VPH Institute
The International Society for In Silico Medicine

Mapping the road towards the Virtual Human Twin

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INSILICO WORLD

SIM CARDIO TEST

SIMCor

EDITH

REALM

DT4PH

STAKEHOLDER ENGAGEMENT

Responsible Research and Innovation; Focus Groups; Surveys; Social acceptance

SYNERGIES AND SUSTAINABILITY

Cross-project collaboration

REGULATORY, POLICY AND STANDARDS

Policy watch; White Papers; Expert working groups; Advocacy; Standardisation

COMMUNICATION AND DISSEMINATION

Strategy & implementation; Social Media; Multimedia Production; Events

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Virtual Physiological Human

Stakeholder Engagement

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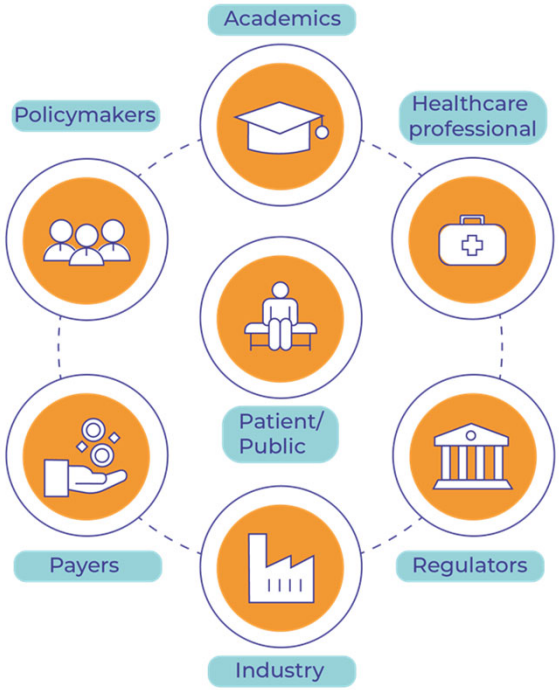
Stakeholders:

Map, analyze, engage



Activities:

Desk review, surveys, workshops

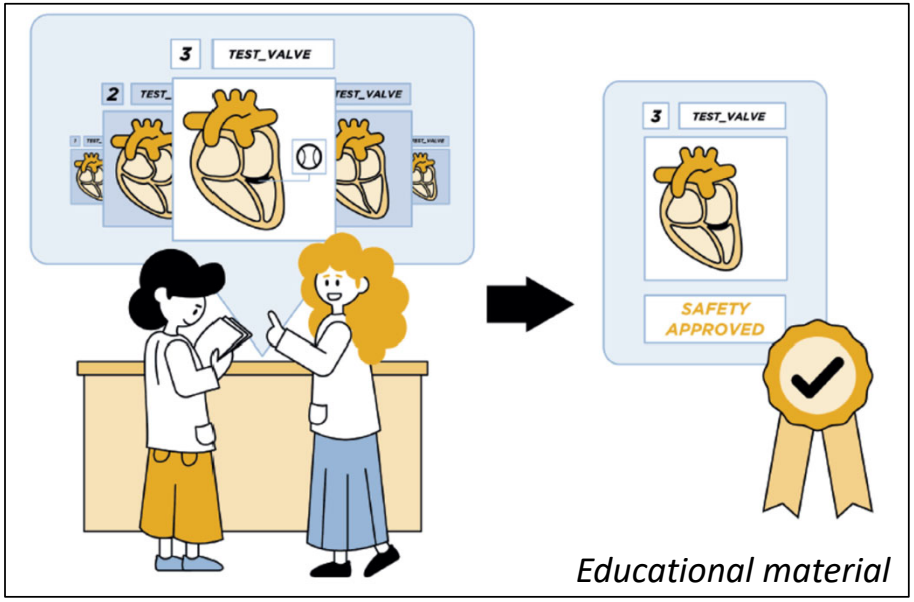
Stakeholder Engagement

- From ELSI to
  Responsible Research & Innovation

- Trust vs trustworthiness
  - Validation
  - Credibility
  - Explainability
  - Transparancy
  - Level of awarenes

