



Final Event
Tuesday 23rd November 2021



Biomaterials Perspective on the Future of Spine Surgery

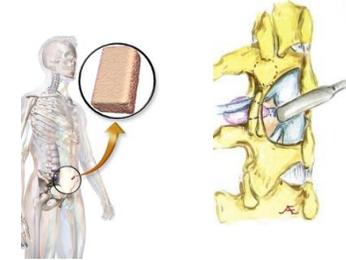
Riccardo Bendoni, PhD



Bone grafts for spine surgery

Autografts

- Autologous Laminectomy Bone (ALB)
- Iliac Crest Bone Graft (ICBG)



Allografts

- Freeze dried
- Fresh frozen



—————> Demineralized bone matrix (DBM)

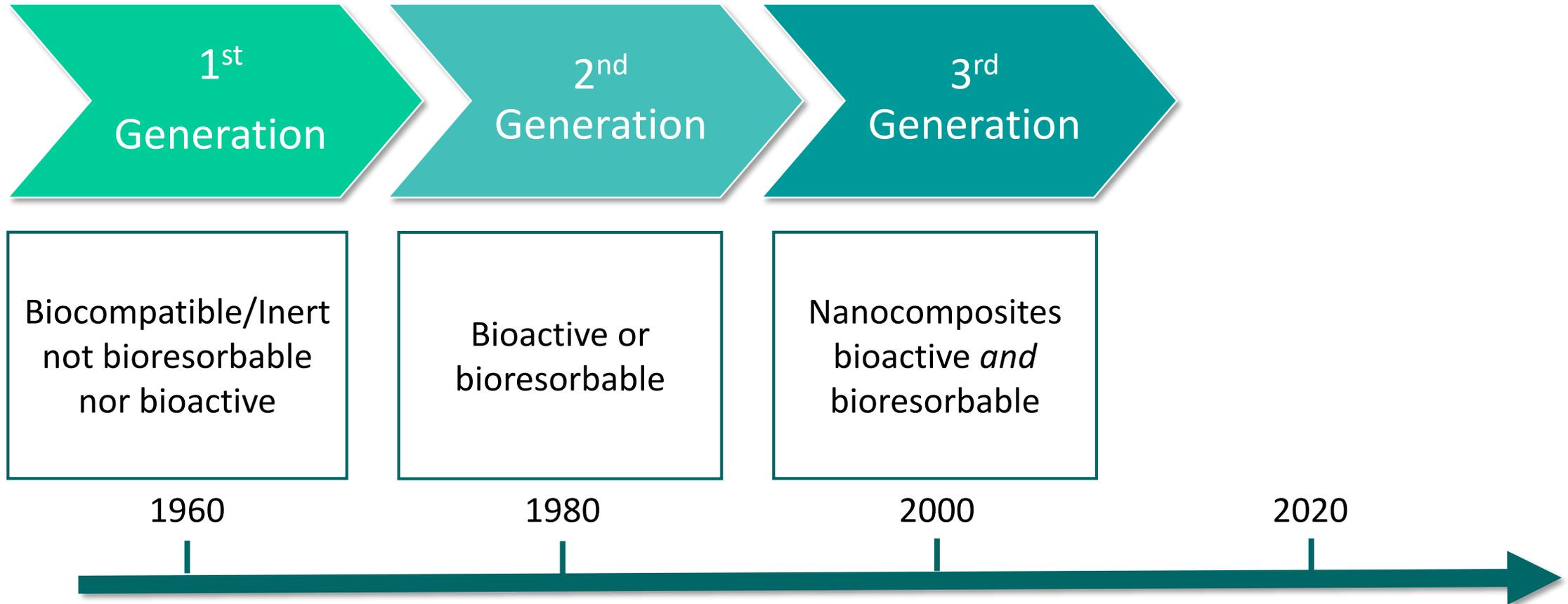


Synthetic grafts

- Metals
- Polymers
- Ceramics
- Composites



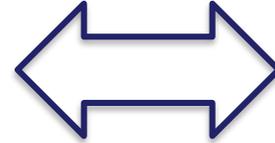
Evolution of bone graft substitutes



A balance of innovation and regulation

New materials

- Osteogenicity
- Osteoconduction
- Osteoinduction
- Biodegradation
- Mechanical properties

