EARTO Working Group
Emerging Technologies for Healthcare

EARTO Position Paper on Advanced Materials for Healthcare

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Introduction

Following the European Commission (EC) Communication on Advanced Materials for Industrial Leadership and this week launch of the IAM-I, the international non-profit Association that will operate the upcoming European co-programmed partnership on Innovative Advanced Materials for Europe (IAM4EU), EARTO would like to provide further inputs for the upcoming Strategic Research Innovation Agenda (SRIA) of this new European partnership.

As a critical technology area[1] for the European Union's economic security, advanced materials are designed and engineered materials that play an increasing role for the European industries' competitiveness thanks to their cross-cutting technology applications[2]. Future demand for advanced materials is expected to rise for renewable energy, chemical energy storage, net-zero ("green") buildings, semiconductors as well as for **medical technologies, and medicine[2]**. Up to now, the sectors of energy, mobility, construction and electronics are already considered advanced materials' RD&I priority areas based on their capacity to increase resource efficiency, improve recyclability, and reduce emissions: all key priorities under the EU Green Deal aiming to reduce Europe's dependencies, increase its resilience, and strengthen its strategic autonomy. The sectors of medical technologies, and medicine have so far not been covered by advanced materials' EU RD&I as not linked to the EU Green Deal. While we understand the first focus on the Green Deal sectors, we believe healthcare sector's importance to be recognised in the new SRIA of IAM4EU as key for the EU healthcare sector's competitiveness.

In EARTO inputs on Healthcare Research and Innovation for the next Strategic Plan of Horizon Europe (2025-2027)[3]', one of the significant gaps clearly identified was related to **advanced biomaterials**. Biomaterials are at the core of innovation in the life sciences and healthcare. Biocompatible, bio-resorbable, and bio-sourced materials such as hydrogels, polymers, nano-based lipids, polypeptides, to name but a few, are crucial building blocks for breakthrough innovations in healthcare. **They enable the development of vaccines, drug delivery systems and devices, cellular therapy, regenerative medicine, or implantable smart medical devices – they drive innovation in healthcare.**

Today, the EU RD&I framework programme Horizon Europe does not properly reflect the EU needs in advanced biomaterials' RD&I. **Tackling healthcare industry challenges for industrial competitiveness requires innovation pathways that reflect the cross-cutting nature of health R&D for medical devices, pharmaceuticals, and biotech-based products and, unfortunately, not sufficient opportunities for maturing biomaterials are provided. This would require Horizon Europe to leverage RD&I actors' expertise and innovation capacity by conducting applied research transversally between Horizon Europe Cluster 1 on Health and Cluster 4 on Digital, Industry and Space.** Today, this lack of transversal ambition has a detrimental impact on the capabilities of European innovative healthcare industry players and stakeholders to access key advanced materials in the future. This is especially true for SMEs and deep-tech start-ups in this sector.

Currently, several consultations regarding the prioritization areas for industrial leadership in advanced materials are being held and will shape the way towards different RD&I related programmes, including the next framework programme FP10. Importantly, the new strategic agenda 2024-2029 to guide the work and priorities of EU institutions, including RD&I, concluded that Europe needs to build up own capacity of key technologies of the future such as **advanced materials** as well as mobility, semiconductors, 5G/6G, **health, biotechnologies**, **pharmaceuticals**, AI, quantum technologies, or space and defense.

In this context, the EARTO Working Group on Emerging Technologies for Healthcare hereby emphasises health as a key RD&I priority area for the new EU advanced materials strategy to maximise the output and outreach that this initiative will have by adding a market with high socio-economic effect and environmental impact.[4]

[1] https://defence-industry-space.ec.europa.eu/commission-recommendation-03-october-2023-critical-technology-areas-eus-economic-security-further_en
[2] https://research-and-innovation.ec.europa.eu/research-area/industrial-research-and-innovation/key-enabling-technologies/chemicals-and-advanced-materials/advanced-materials-industrial-leadership_en
[3] https://www.earto.eu/earto-inputs-on-healthcare-research-and-innovation-for-the-next-strategic-plan-of-horizon-europe-2025-2027
[4] https://www.consilium.europa.eu/media/4aldqfl2/2024_557_new-strategic-agenda.pdf

Accordingly, EARTO would like to point out the following **3 key considerations for advanced materials RD&I for healthcare to be included in the EU strategy for advanced materials and attached RD&I programming**:

1. Healthcare market characteristics highly fit with the selection criteria for priority areas:
The healthcare market (medical devices, pharmaceuticals, biotech products) is the third largest industrial sector in Europe, with an annual turnover of €386 bn euros per year[5,6] and employing 1.6 million people. In its 2021 report "Delivering a 'Net Zero' National Health Service", the UK's NHS attributes as much as a quarter of its carbon footprint to medicines.[7] The pharmaceutical industry emission intensity is about 55% higher than the automotive's. The main drivers for this difference are a lower degree of operations digitalization and the application of batch production, compared to continuous production[8], which matches suitably with the challenge that this initiative is to exploit synergistic effect with the twin transition.