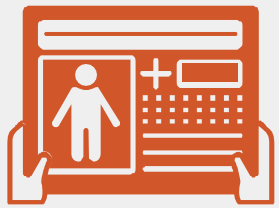
Patients & clinicians

- Important role for clinician
- Accountability

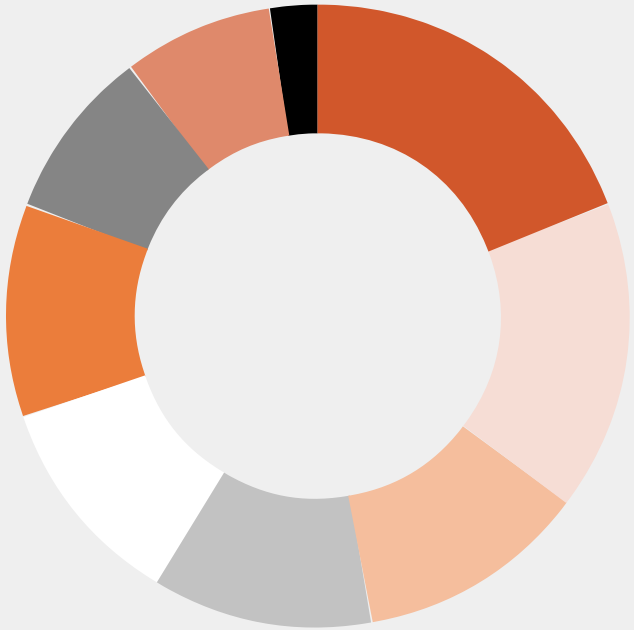


Educational material

Clinical survey on in silico medicine



Clinicians use CM&S mostly for planning interventions and teaching with interest to **enrich diagnosis.**



- Plan interventions (22.8% → 55.9%)
- Teach/Training (28.5% → 45.2%)
- Study Pathophysiology (29.1% □ 20.4%)
- Enrich diagnosis (29.1% → 43.1%)
- Predtict/compare therapeutic outcomes (29.1%)
- Compare different therapeutic outcomes (retrospectively) (28.5% → 27.8%)
- Inform the patient on disease progress (22.8% → 19.4%)
- None of the above (20.3%)
- Other (6.3% → 6.5%)

Applications of CM&S recorded in clinics

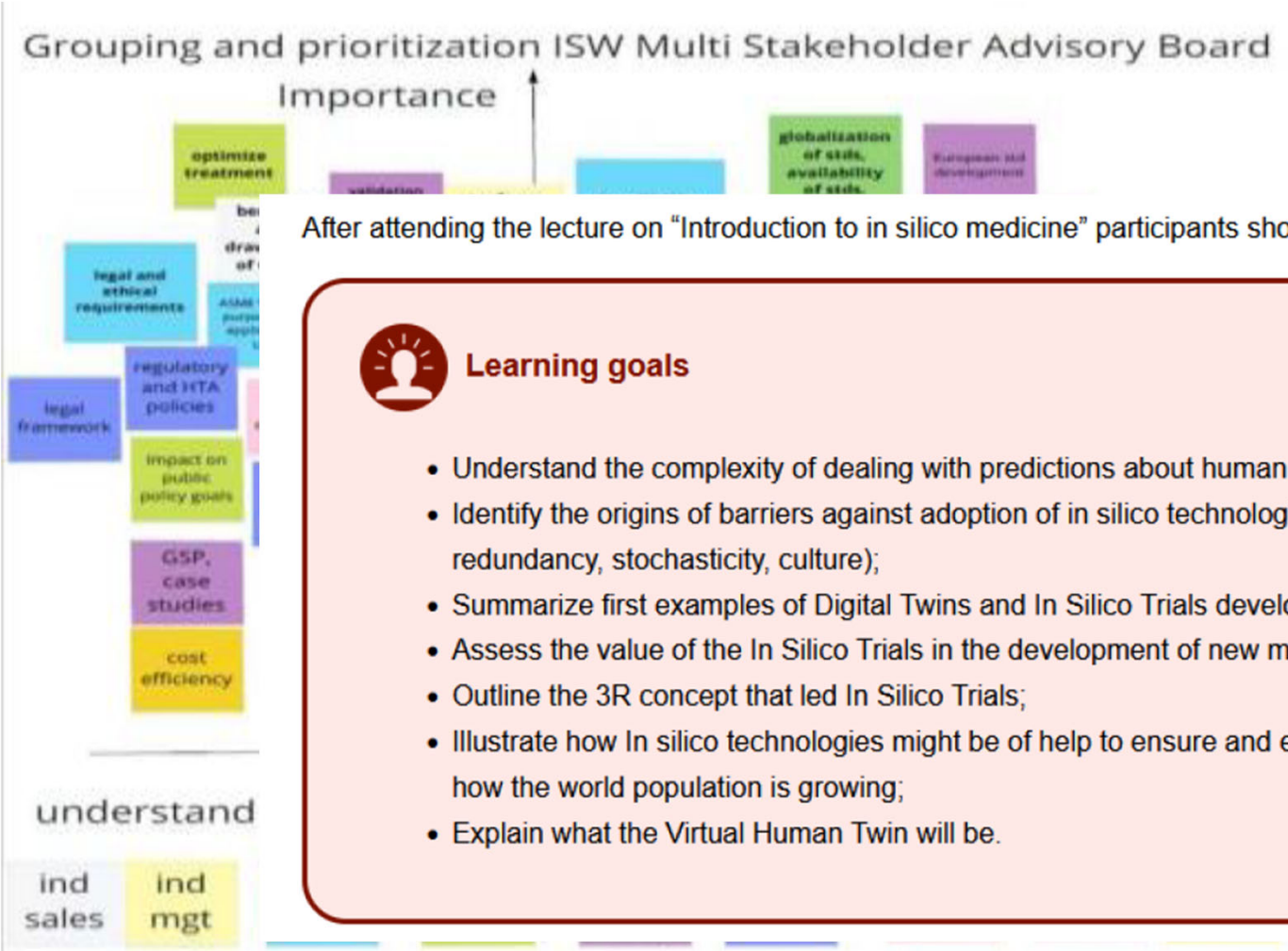
(2021 > 2024)

