Nanotechnology in Global Health: Navigating the Frontiers of Infectious Disease and Antiparasitic Therapy

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Nanotechnologies applications and regulatory aspects in different therapeutic area with focus on infectious diseases and antiparasitic drugs. Leveraging low environmental impact and one health consideration

4-5 June 2026

University of Modena and Reggio Emilia, Modena, Italy

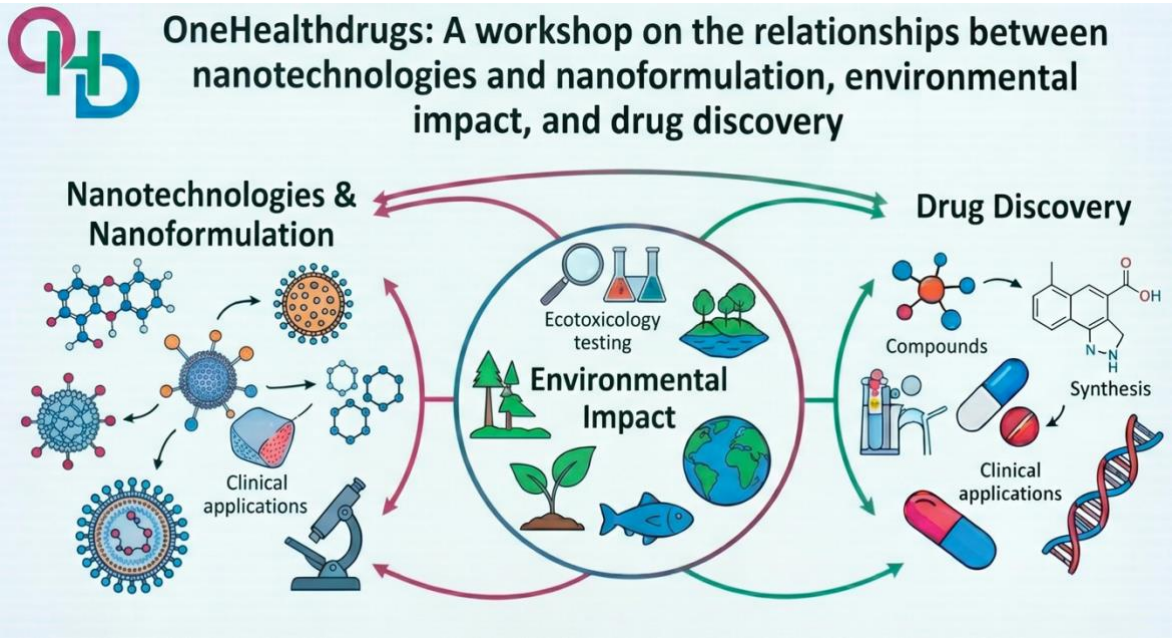
Workshop of the COST Action CA21111 & HIP-TECH PhD School
One Health drugs against parasitic vector borne diseases in Europe and beyond
OneHealthdrugs

BOOK OF ABSTRACTS

The event is open to PhD, young innovators and senior scientists from both academia and pharma

Nanotechnology in Global Health: The 2026 Paradigm Shift

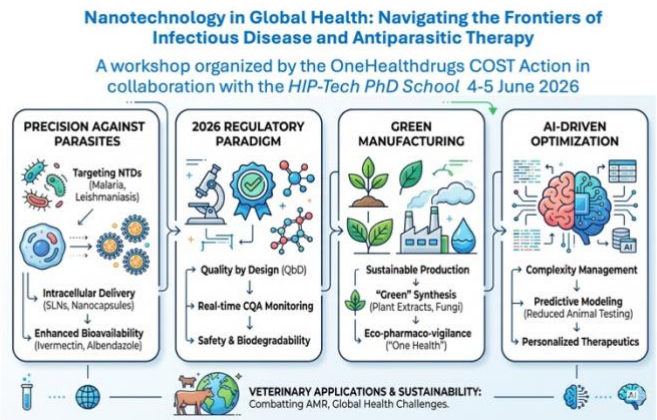
The One Health drugs COST Action and the HIP-Tech PhD School (University of Modena and Reggio Emilia) convene in June 2026 for two international days focused on Nanotechnology in global health.



Introducing the Workshop

The One Health drugs COST Action and the HIP-Tech PhD School (University of Modena and Reggio Emilia) convene in June 2026 for an international day focused on Nanotechnology in global health. The integration of nanotechnology into therapeutic areas represents a critical intersection of innovation, regulatory evolution, and environmental stewardship.

In 2026, nanotechnology has transformed the fight against Neglected Tropical Diseases (NTDs) like malaria. By using intracellular targeting via polymeric nanocapsules, drugs are delivered directly into host cells to strike parasites where they hide. Simultaneously, nano-suspensions have boosted the bioavailability of drugs like Ivermectin, allowing for lower, safer doses.



This progress is governed by a rigorous regulatory landscape. Agencies now mandate Quality by Design (QbD), requiring real-time monitoring of particle size and drug loading. To ensure long-term safety, the industry has pivoted toward biodegradable materials that leave no toxic footprint in the patient.

