CERN IdeaSquare Journal of Experimental Innovation, 2026; 10(1):1-4
DOI: https://doi.org/10.23726/cij.2026.1891

EDITORIAL

Health Innovation and Entrepreneurship: Experimental Pathways for Human-Centered and Systemic Transformation in Healthcare

Bettina Maisch[1], Pieter Vandekerckhove[2], Steven Howard[3], Louis J. Koizia[4], Benjamin H. L. Harris[5], Luc de Witte[6], Christian Hanshans[1,7]

[1]HM Munich University of Applied Sciences, Germany;
[2]Delft University of Technology, The Netherlands;
[3]University of Alabama at Birmingham, United States;
[4]Imperial College London and Imperial College Healthcare NHS Trust, United Kingdom;
[5]University of Oxford, United Kingdom;
[6]The Hague University of Applied Sciences, The Netherlands;
[7]University Hospital Würzburg, Germany
Corresponding author: bettina.maisch@hm.edu

This *Special Issue on Health Innovation and Entrepreneurship* was conceived in response to a long-lasting challenge within this field. Healthcare innovation presents itself as a paradox made up by rigid clinical protocols and developing knowledge we gain everyday. Yet, this tension conceals deeply synergistic dynamics at its core, which can be fuelled through entrepreneurial innovation. In alignment with the mission of the *CERN IdeaSquare Journal of Experimental Innovation*, it seeks to move beyond reductionist and disciplinary approaches to healthcare innovation.

This paradox unfolds at the intersection of what is known about the human body and what remains radically uncertain. Clinical practice relies on accumulated, evidence-based knowledge, yet progress depends on the deliberate exploration of the unknown. This tension can be understood through the lens of Concept–Knowledge (C-K) theory by Hatchuel & Weil (Hatchuel & Weil, 2008), further interpreted at the intersubjective level in design and innovation contexts by scholars such as Frido Smulders (Smulders et al., 2008; Smulders & Bakker, 2012): innovation emerges through the expansion of concepts beyond the boundaries of established knowledge, while simultaneously reshaping that knowledge. Healthcare is, therefore, not only a domain of application of innovation; it is a site where epistemological boundaries are constantly negotiated.

This epistemic paradox is inseparable from an ethical one. Every act of care involves a fundamental dilemma: should a professional apply the best-known, evidence-based treatment, or engage in experimental approaches that may offer superior outcomes but carry uncertain risks? The pursuit of optimal care and the necessity of experimentation are not opposites, they are co-dependent. Healthcare systems can only improve by experimenting within care delivery itself. Yet this implies that uncertainty, risk, and responsibility are not external to healthcare, they are intrinsic to it.

Historically, this paradox is not new. The origins of institutionalized care in Europe already reveal the coexistence of innovation and conservatism. One of the earliest hospitals, 727 AD, Santo Spirito in Sassia in Rome (Sassia et al., 2019), emerged as a response to the suffering of pilgrims and the abandonment of vulnerable populations such as infants born into marginal circumstances. It was a holistic, social and organizational response, embedded within the highly structured and conservative framework of the Catholic Church. From its inception, healthcare has therefore been shaped by a productive tension between stability, transformation, moral duty, and experimental practice.

This foundational paradox persists in contemporary healthcare systems. On one hand, care delivery is inherently innovative: each patient represents a unique constellation of biological, psychological, and social conditions, requiring situated problem-solving by professionals who adapt, improvise, and co-create solutions in practice. Innovation, in this sense, is ubiquitous and continuous—a form of "single-loop" learning embedded in everyday clinical work.

On the other hand, healthcare systems are intentionally rigid. Structures, protocols, and regulatory frameworks are designed to ensure safety, accountability, and quality. While necessary, this rigidity constrains "double-loop" innovation. That is, transformations that are more holistic with the purpose of challenging underlying assumptions, reorganize care across institutional boundaries, and integrate diverse domains such as hospital care, outpatient services, and homecare. However, as innovation remains localized within professional silos, the system as a whole struggles to evolve.

The consequences of this tension are increasingly visible. As healthcare becomes more specialized, it also

becomes more fragmented. Nowhere is this more evident than in complex care trajectories such as those of young adults with cancer. While medical advances have significantly extended life expectancy, patients often experience their care journeys as disconnected and alienating. Simultaneously, healthcare professionals are stretched across fragmented organizational structures, limiting their ability to coordinate meaningfully. The paradox deepens: systems succeed clinically while failing experientially.

In this context, the integration of technological innovation and societal challenges becomes ever more urgent. For example, global workforce shortages in healthcare invite technological interventions such as robotics and artificial intelligence (AI). Yet the implementation of such technologies cannot be reduced to technical feasibility. It requires a deep understanding of healthcare as a socio-technical system operating across multiple disciplines and actors. Vertically, innovators must engage with the complexities of clinical practice, including tacit knowledge, informal workflows, and situated judgment that are often invisible to outsiders. Horizontally, they must navigate misaligned incentives, fragmented governance structures, and competing institutional logics, including financial models and organizational KPIs. Without addressing both dimensions in practice, research and education (Vandekerckhove et al., 2025), innovation risks amplifying fragmentation rather than resolving it.

If healthcare systems are to evolve as coherent and adaptive wholes, innovation must move beyond isolated, marginal improvements. It must become inherently interdisciplinary, integrating insights from health sciences, engineering, social sciences, and design. This requires not only new technologies or ventures but new modes of collaboration, new forms of governance, and new epistemologies of innovation.