160+ 300+

Monitor & treat patients (24.7%)	Generate prognosis(18.3%)
Optimize and calibrate other clinical measurements (23.7%)	Improve rehabilitation (6.5%)

Lesage+, Front Med Tech, 2023
Rangarajan+, VPH 2024

Capacity building & education



After attending the lecture on "Introduction to in silico medicine" participants should be able to: ...

Learning goals

- Understand the complexity of dealing with predictions about human health;
- Identify the origins of barriers against adoption of in silico technologies (complexity, redundancy, stochasticity, culture);
- Summarize first examples of Digital Twins and In Silico Trials developed;
- Assess the value of the In Silico Trials in the development of new medical products;
- Outline the 3R concept that led In Silico Trials;
- Illustrate how In silico technologies might be of help to ensure and extend the healthcare given how the world population is growing;
- Explain what the Virtual Human Twin will be.

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ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA

KU LEUVEN

INSILICO WORLD

Capacity building & education

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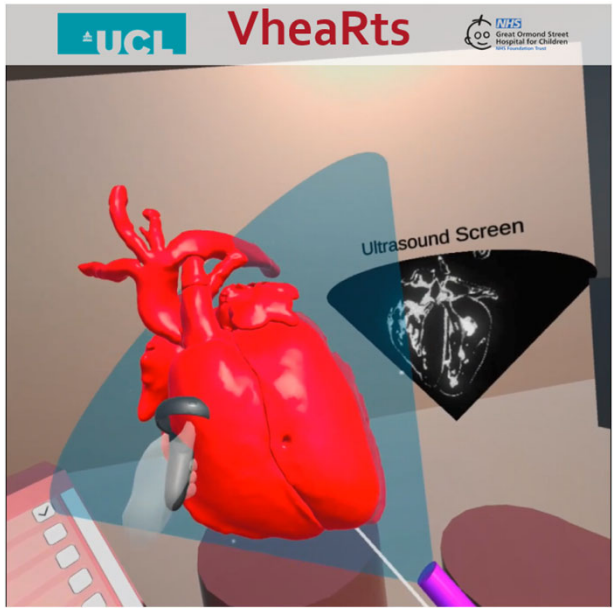