Sustainability is the new manufacturing standard. Through "Green" Synthesis, researchers use plant extracts and fungi instead of hazardous solvents, slashing the carbon footprint of pharmaceutical production. This "One Health" approach extends to eco-pharmaco-vigilance, ensuring that nano-waste does not disrupt aquatic ecosystems or livestock environments, which helps combat antimicrobial resistance.

Powering these breakthroughs is AI-driven optimization. Machine learning now predicts membrane interactions and perfects nanocarrier "recipes," drastically reducing animal testing. From personalized human therapeutics to more efficient veterinary care, these microscopic innovations are solving macroscopic global health challenges.

PROGRAM	Day 1 (Thursday 4 June 2026) room 1.3 MO51
	Registration
13:30 – 14:30	Welcome remarks and introduction *(Prof. G. Tosi MP Costi)*
14:30 – 14:50	*Chai: Prof. Maria Paola Costi Prof. G.Rastelli*
14:55 - 15:25	Lecture 1: Biological profiles of industry standard hit, lead and candidate compounds *Dr. Sheraz Gul, Fraunhofer Institute, Hamburg, DE*
15:30 – 16:00	Lecture 2: *PhD presentation.* Ecotoxicology: chemicals and ecological consequences in a rapidly changing world *PhD Nicole Goede, University of Namur, BE.*
16:05 – 16:35	*Chair: Prof. Giovanni Tosi and Prof. Giulio Rastelli* Lecture 2: Machine Learning in Nanomedicine Formulation Development *Prof. Thomas L. Moore, Università Federico II di Napoli, I.*
16:35 – 16:55	Coffee Break
17:10 – 17:40	Flash PHD presentations *(Poster numbers 1-5)*
17:30 – 18:00	Lecture 3: The One Health Paradigm in Drug Discovery: Challenges and Opportunities *Prof. MP Costi, Unimore, Modena, I.*
18:00 – 18:15	Closing of day 1
20:00	Optional group dinner

	Day 2 (Friday 5 June 2026) room 1.1 MO51
09:00 - 09:30	*Chair Dr. Sheraz Gul and Prof Giovanni Tosi* Lecture 4: Sweet and non-sweet routes to pathogen eradication *Prof. Giuseppe Mantovani, University of Nottingham, UK.*
09:35 - 10:05	Lecture 5: In Situ Nanovaccines: Gene-Activated Hydrogels for Programmable Virus-Like *(Prof. Marcos Garcia-Fuentes, University of Santiago di Compostela and Health Research Inst. ES.*
10:05 - 10:25	Coffee Break
10:25 - 10:40	Group photo
10:40 - 11:10	Flash PHD presentations *(poster number 5-10)*
11:10 - 11:40	Lecture 6: Natural biomaterials and sustainable formulation techniques for nanomedicine production *Dr.Riccardo Caraffi Unimore, Modena, I.*
11:40 -12:10	*Chair Prof. Maria Paola Costi* Lecture 7: High-throughput multi-parametric strategies for comprehensive in vitro compound toxicity assessment *Dr. Sheraz Gul, Fraunhofer Institute, Hamburg, DE*
12:10 - 13:10	Rich coffee break
13:10 - 13:50	Survey delivery on site to participants – collection and review
13:50 - 14:45	Summary report and closing remark

OneHealth*drugs*

Nanotechnology in Global Health: Navigating the Frontiers of Infectious Disease and Antiparasitic Therapy
Meeting Date: 4-5 June 2026

The One Health drugs COST Action and the HIP-Tech PhD School (University of Modena and Reggio Emilia) convene in June 2026, for an international day focused on Nanotechnology in global health.
The landscape of nanomedicine has shifted from experimental proof-of-concept to industrial and clinical reality. The integration of nanotechnology into therapeutic areas, specifically for infectious diseases and parasitic infections, represents a paradigm shift in how we address global health challenges under the One Health framework. This explores the critical intersection of nanotherapeutic innovation, regulatory evolution, and environmental stewardship