2. Several advanced biomaterials developed for the healthcare industry have applications/impact in other industrial sectors such as electronics and energy:
Several advanced materials inherent to health applications can also be applied to other sectors, increasing its market size and social/technological impact. These include smart materials that change properties based on external stimuli, materials dedicated to flexible electronics, bioinspired, biomimetic, and bio-sourced materials. While these can be tailored for the healthcare sector and its regulated environment, increasing market value and providing solutions to a highly innovative environment, they create spill-over effects and added-value to other industrial sectors that are directly interlinked such as energy or electronics. The inclusion of healthcare as a priority area will strongly enhance the market value and outreach of new advanced materials developed while optimizing price settings based on a higher number of applications.

3. Healthcare sector shares advanced materials cross-cutting characteristics:
Across all sectors, digitalization of RD&I holds the potential to speed up scientific hypothesis generation, research, discovery, characterization and validation of the composition or structure of new innovative materials, enabled by the analysis of vast datasets, predictive modelling, and AI. As laid out in the European Commission Communication[2], implementing the 'Safe and Sustainable by Design' concept will be at the core of the general material transformation process. Specifically advanced biomaterials contribute to safety and sustainability while being advantageous with respect to cost and performance, as well as to peoples' health and the environment. Taking into account the specificities of each sector, in healthcare it is key to match RD&I with both regulatory and sustainability requirements for safety, re-use, and environmental footprint, to achieve sufficient harmonization of methods, computation, and assessment tools, and to exploit the European Health data space as first data space across the EU to provide the data infrastructure requires by digital modelling tools.

Following these 3 considerations, EARTO healthcare experts very much support the inclusion of healthcare as a strategic area for advanced materials RD&I priorities in the Strategic Research Innovation Agenda (SRIA) of the new European public-private partnership IAM4EU on Advanced Materials for Industrial Leadership.

Strategic Area	Proposed Definition
Healthcare	Smart biomaterials and functional surfaces for controlled drug delivery and medical devices; sustainable materials for single-use products; eco-friendly functional materials for biosensing and imaging; materials for sustainable power supplies in disposable diagnostic and therapeutic devices; flexible and implantable electronics; biomaterials for non-invasive continuous monitoring for healthcare applications.

Especially, EARTO healthcare experts would like to propose how such inclusion could be derived in RD&I priorities for healthcare by proposing the following focus areas for IAM4EU SRIA:

a) Smart biomaterials and functional surfaces for controlled drug delivery and medical devices:
Such materials are key to significantly improve the efficacy and safety of therapies, improving target release and modulation based on the microenvironment, and maintaining a high-performing interface between cells, tissues, organs, and the medical device. This may include: 1) new stimuli-responsive materials (e.g., responsive to light or temperature) such as hydrogels for continuous and controlled release of drugs for theragnostic approaches used in bio-responsive closed-loop drug delivery systems, 3D-printable, or dispensable materials with biocompatible properties; 2) functional biomaterials used in medical devices, including implantable devices; 3) biocompatible materials used in regenerative medicine; or 4) interstitial-based wearable biosensors used in molecule sensing, microneedle-based sampling, micro-dialysis, or dug and nutrient monitoring.

[5] https://www.efpia.eu/publications/data-center (2021)
[6] https://www.medtecheurope.org/resource-library/medtech-europes-facts-and-figures-2022 (2022)
[7] B1728-delivering-a-net-zero-nhs-july-2022.pdf (england.nhs.uk)
[8] Carbon footprint of the global pharmaceutical industry and relative impact of its major players - ScienceDirect

b) Sustainable materials for single-use products: There is a lack of bio-based and bio-degradable materials with the required physicochemical characteristics to be used in different single-use settings such as diagnostic and drug-delivery devices, including lab point-of-care testing, which significantly contribute to waste production. This category may include: 1) bio-based polymer materials for medical *in-vitro* and *in-vivo* diagnostic applications; or 2) materials for injection molding, polymer foils, or coatings. Materials need be optimized with respect to the application-specific requirements such as avoiding ingredients that chemically interfere with the diagnostic assay, ensuring biocompatibility (i.e., medical grade), fluidic properties, suitability for biofunctionalization, suitability for sterilization, offering biodegradability when necessary, and being non-hazardous and non-toxic when incinerated.