UCL
NHS
Great Ormond Street Hospital for Children
NHS Foundation Trust
VHEARTS

Courtesy of C. Capelli & S. Schievano

Academia & industry

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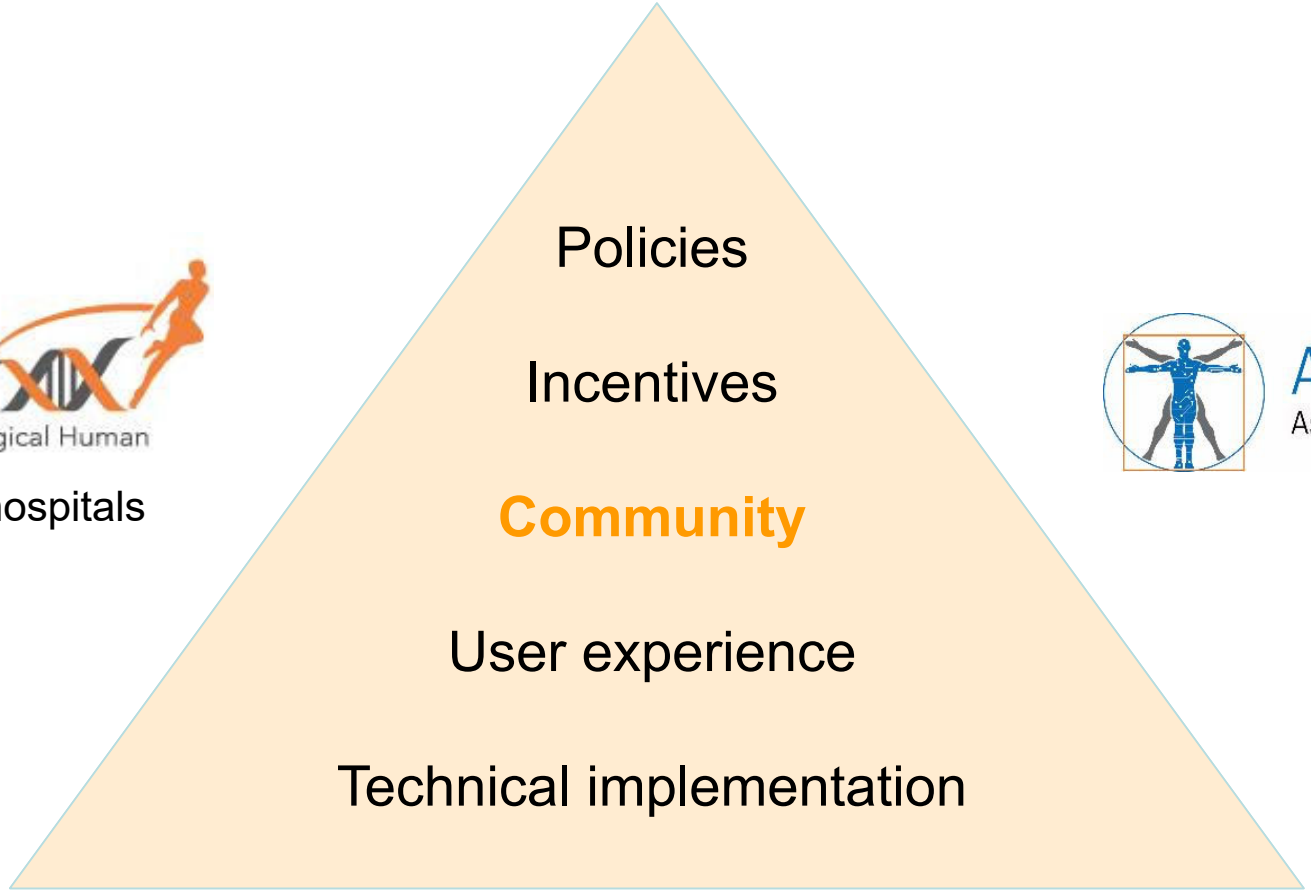
Academia, HTA, hospitals