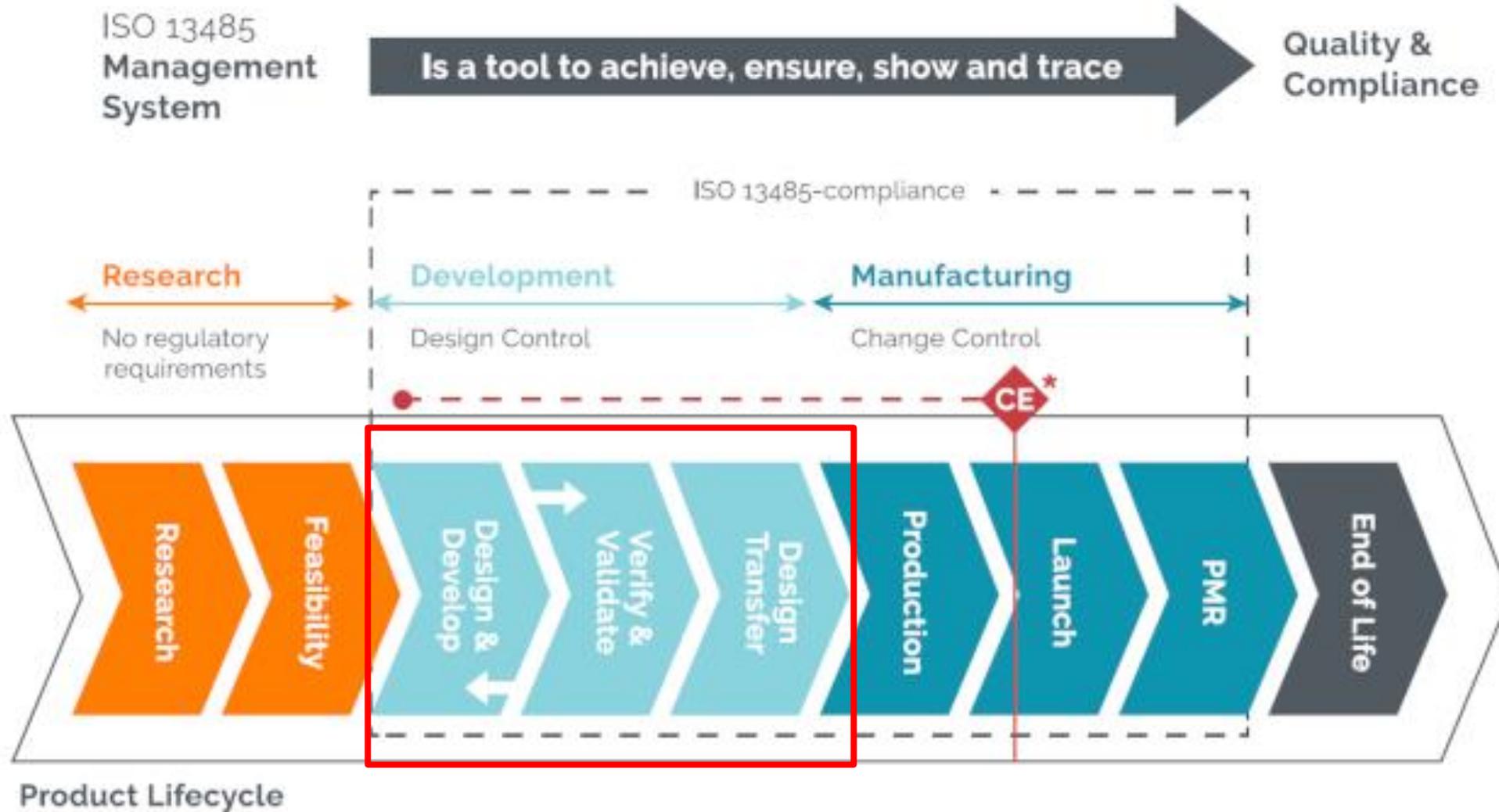


Medical devices

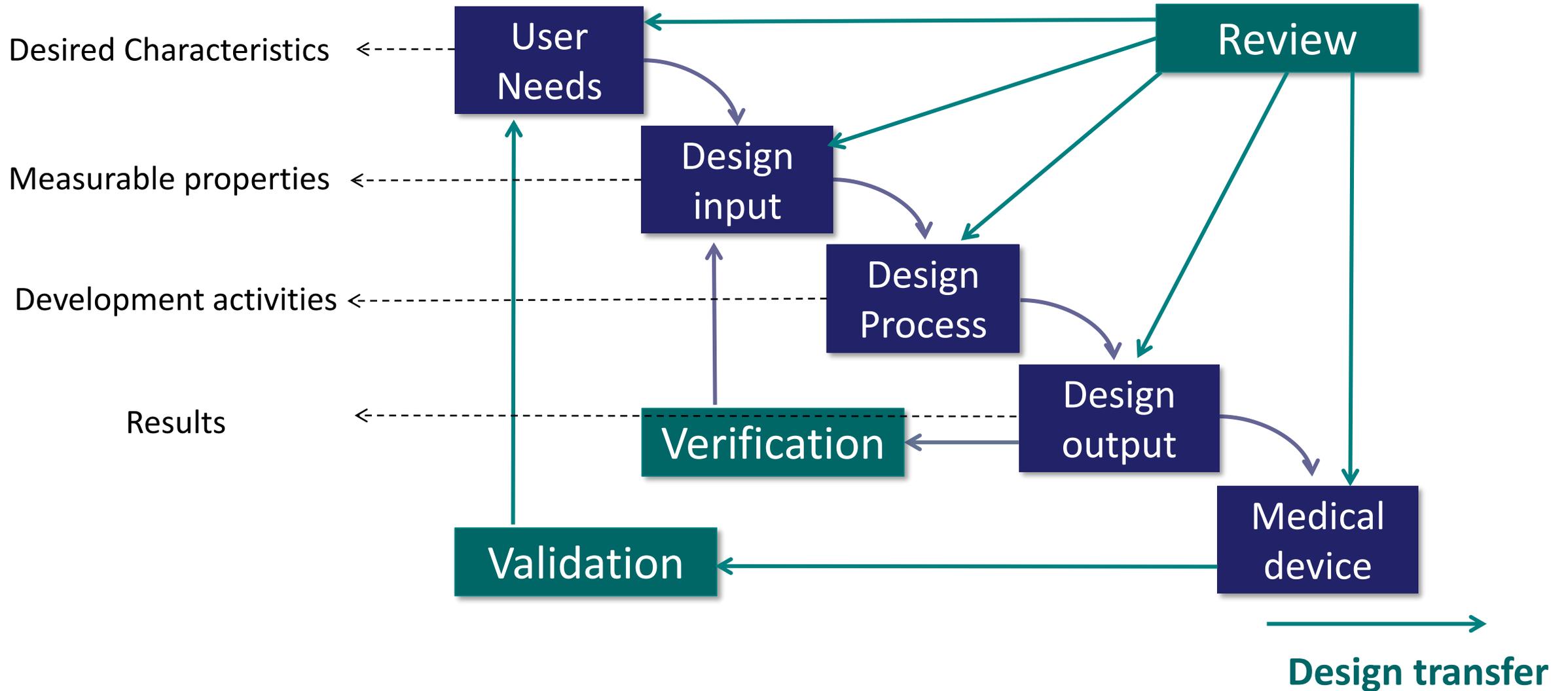
- Regulatory
- Scalability
- Safety
- Efficacy
- Usability
- Cost