c) Eco-friendly functional materials for biosensing and imaging: Such materials offer improved or new functions for biosensing (e.g., via optical, piezoelectrical or electrochemical modalities), liquid handling (e.g., micropumps or microvalves), and medical imaging applications. This may cover: organic and inorganic materials, nanomaterials, and nanostructured surfaces as well as the associated scalable, material- and energy-saving fabrication and deposition processes (e.g., printing, local dispensing).

d) Materials for sustainable power supplies in disposable diagnostic and therapeutic devices: In many diagnostic devices power supplies are required. Typically, these devices are active for a limited time span and consume a small amount of the energy stored in conventional batteries to fulfil their function. Sustainable power supplies employing eco-friendly materials are therefore a vital building block to enable the widespread use of these devices. This may cover: paper, cellulose, or other non-toxic electrolytes for power supplies engineered for their specific diagnostic and therapeutic use, as well as materials capable of converting endogenous biochemical energy (e.g., glucose) into electrical power.

e) Flexible and implantable electronics: Both implantable and insertable devices for diagnostic or therapeutic purposes require biocompatible encapsulation materials as well as durable sensor and actuator site materials exposable to tissue without performance degradation or tissue damage. The move to further miniaturized, spatially distributed devices in proximity to the heart of the effect (higher efficacy, minimal surgical damage) asks for the development of novel functional materials, cost-efficient fabrication, and compliance test methods. The 'frugal engineering concept' promotes the sustainable use of resources by substantially reducing the complexity of a device, resulting in higher durability and lower maintenance costs. This may cover: electrode materials, bio-functional coatings, nanostructures surfaces for sensing purposes, hermetically sealing conformal coating materials as well as the exploitation of intrinsic nonlinear material properties in electronic components (e.g., smart ceramics).

f) Biocompatible and biodegradable materials for advanced therapies and complex cellular systems: Advanced therapies, including cell and tissue therapies, as well as 3D-printed tissues or scaffolds, represent a rapidly growing field with significant potential for the pharmaceutical industry and healthcare advancements. Novel drug development requires *in vivo*-like complex cellular systems for drug screening, safety assessments, and functionality evaluations prior to clinical trials. Advanced biomaterials are crucial in this field, as they provide the necessary scaffolds for developing the next generation of complex cellular systems. This may include: 1) biodegradable scaffolds to mimic extracellular matrix, providing structural support and promoting cell attachment, proliferation, and differentiation. 2) hydrogels for tissue engineering, 3) bioactive coatings, 4) 3D-printing/bioprinting materials and 5) nanocomposites.

EARTO healthcare experts remains ready to provide additional input on their proposed RD&I topics. They would be glad to further discuss the implications of this paper for the competitiveness of the EU healthcare industry and its RD&I ecosystem.

EARTO - European Association of Research and Technology Organisations
Founded in 1999, EARTO promotes RTOs and represents their interest in Europe. EARTO network counts over 350 RTOs in more than 31 countries. EARTO members represent 150,000 highly-skilled researchers and engineers managing a wide range of innovation infrastructures.
RTOs - Research and Technology Organisations
From the lab to your everyday life. RTOs innovate to improve your health and well-being, your safety and security, your mobility and connectivity. RTOs' technologies cover all scientific fields. Their work ranges from basic research to new products and services' development. RTOs are non-profit organisations whose core mission is to produce, combine and bridge various types of knowledge, skills and infrastructures to deliver a range of research and development activities in collaboration with public and industrial partners of all sizes. These activities aim to result in technological and social innovations and system solutions that contribute to and mutually reinforce their economic, societal and policy impacts.
***EARTO Working Group Emerging Technologies for Healthcare**: the WG is composed of 100 experts coming from 37 RTOs in 18 European countries. This WG is looking at the implementation of the EU RD&I Framework Programmes (Horizon Europe) addressing the healthcare sector, and especially medical technology, pharmaceuticals, biotechs. Its members are conducting technological research for biomedical and medical applications, both for large companies and SMEs. They strongly support the emergence and the growth of spin offs in healthtech. This WG is also looking at how RTOs can be involved in and benefit from projects under the European Digital Programme as well as the EU4Health programme, but also about the specific role of RTOs in Institutionalised Partnerships such as Innovative Health Initiative.*
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