Avicenna Alliance
Association for Predictive Medicine

VPHi + industry

Standards & Regulatory Actors

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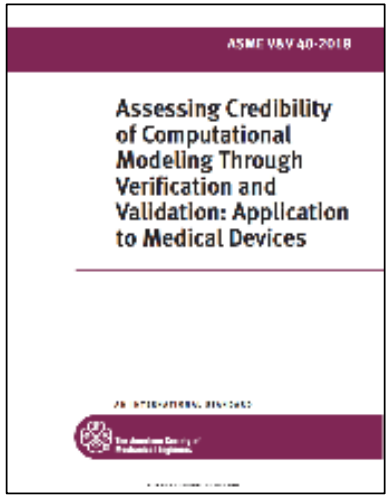
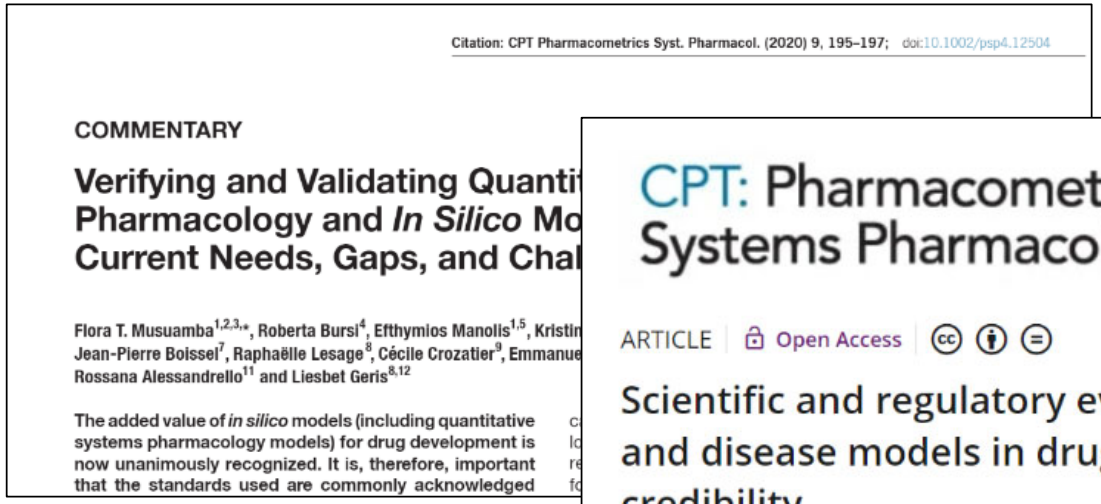