1. Focus on Antiparasitic Drugs and Neglected Tropical Diseases (NTDs)
Parasitic diseases like malaria, leishmaniasis, and trypanosomiasis continue to affect millions. Nanotechnology is providing the tools to treat these often-neglected conditions with unprecedented precision.
Intracellular Targeting: Many parasites hide within host cells (e.g., macrophages). Modern nano-formulations, such as solid lipid nanoparticles (SLNs) and polymeric nanocapsules, are designed to be "swallowed" by these very cells, delivering the antiparasitic payload directly to the parasite's doorstep.
Enhanced Bioavailability: Traditional antiparasitic drugs often suffer from poor water solubility. Nano-suspensions and lipid-based carriers have successfully increased the oral bioavailability of drugs like Ivermectinand Albendazole, allowing for lower doses and fewer side effects.
2. The Regulatory Landscape: Navigating 2026 Standards
The regulatory environment has matured significantly. Agencies like the EMA and FDA have moved toward more standardized frameworks for "nanomedicines" rather than treating them as "edge cases."
Quality by Design (QbD): Regulatory bodies now emphasize Real-time Critical Quality Attribute (CQA)monitoring. Manufacturers must demonstrate precise control over particle size distribution, surface charge, and drug loading consistency at scale.
Safety and Biocompatibility: 2026 regulations place a higher burden of proof on the long-term "fate" of inorganic nanoparticles in the body. There is a growing preference for biodegradable and bio-resorbable nanomaterialsthat leave no toxic footprint in human tissue.
3. One Health and Low Environmental Impact
A defining theme of this session is the One Health approach, which recognizes that human health is inextricably linked to the health of animals and our shared environment.
"Green" Nanomanufacturing: There is a concerted shift toward using plant-derived extracts and "green" chemistry to synthesize nanoparticles. This reduces the use of toxic solvents and hazardous precursors during the production phase.
Environmental Persistence: As nanotherapies enter mass production, their environmental impact is under scrutiny. Researchers are focusing on the ecotoxicity of nano-waste, ensuring that excreted metabolites or discarded medical waste do not disrupt aquatic ecosystems or contribute to environmental antimicrobial resistance (AMR).
Veterinary Applications: By improving the efficacy of antiparasitic treatments in livestock, nanotechnology reduces the total chemical volume released into pastures and water systems, embodying a sustainable approach to animal husbandry and food security.

BOOK OF ABSTRACTS

Meeting Venue

University of Modena and Reggio Emilia
Via Campi 103, Modena, Italy

Scientific Commettee

Maria Paola Costi and Giovani Tosi

Organizing Commettee

Valeria La Gatta
Sabrina Cuoghi
Sofia Tagliavini
Alessandro Anderlini

Contents

Transformation-aware molecular networking for rapid metabolite investigation in complex biological samples

Elena Ferri,[a,b] Cristian Caprari,[a] Maria Angela Vandelli,[a] Rossana Cecchi,[c] Patrizia Verri,[c] Cinzia Citti,[d,a] Giuseppe Cannazza,[a,d]

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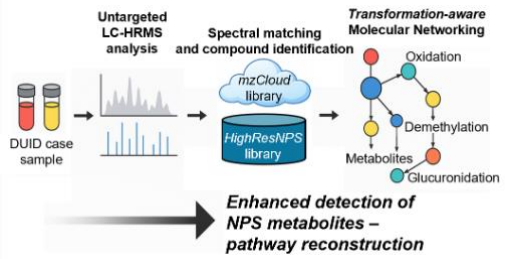
The rapid emergence of new psychoactive substances (NPS) and their extensive biotransformation challenge the reliability and interpretability of chemical measurements in forensic toxicology and exposure monitoring. Targeted analytical workflows offer high selectivity but frequently fail when parent compounds are present at low concentrations or are absent from biological matrices, limiting metabolite coverage and evidential interpretation.
In this study, an untargeted LC–HRMS measurement and data-analysis framework was evaluated to improve metabolite annotation and structural contextualization in complex biological samples. Blood and urine collected from a suspected driving under the influence of drugs (DUID) case were analyzed using high-resolution full-scan and data-dependent MS/MS acquisition as a representative test system. Data were processed in Compound Discoverer using a customized workflow combining spectral library matching (*mzCloud* and an *in-house* spectral database built from *HighResNPS.com*, containing over 2400 high-resolution spectra of drugs of abuse and NPS), rule-based metabolite prediction (MetID), and transformation-aware molecular networking. The transformation-aware molecular networking strategy integrates MS/MS spectral similarity with predicted phase I and phase II biotransformations, enabling relational organization of parent compounds, metabolites, and structurally related features. Compared to rule-based metabolite prediction alone, this approach increased the number of metabolite-related features associated with detected xenobiotics and supported reconstruction of chemically consistent metabolic families, including cases in which parent compounds were not observed in the measured sample.Taken together, the results demonstrate that transformation-aware molecular networking provides an effective strategy for organizing and interpreting untargeted LC–HRMS data by linking spectral similarity with biotransformation relationships. Beyond forensic toxicology, the integration of AI-assisted molecular networking and biotransformation-aware analysis may support future analytical and monitoring strategies for complex therapeutic compounds, environmental xenobiotics, and emerging bioactive molecules within a broader One Health framework.



Acknowledgment: This work was funded by Fondo Di Ateneo Per La Ricerca Anno 2024 (FAR2024PD), A.D06@FAR2024_DIP@05FA-CANNAZZA_FARDIP_2024.

Production of Biodegradable PLGA–Mannose Nanoparticles via Scalable Microfluidics for Targeted Cancer Therapy

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Mannose, a natural monosaccharide, has shown promising radiosensitising effects in Phosphomannose Isomerase Knockout Head and Neck Squamous Cell Carcinoma models (PMI KO HNSCC) by disrupting tumour metabolism, reducing ATP production, and impairing DNA damage repair after irradiation. However, its therapeutic use is limited by high water solubility and rapid renal clearance, resulting in low bioavailability and a short plasma half-life.