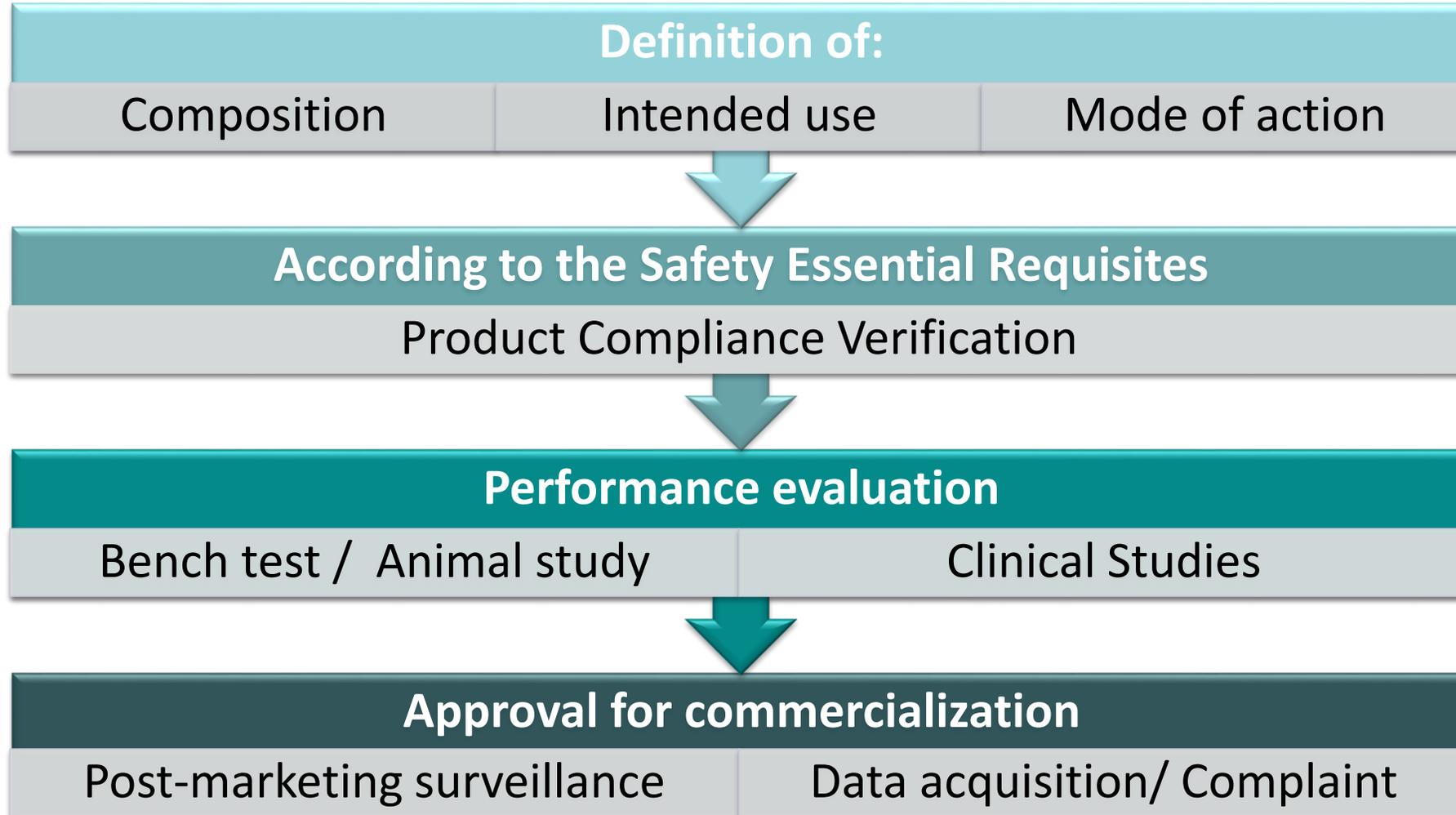
Development of Medical Devices



Design control



Regulatory aspects



A practical example

Innovation ↔ Regulation



- Implantable (class III) device
- 3rd generation
- 40 wt% Type I Collagen
- 60 wt% Mg-HA



