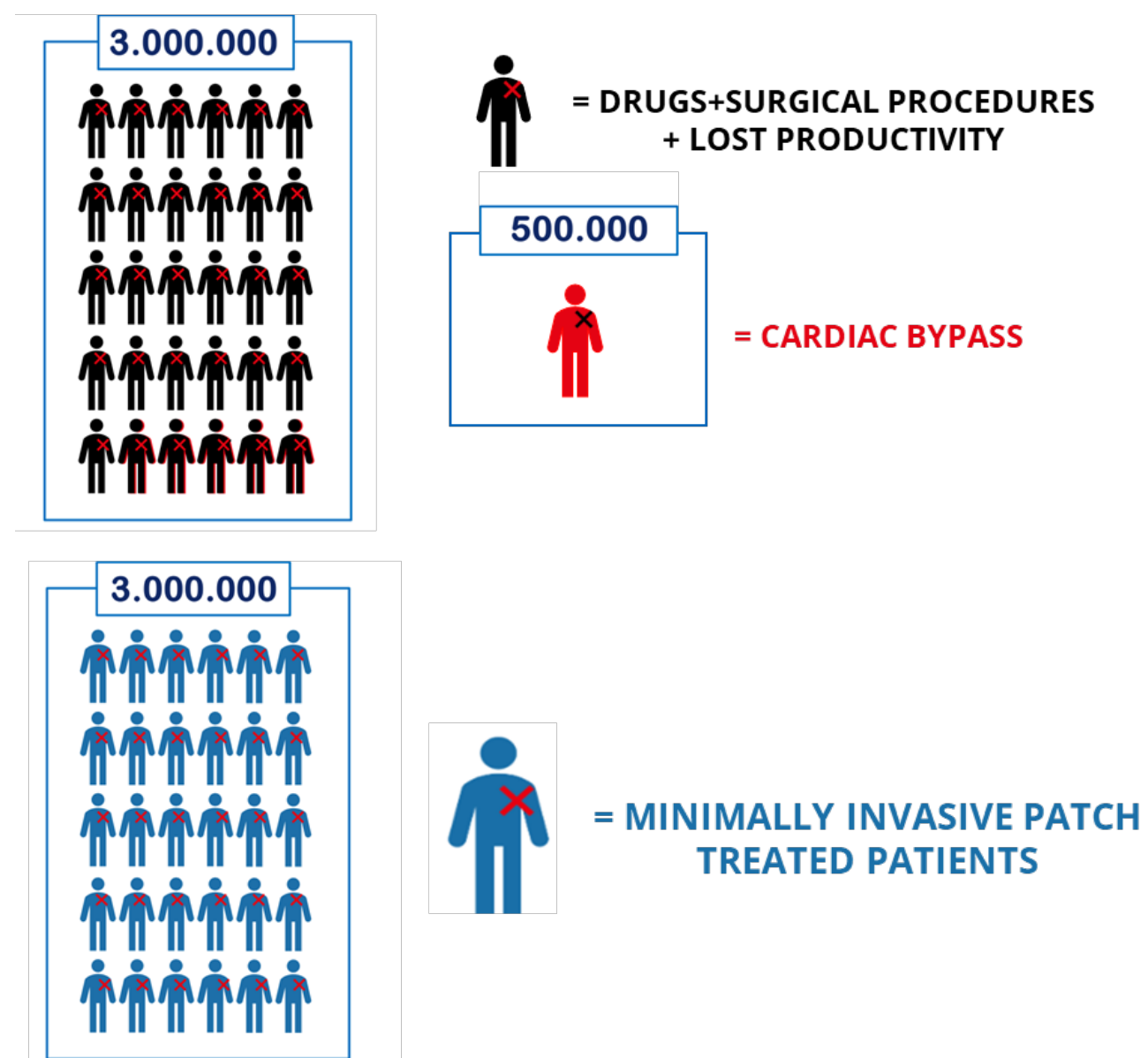
Open heart surgery
during CABG



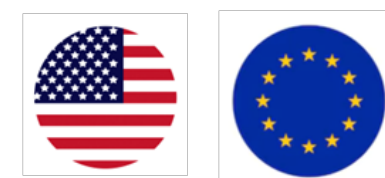
Minimally invasive surgery

TARGET PATIENTS AND POTENTIAL MARKET

Target patients



Market opportunity and competitive scenario



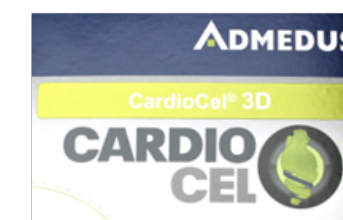
THE GLOBAL MARKET IS
DIVIDED INTO

- SYNTHETIC PATCH
- BIOLOGICAL PATCH



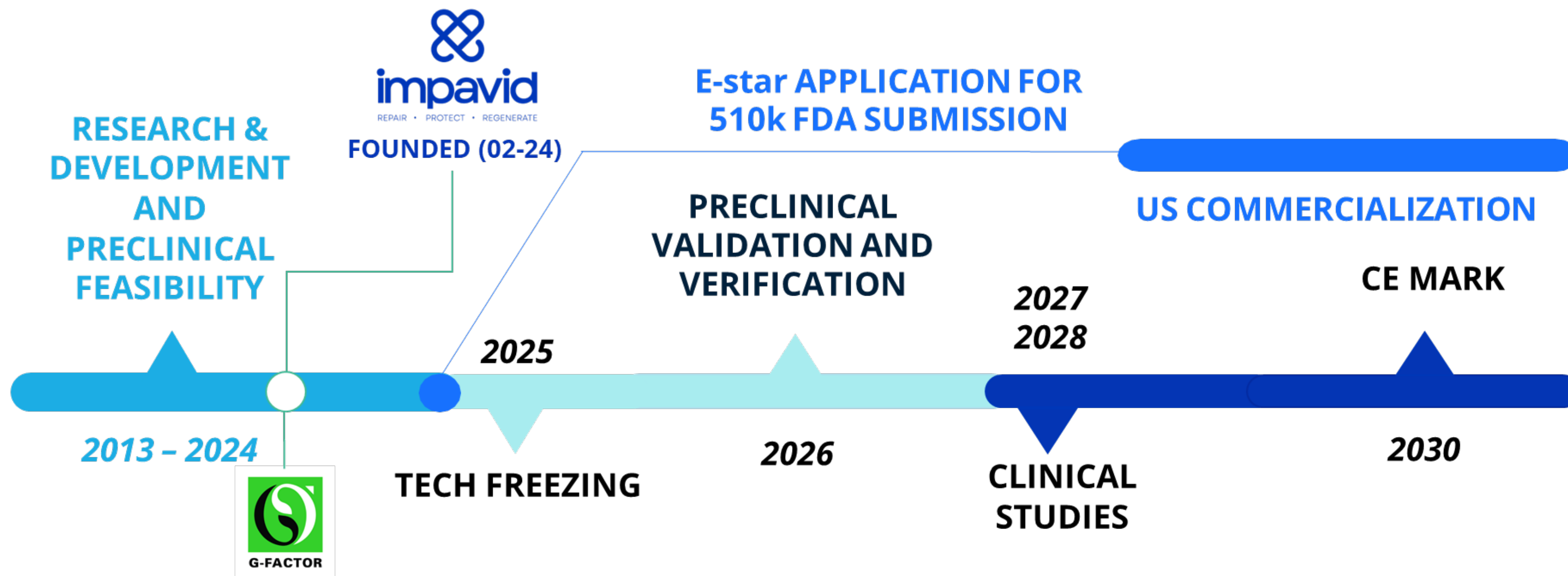
Market expansion with foreseen
CAGR 9-10% from 2023 to 2028

THE COMPETITIVE SCENARIO



	impavid	GORE ACUSEAL	ADMEDUS	CorMatrix
MATERIAL COMPOSITION	BIOARTIFICIAL	SYNTHETIC	BIOLOGICAL	BIOLOGICAL
MANUFACTURING BATCH TO BATCH REPRODUCIBILITY	YES	YES	LIMITED	LIMITED
VERSATILITY OF APPLICATION	YES	LIMITED	LIMITED	LIMITED
MYOCARDIAL BIOMIMICRY (micropatterning, mechanical anisotropy, electroconductivity)	MYOCARDIAL BIOMIMETIC DESIGN	NOT BIOMIMETIC	PERICARDIAL STRUCTURE	INTESTINAL STRUCTURE

ROADMAP TO CE-FDA CERTIFICATION



COLLABORATIONS AND PARTNERSHIPS



Biomaterials group
@ CNR Pisa-UniPI



Translational medicine group @UniTO

15 years of joint research leading to:

- **Publications** (CNR, UNIPI, UNITO)
- **International and National Research Projects**



Specialized consultants



Investors & Public fundings

Aim: technological transfer of the research product



Spin-off CNR



Spin-off UNITO



Spin-off UNIPI

Education and recruitment of young research scientists: engineers, biologists, chemists, experts in economy and law



Growth of the company's organizational structure

TEAM



**NICCOLETTA
BARBANI**

COO
UNIFI

**CATERINA
CRISTALLINI**

CTO
CNR-IPCF

**ROBERTO
VANNI**

CEO
UNITO

**CLAUDIA
GIACHINO**

CSO
UNITO

**RAFFAELLA
RASTALDO**

SS
UNITO



e-mail: info@impavid.tech

website: <https://impavid.tech/>



Spin-off

Consiglio Nazionale
delle Ricerche

Investor as a partner of the society



GFactor: Incubator-accelerator of startups created in 2018 by the Golinelli Foundation, operates mainly in the pre seed, seed and early-stage segments

Collaborators:

- **Clinical and Scientific Advisory Board**
- Companies and Consultants: i.e. NanoPhoenix, Sterox, Gard consulting, Myra Medical srl
- Researchers, Research Fellows & PhD students