To overcome these limitations, this project focused on the development of poly(lactic-co-glycolic acid) (PLGA)-based nanoparticles (NPs) encapsulating mannose for use in combination with radiotherapy. PLGA is a biocompatible and biodegradable polymer approved by the Food and Drug Administration and the European Medicines Agency, widely employed for the protection and controlled delivery of bioactive compounds. In addition, PLGA NPs can be functionalised with specific ligands, making them selective to different tumour types.

Two production methods were optimised: double emulsion (DE) and microfluidics (MF) (**Figure 1**). Among them, MF showed superior performance, enabling the production of NPs with mean diameters below 200 nm, high homogeneity (PDI < 0.15), stable negative surface charge (~–30 mV), and significantly higher mannose loading (up to 40%) compared with DE formulations. Furthermore, the NPs maintained physicochemical stability for at least one month without cryoprotectants, supporting their suitability for storage and industrial handling. The automated and continuous microfluidic process also represents a scalable and reproducible manufacturing platform suitable for future clinical translation.

Preliminary *in vitro* studies in PMI KO HNSCC models demonstrated efficient cellular uptake and enhanced antitumour activity when combined with radiotherapy compared with free mannose. Future developments will focus on NP functionalisation to improve tumour targeting and on *in vivo* evaluation of therapeutic efficacy and safety.

Overall, PLGA–mannose NPs represent a promising strategy for radiosensitisation and targeted cancer therapy.

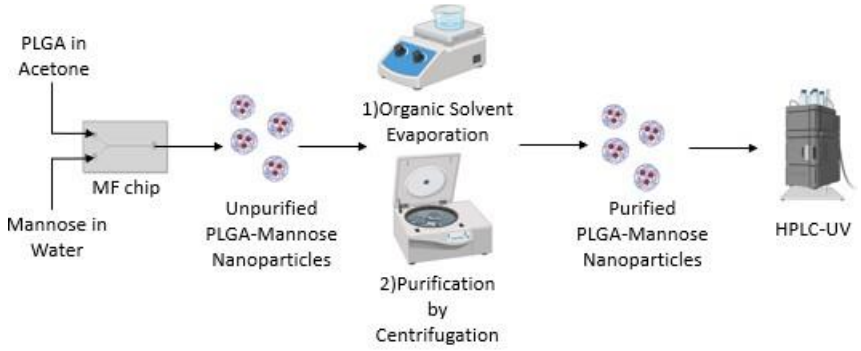

Figure 1: Workflow of nanoparticle production via microfluidics (MF)

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Acknowledgement

The Authors acknowledge HIP-TECH PhD Program, Nanotech Lab/Te. Far. T.I. and Professor Jonathan Coulter's group at the School of Pharmacy, Queen's University B

Immunomodulatory properties of heat-inactivated biomasses by selected bacterial and fungal species included in the Qualified Presumption of Safety list of the European Food Safety Authority

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Abstract

Microbial lysates have been described to manage recurrent respiratory infections, and as a defense against urinary infections by modulating host responses with partially understood mechanisms. We recently showed that bacterial lysate from *Cutibacterium acnes* (BL) enhances cellular responses against *Candida albicans*, *Escherichia coli*, and *Gardnerella vaginalis* in an *in vitro* model of vaginal infection, through trained immunity-associated mechanisms. This project aims to identify new microbial lysates with immunomodulatory capacity comparable to or better than BL, to be tested in *in vitro* models of *E. coli*-induced urinary tract and gastrointestinal infection.

We selected 10 microorganisms included in the QPS list published by the EFSA. Microorganisms were cultured in broth, incubated at 30 °C for 48h and growth was monitored by optical density and colony-forming units. Then, cultures were heat-inactivated at 75 °C for 3h. The resulting microbial biomasses (Hi-MBs) were harvested by centrifugation and dried overnight using a speed-vacuum system. The murine macrophages J774A.1 were then primed with Hi-MBs for 24h at 37 °C and 5% CO_2 and the phagocytic activity versus *E. coli* fluorescent bioparticles, was assessed after 30 min or 2h, using the Vybrant™ Phagocytosis Assay Kit.

In the first series of experiments, macrophages primed with Hi-MB obtained by the yeast *Hanseniaspora uvarum* and the Gram-negative bacterium *Xanthomonas campestris* significantly increased their phagocytic activity with respect to unprimed controls. Such activity was comparable to that observed in cells primed with either BL or LPS, indicating that these Hi-MBs could be effective in triggering macrophages activation possibly by training immunity mechanisms, thus supporting the possibility to be employed for the development of new microbial lysates with immunomodulatory properties. Future studies will evaluate whether these lysates can also enhance mitochondrial activity and microbicidal efficacy and if they are able to improve cellular responses to *E. coli* in an *in vitro* model of urothelial and intestinal infection.