Scoliosis (extended fusion)
Postero-lateral fusion

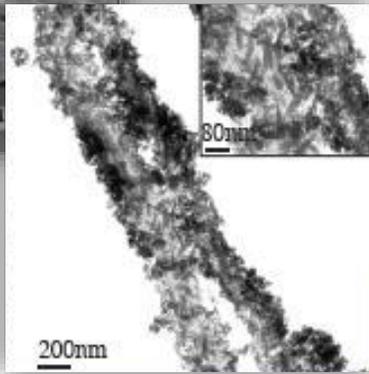
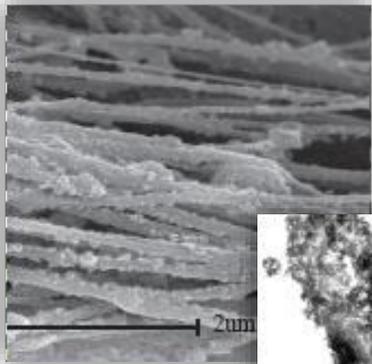
Biomimetic

Mg-HA nanoparticles

nucleated onto collagen fibers



High hydrophilicity
Cell adhesion
Bone formation



Risk related to the release
of nanoparticles

Nanoparticles evaluation

MDR 2017/45 (EU)
Medical Device Regulation

ISO 10993-22:2017
Biological evaluation of medical devices
Part 22: Guidance on nanomaterials

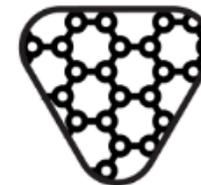
Assess **safety** of devices containing/generating nanoparticles

What we considered

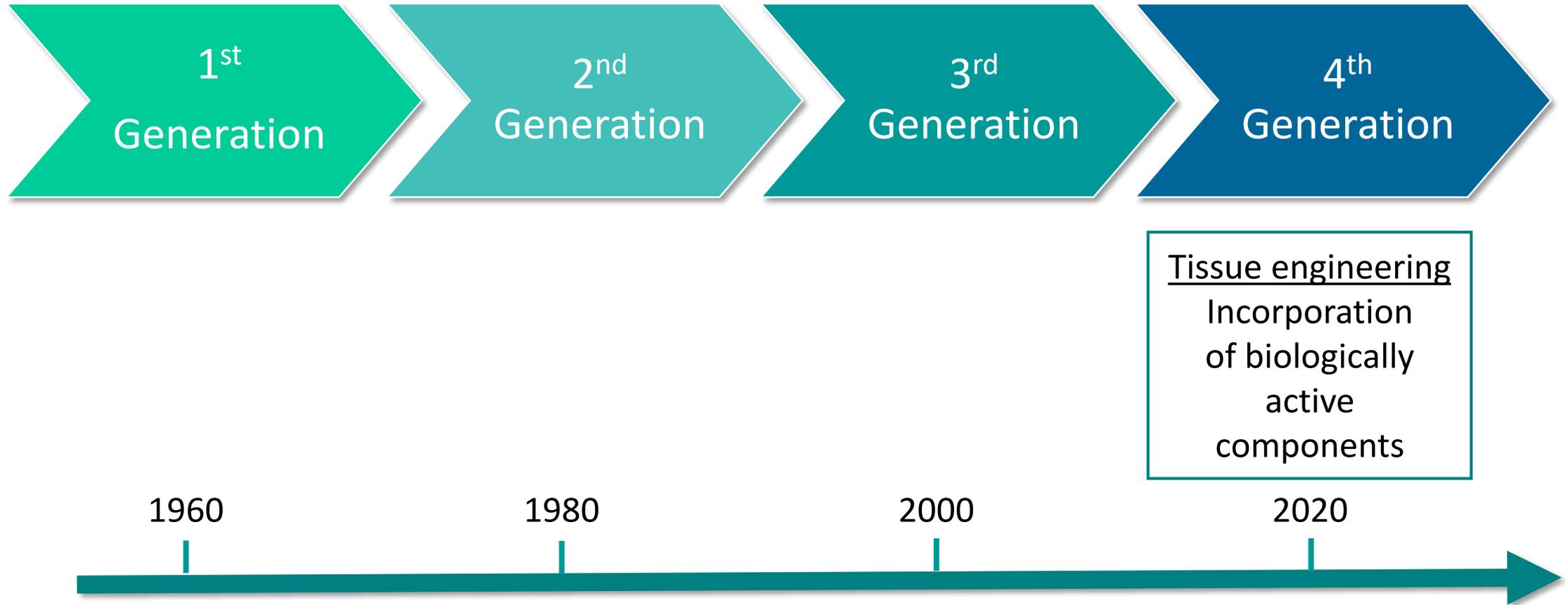
- Release kinetics of the nanoparticles
- Potential cellular or tissue effects due to direct interaction with nanoparticles
- Toxicokinetics and tissue distribution of nanoparticles
- Biological evaluation of nanoparticles