ASME V&V 40-2018

Assessing Credibility of Computational Modeling Through Verification and Validation: Application to Medical Devices


Citation: CPT Pharmacometrics Syst. Pharmacol. (2020) 9, 195–197; doi:10.1002/psp4.12504

COMMENTARY

Verifying and Validating Quanti
Pharmacology and *In Silico* Mo
Current Needs, Gaps, and Chal

Flora T. Musuamba[1,2,3,*], Roberta Bursi[4], Efthymios Manolis[1,5], Kristin
Jean-Pierre Boissel[7], Raphaëlle Lesage[8], Cécile Crozatier[9], Emmanue
Rossana Alessandrello[11] and Liesbet Geris[8,12]

The added value of *in silico* models (including quantitative systems pharmacology models) for drug development is now unanimously recognized. It is, therefore, important that the standards used are commonly acknowledged


CPT: Pharmacometrics & Systems Pharmacology

ARTICLE | Open Access

Scientific and regulatory evaluation of mechanistic *in silico* drug and disease models in drug development: building model credibility

phaëlle Lesage, Giulia Russo, Roberta Bursi, Luca Emili,
arlsson, Alexander Kulesza, Eulalie Courcelles, Jean-Pierre
n, Rossana Alessandrello, Nuno Curado, Enrico Dall'ara,
Geris ... See fewer authors

10.1002/psp4.12669

d undergone full peer review but has not been through
ofreading process, which may lead to differences
Please cite this article as doi:10.1002/psp4.12669


EMB IEEE ComSoc IEEE Signal Processing Society

IEEE JOURNAL OF BIOMEDICAL AND HEALTH INFORMATICS, VOL. 25, NO. 10, OCTOBER 2021 3977

Possible Contexts of Use for *In Silico* Trials Methodologies: A Consensus-Based Review

Marco Viceconti, Luca Emili, Payman Afshari, Eulalie Courcelles, Cristina Curreli, Nele Famaey, Liesbet Geris, Marc Horner, Maria Cristina Jori, Alexander Kulesza, Axel Loewe, Michael Neidlin, Markus Reiterer, Cecile F. Rousseau, Giulia Russo, Simon J. Sonntag, Emmanuelle M. Voisin, and Francesco Pappalardo

***Abstract*—The term "*In Silico* Trial" indicates the use of computer modelling and simulation to evaluate the safety and efficacy of a medical product, whether a drug, a medical device, a diagnostic product or an advanced therapy**

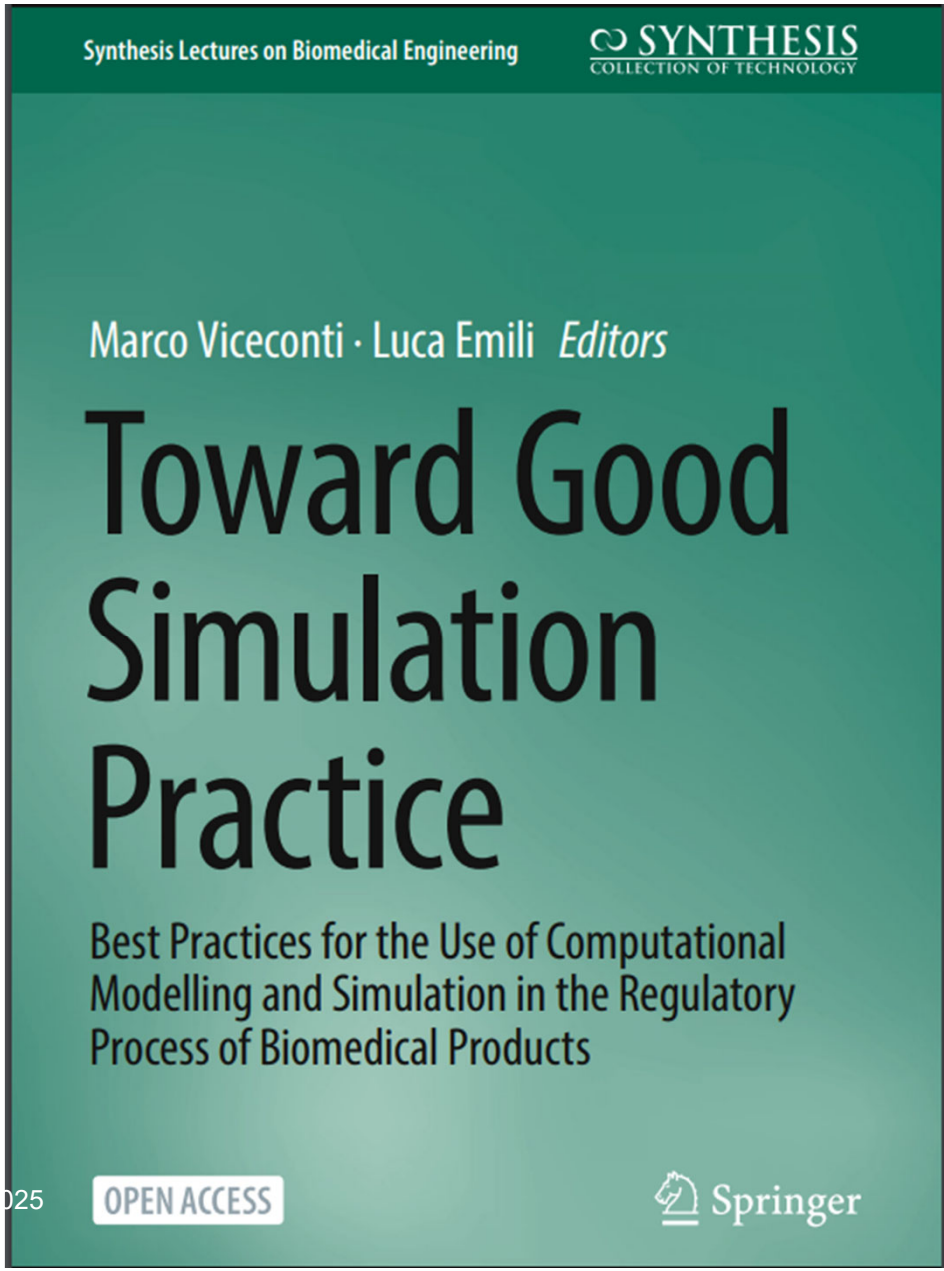
medicinal product. Predictive models are positioned as new methodologies for the development and the regulatory evaluation of medical products. New methodologies are qualified by regulators such as FDA and EMA through formal