Sweet and non-sweet routes to pathogen eradication

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Advanced polymeric architectures offer powerful frameworks to improve the precision of antimicrobial agents and manipulate host-pathogen interactions. Placed uniquely at the interface of chemistry, pharmaceutical science, and medicine, synthetic macromolecular science is ideally suited to address these critical healthcare needs. Within this context, we demonstrated that selective binding and sequestration of specific bacterial strains among other strains can be achieved by using bacteria simultaneously as templates for synthesizing polymer-based ligands and as generators of the polymerization catalysts [1]. This "bacteria-instructed synthesis" shifts how synthetic materials can be built dynamically to isolate distinct microbial populations.

Our work also centres on harnessing the glycocode, a biological language that underpins essential cellular communication and pathogen entry. This system operates through intricate interactions between carbohydrates and carbohydrate-binding proteins (lectins), which encode and decode biological information. This information can be strategically exploited to navigate cellular barriers and direct therapeutics to specific intracellular environments. For instance, we showed that mannose-decorated vehicles that selectively target the mannose receptors of infected macrophages effectively internalize membrane-impermeable antibiotics to eradicate reservoir intracellular pathogens like *Salmonella* [2].

Further deciphering this sugar code has recently yielded important tools to actively modulate immune pathways. By tailoring the sulfation patterns on glycopolymer side chains, a novel mechanism of receptor blockade has been uncovered at the macrophage mannose receptor (CD206) [3]. This achievement represents the first example of a synthetic CD206 inhibitor that prevents receptor recycling to the cell membrane. Because CD206 is highly relevant both for immunomodulation and as an entry portal or mediator for viral infections, this macromolecular approach aligns with the urgency to intercept viral and infectious threats through targeted nanotechnology.

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Acknowledgment

The Authors acknowledge Engineering and Physical Sciences Research Council [EP/J02158X/1], Medical Research Council [MR/M02251X/1], Cancer Research UK [C17282/A24554], GSK and Biotechnology and Biological Sciences Research Council [BB/H53052X/1].

High-throughput multi-parametric strategies for comprehensive *in vitro* compound toxicity assessment

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High-throughput methods for assessing compound toxicity enable rapid, parallel testing of large chemical libraries, reducing time and cost compared with traditional toxicology. Most approaches are miniaturized, automated, and rely on multiplexed readouts to capture multiple toxicity endpoints from a single experiment.

A core platform is high-throughput cell-based assays, typically performed in 96- to 1536-well plates using automated liquid handlers and imaging systems. Viability assays (e.g., ATP content, resazurin reduction) detect general cytotoxicity, while more specialized assays evaluate apoptosis, necrosis, oxidative stress, mitochondrial dysfunction, or DNA damage. High-content imaging adds morphological profiling, capturing changes in cell shape, organelle integrity, and subcellular localization of markers, providing rich phenotypic signatures of toxicity.

In vitro models are increasingly sophisticated, including 3D spheroids, organoids, and microphysiological systems (organ-on-a-chip) adapted to higher-throughput formats. These models offer more physiologically relevant responses, such as tissue-specific toxicity (e.g., hepatotoxicity, cardiotoxicity), although full industrial-scale throughput is still evolving. Integration of multi-parametric data: viability, imaging, omics, and *in silico* predictions underpins modern toxicity evaluation frameworks like Tox21 and ToxCast.

Reference

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Acknowledgment

The Author acknowledges OneHealthdrugs CA21111 for the financial support.

Biological profiles of industry standard hit, lead and candidate compounds

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In small-molecule drug discovery, the terms hit, lead, and candidate describe stages with progressively stricter property requirements as compounds move toward development. A hit compound is an initial active identified from screening campaigns such as high-throughput, fragment-based, or virtual screening. Its defining property is reproducible biological activity in the primary assay, typically in the low- to mid-micromolar range, confirmed by orthogonal and counter-screens to exclude artifacts. Hits should be chemically tractable, avoiding obvious reactive functionalities and pan-assay interference structures, with acceptable molecular weight and synthetic feasibility, but they often have poor selectivity and suboptimal ADME properties. Through iterative medicinal chemistry, hits are optimized into lead compounds, which show improved potency (often sub-micromolar), emerging selectivity versus related targets, and a clearer structure–activity relationship. Leads are expected to display more drug-like physicochemical properties, including balanced lipophilicity, adequate solubility, appropriate pKa, and usually molecular weight below about 500 Da, together with better *in vitro* ADME characteristics such as metabolic stability, reasonable permeability, reduced CYP inhibition, and absence of obvious reactive metabolites. Early safety issues, including cytotoxicity, genotoxicity alerts, and hERG blockade, should be mitigated. A candidate compound combines high potency and efficacy in relevant cellular and animal models with robust selectivity and a well-defined mechanism of action. They exhibit favorable pharmacokinetics, including adequate exposure, half-life, clearance, and, ideally, oral bioavailability in at least one preclinical species, and they achieve *in vivo* proof of concept at tolerable doses as well as an acceptable safety profile in exploratory toxicity and safety pharmacology.