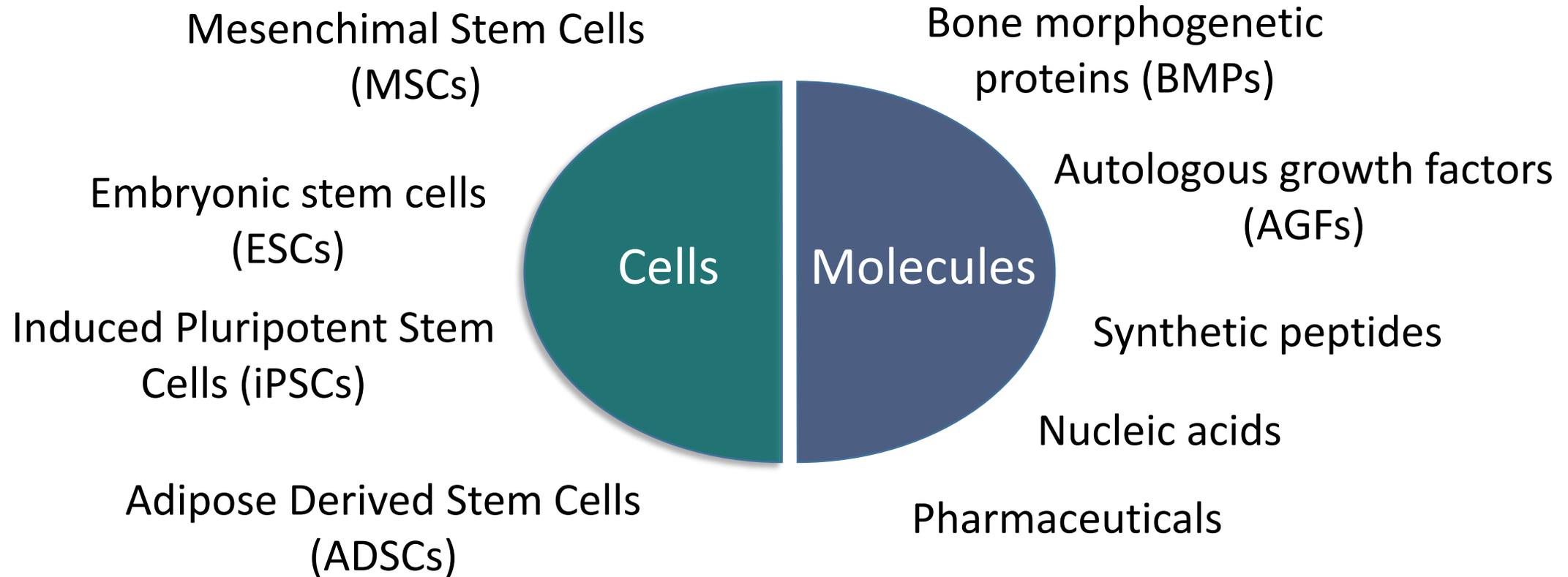
Added symbol
“Contains nanomaterials”
to RegenOss label



What's next?