FDA

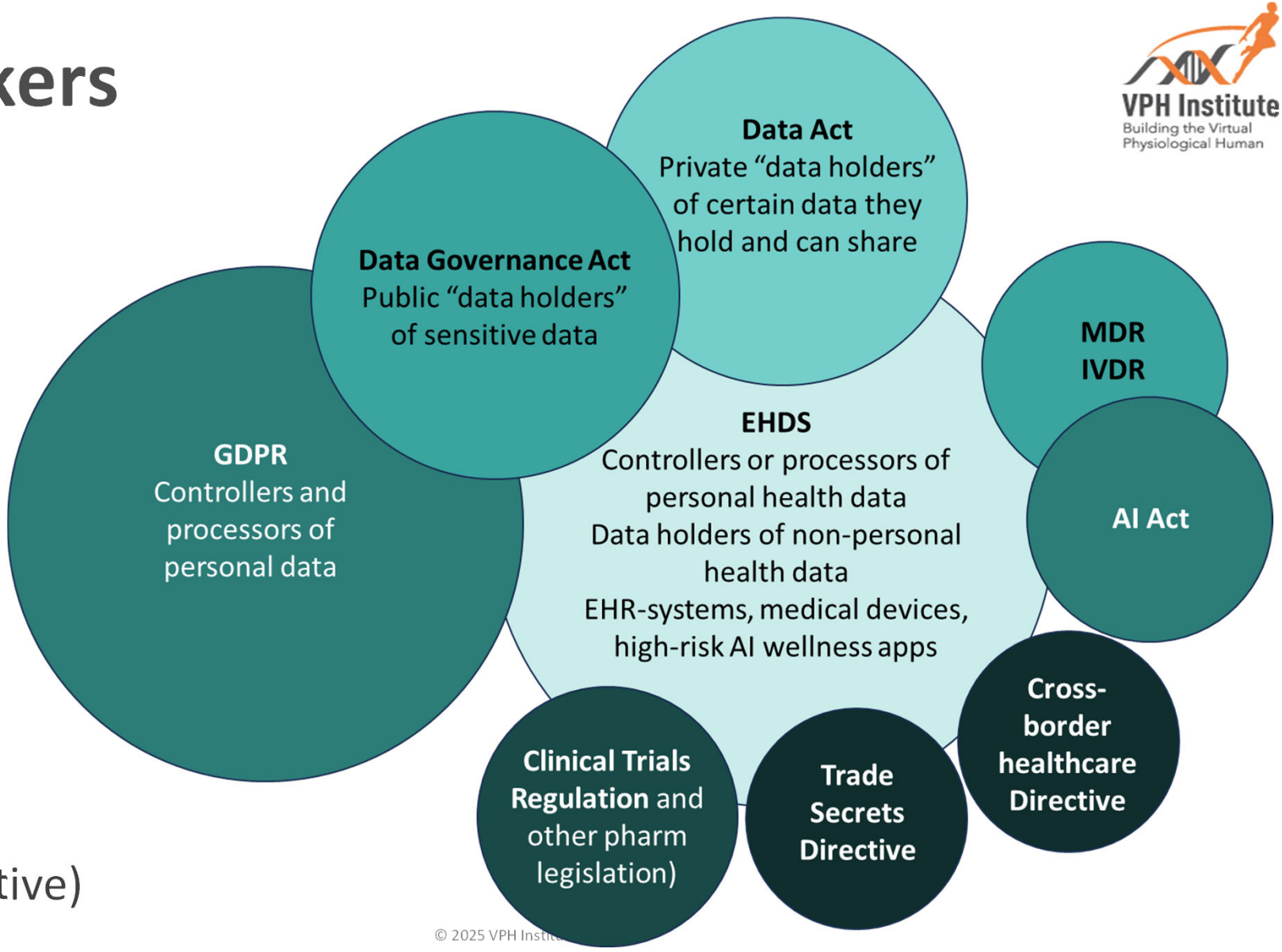
EUROPEAN MEDICINES AGENCY
SCIENCE MEDICINES HEALTH

Good Simulation Practice

- Community effort
  - Academia
  - Industry
  - Regulators
  - HTA
  - Ethics & social sciences
- Used GCP as basis
- Each chapter reviewed by FDA



Policy makers



+ Biotech Act
+ (AI liability directive)

Policy makers

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European Commission
Directorate-General for Health and Food Safety (DG SANTE)

Committees
European Parliament

Choose your committee | SANT | Home | Meetings

Committee on Public Health


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Virtual Physiological Human Twins

European Commission

European Virtual Human Twins

An EU framework supporting the emergence and adoption of the next generation of virtual human twin solutions in health and care

The European Virtual Human Twins Initiative aims to accelerate personalised care with tangible benefits for citizens and patients, while sustaining and advancing EU science and technology in the Digital Single Market.

EDITH Coordination & Support Action

Ecosystem

Roadmap

Repository

Simulation Platform

VPH Institute Building the Virtual Physiological Human · vito · Queen Mary University of London · PI SCHOOL MACHINE INTELLIGENCE MEETS HUMAN CREATIVITY · LYNKEUS · ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA · ATHENA Research & Innovation Information Technologies · CYFRONET · empirica · BSC Barcelona Supercomputing Center Centro Nacional de Supercomputación

JÜLICH Forschungszentrum · Inria · HITS · EPFL · DIGITALEUROPE · Universiteit van Amsterdam · LIÈGE université · UNIKLINIK RWTH AACHEN · FORTH FOUNDATION FOR RESEARCH AND TECHNOLOGY - HELLAS

Roadmap writing & validation

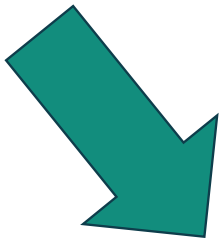
- **Design phase** (1/10/2023-31/7/2023)
  - Consortium, industry advisory board, expert meetings (covering all elements of ecosystem)
  - Public writing 1st draft
- **Develop phase** (1/8/2023-16/7/2024)
  - Manifesto, boards, expert meetings, ecosystem meetings
  - Public writing 2nd draft
- **Deliver phase** (17/7/2024-31/12/2024)
  - Ecosystem: public endorsement
  - Advisory boards: expert / political endorsement