Reference

Quancard J, Bach A, Borsari C, Craft R, Gnamm C, Guéret SM, Hartung IV, Koolman HF, Laufer S, Lepri S, Messinger J, Ritter K, Sbardella G, Unzue Lopez A, Willwacher MK, Cox B, Young RJ. The European Federation for Medicinal Chemistry and Chemical Biology (EFMC) Best Practice Initiative: Hit to Lead. ChemMedChem. 2025 Apr 14;20(8):e202400931. doi: 10.1002/cmdc.202400931. Epub 2025 Feb 16. PMID: 39957306.

Acknowledgment

The Author acknowledges OneHealthdrugs CA21111 for the financial support.

Exploring gene editing approaches to modulate Periostin in tumoral and stromal compartments of Pancreatic Ductal Adenocarcinoma

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Pancreatic ductal adenocarcinoma (PDAC) is characterized by a highly desmoplastic tumor microenvironment that drives disease progression and therapy resistance [1]. Tumor–stroma interactions, particularly those involving cancer-associated fibroblasts (CAFs) and extracellular matrix components, are central to PDAC biology [2]. Among stromal factors, Periostin (POSTN) has been implicated in tumor–stroma communication [3], although its functional role in PDAC remains incompletely defined. The aim of this study was to establish and optimize CRISPR/Cas9-based strategies to silence POSTN in PDAC-relevant tumor and stromal models. Distinct genome editing approaches were implemented to accommodate the biological differences between immortalized PDAC cell lines and primary CAFs isolated from freshly resected surgical specimens.

A standardized protocol for CAF isolation and characterization was established, enabling CRISPR/Cas9 editing after cellular stabilization. POSTN targeting was achieved using tailored Cas9–gRNA expression plasmid delivery via nucleofection on primary CAFs and lentiviral transduction in commercial PDAC cell lines; RNP-mediated editing was also explored and is currently under optimization. Editing conditions were systematically optimized to balance efficiency and cell viability, with POSTN modulation assessed by RT-PCR and ELISA. Functional assays in 2D and 3D culture systems were initiated to benchmark editing strategies and identify suitable models for future investigation. Overall, this work establishes a robust and adaptable CRISPR/Cas9 platform for POSTN silencing in PDAC tumor-stroma models, providing a foundation for subsequent mechanistic and translational studies.

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Acknowledgment

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One Health drugs against parasitic vector borne diseases in Europe and **OneHealth*drugs*** **Cost Action**

Design and Fabrication of Biodegradable Electrospin Nanofiber Platforms for Locoregional delivery of Lipid Nanoparticles

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Innovative locoregional therapeutic approaches rely on the advanced fabrication of biomimetic scaffolds combined with the controlled release of non-viral drug delivery systems. In this work, we integrate two industrially scalable and sustainable techniques, i.e. electrospinning and the automated nanoparticle (ANP) microfluidic system, to develop hybrid poly(vinyl alcohol) (PVA) nanofibrous scaffolds for the sustained locoregional release of lipid-based nanoparticles (LNPs). The proposed strategy aims to develop an electrospun nanofiber (NF) platform loaded with two therapeutic LNP systems for implantable treatment of rheumatoid arthritis and topical therapy for epidermolysis bullosa.

Electrospun NFs were synthesized using different PVA concentrations via monoaxial setup, resulting in fiber diameters between 0.4–0.7 µm, and loaded with model LNPs. Mild, green cross linking conditions were optimized to improve NF aqueous stability without affecting fiber dimensions, and scaffold weight loss was evaluated under physiological conditions to assess LNP release potential (**Fig.1A**). Fluorescently labelled LNPs (size <300 nm, PDI <0.3, Z pot. ≈ -30) were formulated with the ANP system and embedded into NFs at different concentrations without altering their physicochemical properties (**Fig.1B**). Microscopic (SEM, confocal – **Fig.1D**) and spectroscopic analyses confirmed efficient LNP loading. Release studies (**Fig.1C**) demonstrated a slow and sustained LNP release profile over 21 days, with approximately 5% of the loaded nanoparticles released. These findings suggest effective LNP retention within the NFs, supporting the potential of the platform for prolonged localized therapeutic delivery. Preliminary studies explored the incorporation of chitosan into blended scaffolds to provide antibacterial properties and expand the platform for topical epidermolysis bullosa applications.

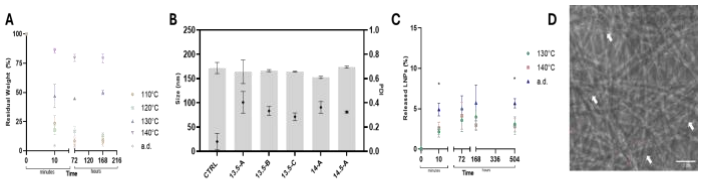

Fig 1. **A**) Degradation studies under physiological conditions of non-crosslinked (a.d.) and thermally crosslinked PVA NFs. Degradation is expressed as residual weight (%). **B**) Size and polydispersity index (PDI) of LNPs in the fresh state (CTRL) and after incorporation into NFs, following NF resuspension. PVA concentrations of 13.5, 14, and 14.5 (w/v%) and different LNP loadings (A, B, C) are indicated. **C**) Release profile of LNPs from PVA NFs (a.d. and crosslinked at 130 and 140°C) under physiological conditions at different time points. **D**) Confocal images of PVA NFs incorporating LNPs. The presence of labelled-LNPs is evidenced by red dots.