Biologically active components



Potential and limits



- ✓ Promotion of osteogenesis, osteoinduction and osteoconduction
- ✓ Promotion of spinal fusion
- ✓ Possible use with autografts, allografts, synthetic scaffolds
- ✓ Very small quantities needed

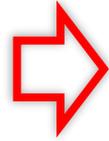


- ✗ Regulatory aspects
- ✗ Lack of clinical data
- ✗ Difficult assessment of performance in clinical trials
- ✗ Potentially severe complications (e.g. rhBMP-2)

1970-1980
Discovery of
BMPs



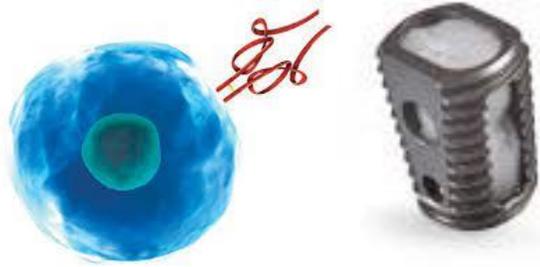
2002
FDA approval of
rhBMP-2 containing
device



2008
FDA warning
anterior cervical
spine surgery



2020
Withdrawal from
Australian market



Infuse™ (Medtronic)

Potential adverse events

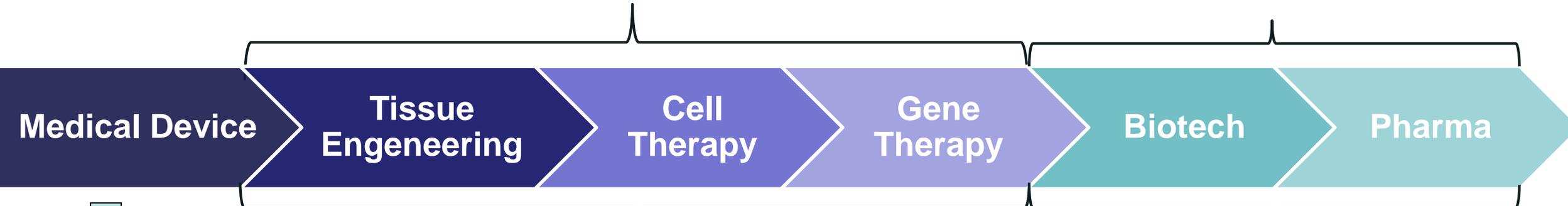
- Swelling of neck and throat tissue
- Bone overgrowth
- Neurological events
- Carcinogenicity

«Risk of adverse events
10 to 50 times higher
than original estimates»

The weight of the regulatory process..

Advanced Therapies Medicinal products
(ATPMs)

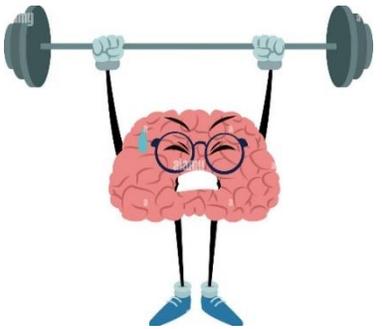
Medicinal products



MDR
2017/745

Regulation EU 1394/2007
+
(Committee for Advanced Therapy)
CAT expertise

Medicinal Products Regulation
+
(Committee for Medicinal Products
for Human use)
CHMP expertise



**Thank you
for
the attention**