Validation – key principles

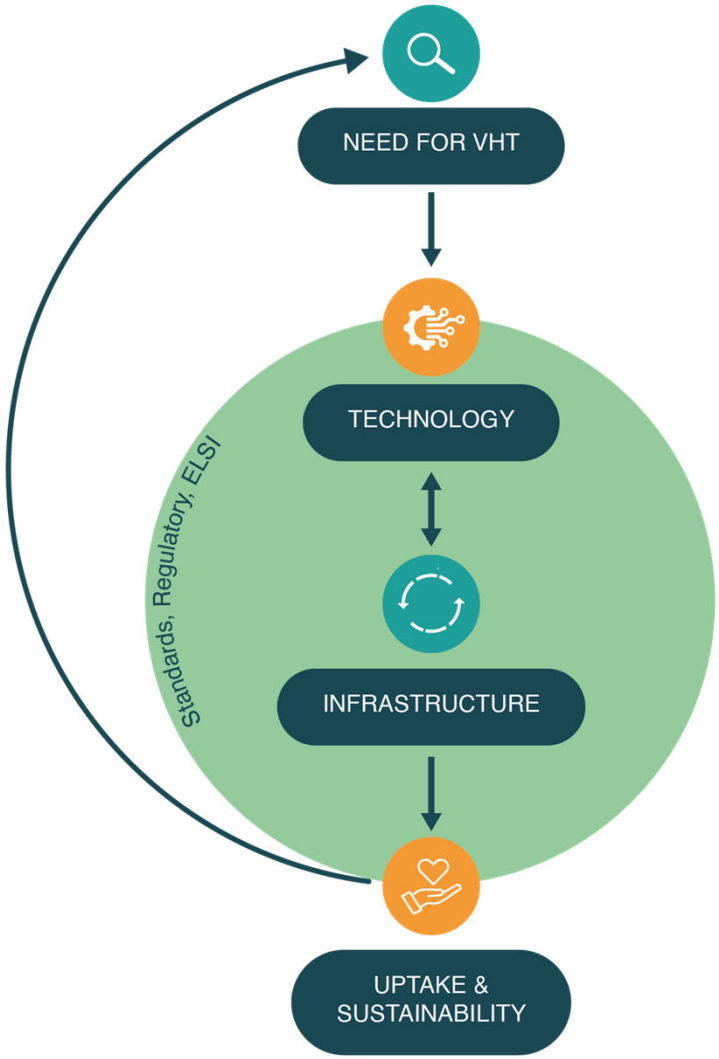
Need identification	Roadmap's (RM) ability to identify and address existing gaps in programs
Understanding	ease of RM and roadmap contents comprehension
Acceptability	perception, satisfactoriness and organizational fit of the roadmap
Integration	RM's ability to fit into the current programming
Translation	measures facilitators of translation such as appropriateness, context nuances and budget feasibility
Implementation	measures possible execution of all sections and actions listed in the RM
Practicality	ability of existing financial and human resources to implement the RM
Political buy-in	political support for implementation of RM (national & EU level)

Validation by connection, interrogation and collaboration with engaged ecosystem

- Innovation ecosystem
  - Identified stakeholders & brought together ecosystem
  - Identified needs & expectations
  - Actively engaged with the entire ecosystem



Towards innovation framework



- **PART 1** : from DTs in healthcare to the VHT – need & vision

- **PART 2**: realizing the VHT – technology
- **PART 3**: realizing the VHT – infrastructure
- **PART 4**: realizing the VHT – ELSI, standards & regulatory
- **PART 5**: realizing the VHT – users, uptake & sustainability

- **PART 6**: 30 recommendations for a successful VHT

Format of the final roadmap

- Full (technical) roadmap
  - 337 pages
  - Comprehensive document

- Extended summary – policy brief
  - High-level content
  - Why – what – who
  - Recommendations & timeline

- [Layman book]

Manifesto for the Virtual Human Twin

- Driven by EC, facilitated by EDITH

- Why?
  - Way of demonstrating support from ecosystem
  - Increase visibility of VHT-related activities
  - High-level entry into the VHT

- Over 100 organisations signed
  - Across all stakeholders

- *A rising tide will lift all boats*

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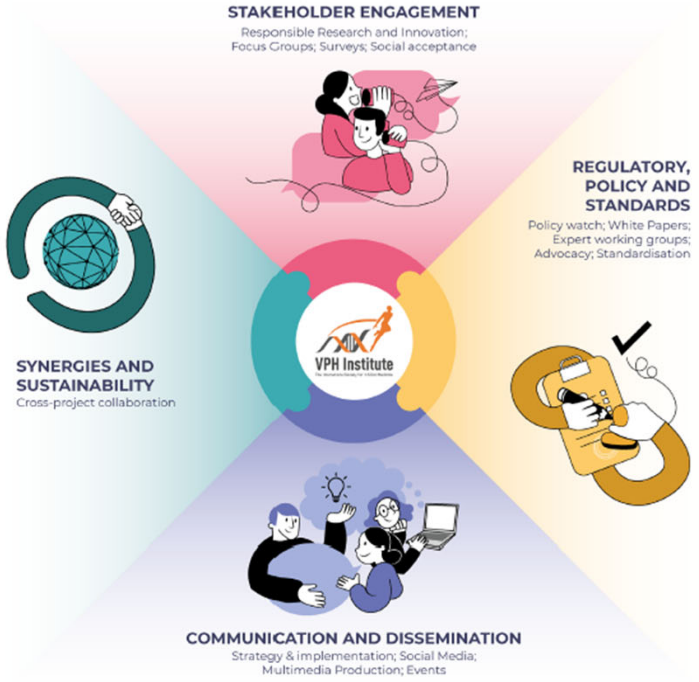
VPH - The International Society for In Silico Medicine

As an ecosystem organisation, our vision is to bring together diverse stakeholder communities of scientists, industry, healthcare providers, patients, regulators, and policymakers to drive the development and integration of computer models in healthcare for the benefit of all.

One society, a whole ecosystem!



Be part of the digital revolution of health: become a VPH member now!

Discover the VHT Roadmap - the community-built strategy for the full realisation of the Virtual Human Twin.

EDITH

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Thank you!

www.vph-institute.org
www.virtualhumantwins.eu

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