Overall, these results demonstrate the feasibility of combining microfluidic-produced LNPs with biodegradable electrospun PVA-based scaffolds to obtain a locoregional sustained drug delivery platform. The use of FDA-approved polymers and lipids with established safety profiles, together with a mild heat-induced crosslinking process and limited use of organic solvents, underscores the translational potential of the proposed approach.

One Health drugs against parasitic vector borne diseases in Europe and **OneHealth*drugs*** **Cost** **Action**

Clinical vaginal isolates of *Candida albicans* elicit distinct Type I Interferon-mediated epithelial responses

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Vulvovaginal candidiasis (VVC) affects up to 75% of women globally and is mainly caused by *Candida* (*C.*) *albicans*. Our previous studies showed that two clinical isolates of *C. albicans*, a VVC-associated strain (Ca01887) and a colonizing strain (Ca14314), trigger distinct epithelial responses. Specifically, Ca01887 induced extensive epithelial damage, increased fungal shedding, and marked exfoliation, without activating type I interferon (IFN-I) signaling. In contrast, Ca14314 caused milder damage and shedding while promoting activation of the IFN-I pathway [1].

To investigate the role of the IFN-I pathway, we used an *in vitro* infection model based on A-431 vaginal epithelial cells (VECs). VECs were treated with a neutralizing IFNAR-2 antibody, the STING agonist 2'3'-cGAMP, and the JAK-STAT inhibitor Ruxolitinib, either individually or in combination. After 24 hours, fungal shedding was assessed by quantifying colony-forming units (CFUs).

Inflammasome activation was evaluated by measuring IL-1β, IL-1α, and IL-1RA levels in VEC supernatants using ELISA test. Mitochondrial ROS (mtROS) production was analyzed using MitoSOX Red staining and quantified by fluorometry. To further explore the relationship between mtROS production and fungal shedding, cells were also treated with the mtROS inhibitor Visomitin.

Our findings revealed that fungal shedding increased, following Anti-IFNAR2 and Ruxolitinib treatment, and decreased with 2'3'-cGAMP in Ca14314-infected VECs, whereas no significant effects were observed with Ca01887. In addition, Ca14314 induced significantly higher mtROS levels compared to Ca01887, while Ca01887 elicited a massive inflammasome response. Treatment with Visomitin increased fungal shedding exclusively in Ca14314-infected VECs.

Overall, these results strengthen the evidence that IFN-I signaling and mtROS play a central role in vaginal epithelial cell defense against *C. albicans* infection, highlighting their potential as promising therapeutic targets for VVC and recurrent VVC (RVVC) [2,3].

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One Health drugs against parasitic vector borne diseases in Europe and **OneHealth*drugs*** **Cost Action**

Synergistic Hybrid Nanomaterials for Environmental Water Remediation

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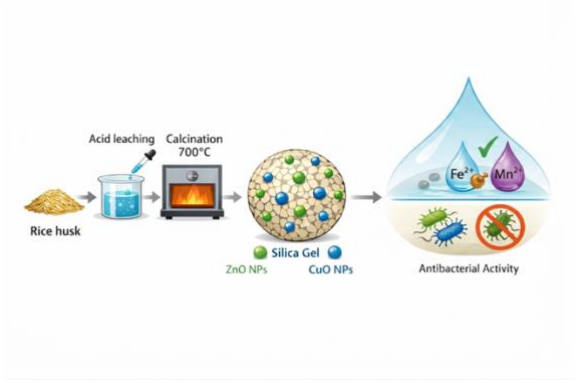
Clean water scarcity represents one of the most urgent global health and environmental challenges of our time, directly aligned with the United Nations Sustainable Development Goals, which aims to reduce the extent of untreated wastewater and promote water reuse worldwide. This work reports the development of low-environmental-impact hybrid nanocomposites designed for comprehensive water treatment (Figure 1). The strategy focuses on valorising rice husk waste—an abundant agricultural byproduct—by converting it into a high-surface-area, porous silica support [1]. This bio-derived matrix was successfully integrated with green-synthesized zinc oxide (ZnO) and copper oxide (CuO) nanoparticles to combine pollutant adsorption and antimicrobial properties within a single material [2-3]. The resulting multifunctional platform demonstrated exceptional performance. In decontamination trials, the composites showed high activity in the removal of Fe(II) and Mn(II), maintaining outstanding chemical stability over time. Furthermore, the nanoparticle-functionalized materials exhibited powerful, broad-spectrum antibacterial activity. Notably, the co-loaded bimetallic system triggered a remarkable synergistic effect with a near-total microbial eradication. Overall, these findings validate bio-derived silica as a sustainable, and efficient scaffold. This work highlights how combining green chemistry with waste valorisation can pave the way toward next-generation water purification technologies.



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Computationally Guided Disease Therapeutics: Nanotechnology-Enabled Precision Drug Delivery for Sustainable Healthcare

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Computational modelling offers understanding of host pathogen and immune-mediated mechanisms underlying infectious diseases and their complications. Integrating patient-specific biological data with predictive therapeutic models may facilitate personalized drug delivery strategies, particularly in diseases involving dysregulated immune responses, including viral infections and inflammatory complications. Modelling approaches may further improve intracellular targeting The growing burden of infectious diseases and environmentally associated health concerns, highlights the need for therapeutic strategies that are not only effective but also precise, predictive, and sustainable. Nanotechnology has emerged as a transformative approach in disease therapeutics by enabling targeted drug delivery systems that enhance bioavailability, improve intracellular targeting, and reduce systemic toxicity. However, the increasing complexity of nanotherapeutic design necessitates complementary computational approaches to accelerate innovation and optimize translational outcomes. Computational modelling is increasingly reshaping the development of precision therapeutics by enabling the simulation, prediction, and optimization of drugcarrier interactions, pharmacokinetics, toxicity, and therapeutic efficacy before experimental validation. In nanotechnology driven therapeutics, computational tools including artificial intelligence, machine learning, multiscale modelling, and bioinformatics that can support the rational design of nanocarriers through predictive assessment of particle size, drug loading efficiency, cellular uptake, membrane interactions, and controlled-release kinetics. Such approaches significantly reduce experimental burden, development costs, and reliance on animal testing while accelerating the identification of effective therapeutic candidates.

and optimize therapeutic windows while minimizing toxicity to host tissues and ecosystems. The integration of computational intelligence with sustainable nanotechnology supports eco-pharmaco-vigilance, green therapeutic design, and environmentally responsible healthcare innovation. By bridging nanotechnology, predictive modelling, and sustainability, precision disease therapeutics holds substantial promise for addressing complex global infectious health challenges through safer, faster, and more efficient therapeutic development.

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Formulating Natural Small-Molecule nanomedicines against Iron Overload Disorders: strategies and ex-vivo validation

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Iron overload disorders pose complex clinical challenges[1]. Hinokitiol (HK) is a promising therapeutic candidate as it can shuttle iron across cell membranes and release sequestered intracellular iron, especially for conditions like Ferroportin Disease (FD), where phlebotomy and iron chelation are often inadequate or burdensome[2,3]. However, HK's clinical utility is limited by its physical-chemical properties and biodistribution.

In this study, we report the first evaluation of biodegradable and biocompatible Nanomedicines (NMeds) developed for the parenteral administration of HK. Polymeric and lipidic NMeds were evaluated, namely poly lactic-co-glycolide (PLGA), Cholesterol (Chol) NMeds, and Nanostructured Lipid Carriers (NLC). The optimization led to homogeneous NMeds with size < 300 nm and encapsulation efficiency up to 40%, despite the small molecular weight and volatile nature of HK. Drug retention ability was assessed, allowing for the selection of 3 NMeds to be tested on iron-loaded macrophage model (J774 cell line) and human primary macrophages obtained from healthy blood donors and FD patient-bearing two different mutations. Data revealed that all HK-loaded NMeds are non-toxic and can accumulate in the cells, but most importantly they are more efficient than the free HK in reducing the intracellular iron pool. NLCs in particular showed the most promising behavior in terms of high efficacy and low toxicity.

These results demonstrate that delivering HK via NMeds is preferable to administering free HK, representing the first step towards the development of a more efficient treatment of this currently challenging disease.

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Nanotechnology-Based Strategies for *Helicobacter pylori* Eradication: Innovative Therapeutic Approaches, Antimicrobial Resistance, and One Health Perspectives

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Abstract

Helicobacter pylori infection infection remains one of the most prevalent chronic bacterial infections worldwide and is strongly associated with chronic gastritis, peptic ulcer disease, gastric adenocarcinoma, and mucosa-associated lymphoid tissue lymphoma. The increasing resistance of *Helicobacter pylori* to commonly used antibiotics, including clarithromycin, metronidazole, and levofloxacin, has significantly reduced the effectiveness of standard eradication regimens and represents a major global health concern. In this context, nanotechnology-based therapeutic systems have emerged as promising alternatives to improve antimicrobial efficacy and optimize targeted drug delivery.

Recent advances in nanomedicine have demonstrated that nanoformulations, including liposomes, polymeric nanoparticles, nanoemulsions, metallic nanoparticles, and mucoadhesive delivery systems, may enhance gastric stability, improve mucosal penetration, prolong drug release, and increase local drug concentration at the infection site. These approaches may contribute to overcoming bacterial resistance mechanisms while reducing systemic adverse effects and treatment failure rates. Furthermore, nanotechnology may support lower antibiotic consumption and reduced environmental antimicrobial contamination, aligning with sustainable healthcare strategies and One Health principles.

This work discusses current applications of nanotechnology in *H. pylori* treatment, with particular focus on innovative antimicrobial delivery systems, resistance mitigation, biosafety, and regulatory considerations for nanomedicines in infectious diseases. Emphasis is also placed on environmentally conscious therapeutic development and the importance of integrating human, animal, and environmental health perspectives in future anti-infective strategies.

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