It is within this broader philosophical and systemic framing that entrepreneurial behavior for healthcare innovation emerges as one of the defining challenges of the twenty-first century. Health systems are confronted with converging pressures: demographic aging, chronic disease burdens, workforce shortages, rising costs, digital transformation, climate-related risks, and persistent inequalities. At the same time, advances in AI, digital health, robotics, telepresence, platform technologies, and data-driven care are expanding what is technically possible. The central question is therefore no longer whether healthcare requires innovation, but how such innovation can be designed, governed, implemented, and scaled in ways that create meaningful and equitable value.

The contributions collected here approach healthcare as an experimental, interdisciplinary, and deeply human endeavor. Rather than focusing solely on technological artifacts or entrepreneurial success stories, the issue explores how innovation unfolds through design practices, co-creation processes, educational interventions, governance structures, and critical reflection. Together, the eight contributions form a coherent intellectual trajectory. They demonstrate that healthcare innovation is not linear but iterative, situated, and relational. It requires methodological rigor alongside institutional imagination, stakeholder participation alongside system-level coordination, and a willingness to engage with uncertainty (C-space) rather than eliminate it. Together, the papers show that health innovation is not a linear process of invention and diffusion. Rather, it is a situated, iterative, and relational process that requires methodological rigor, institutional imagination, stakeholder participation, and the courage to engage with uncertainty.

The issue opens with Barry Katz's (2026) methodological paper, *Design Thinking and Healthcare Innovation: Notes for Researchers and Practitioners*. Design is a promising process to facilitate the interaction between the unknown C-space and K-space allowing the integration of different perspectives. Katz revisits the intellectual foundations of design thinking, drawing on Simon's understanding of design as the transformation of existing situations into preferred ones, and situates design thinking as a structured methodology for healthcare improvement. The contribution is particularly valuable because it resists the reduction of design thinking to a set of workshop techniques. Instead, it outlines a rigorous process for healthcare innovation that includes scoping, preparation, discovery, synthesis, ideation, prototyping, piloting, and spreading. The paper also introduces an important shift from designing *for* healthcare professionals toward designing *with* them and ultimately enabling design *by* healthcare professionals themselves. As such, it provides a methodological foundation for the issue as a whole and frames healthcare innovation as a disciplined practice of inquiry, experimentation, and stakeholder engagement.

The second paper, Thom Joosten, Timothy Singowikromo, Robert Al, and Onno Helder's (2026) *How to Effectively Disseminate Bottom-Up Developed Nursing Technological Innovations that Enhance Job Satisfaction? The Essential Role of Collaborative Makerspaces* translates this methodological orientation into the everyday realities of nursing work. In doing so, the authors illustrate how to embed a system for double-loop innovation in a large academic hospital. They examine the dissemination of bottom-up, co-created innovations developed in healthcare makerspaces. Their paper shows that nurses are not merely end-users of innovation but can be originators, co-designers, and diffusion agents of practical healthcare improvements. At the same time, the contribution highlights a central tension in health innovation: locally developed solutions may improve efficiency and job satisfaction, yet their wider dissemination is constrained by regulation, uncertain market opportunities, and institutional responsibilities under the Medical Device Regulation. The paper therefore extends the design logic of the opening contribution into the organizational and regulatory realities of healthcare innovation.

The third contribution, Valeria Pannunzio's (2026) *De-implementation as a Missing Link in Digital Health Innovation Dynamics: The Example of Remote Patient Monitoring Services*, shifts the focus from creating and disseminating innovations to the equally important question of when and how innovations should be

removed. Drawing on evolutionary perspectives on innovation dynamics, Pannunzio argues that digital health systems have largely focused on development, implementation, and scaling while neglecting de-implementation. Using remote patient monitoring as an illustrative case, the paper shows how ineffective, inefficient, or obsolete digital services may remain embedded in healthcare systems because responsibilities for removal are unclear. This contribution is significant because it reframes innovation governance: mature health innovation ecosystems require not only pathways for adoption and scale-up, but also mechanisms for evaluation, discontinuation, and replacement. This raises the question about how an integrated care pathway would look like from an innovation point of view. What kind of innovation management and entrepreneurial practice is needed to maintain the optimal value chain?

Where Pannunzio examines system adaptation through de-implementation, Nadja Aagaard Færgemand, Hanne Møjbæk Duedahl Nørgaard, and Michael Breum Ramsgaard's (2026) paper, *Embracing Chaos in Health Education: Dark Pedagogy and Scenario-Based Learning in Entrepreneurship Education*, asks how future healthcare professionals can be educated for uncertainty, instability, and complex futures. Attention for this type of meta-competencies is essential if we want to train people to be able to navigate from the unknown experimental space to the known space and back. The authors present a scenario-based teaching design in nursing education that combines education for sustainable development, dark pedagogy, and entrepreneurship education. By placing students in a dystopian future scenario shaped by climate-related pressures and healthcare system strain, the paper demonstrates how discomfort, imagination, and future-thinking can become pedagogical resources. The contribution bridges health education and entrepreneurship by showing that professional agency must be cultivated not only through knowledge acquisition but also through the capacity to imagine, evaluate, and enact alternative futures.

The fifth paper, Christian Markus, Leila Wanner, and Andreas Fraunhofer's (2026) *From Spreadsheet Workarounds to an Innovation Experiment: Co-Creating a Clinical Placement Planning Prototype in Nursing Education*, continues the educational theme but moves from pedagogy to infrastructure. The authors address the problem of clinical placement planning in German nursing education, where fragmented coordination, manual workarounds, and insufficient digital tools can limit training capacity. Their contribution presents the iterative development and initial evaluation of a web-based prototype for placement planning, grounded in requirements engineering, stakeholder workshops, and co-creation. The paper is especially relevant because it shows that health innovation does not only occur in clinical devices or patient-facing technologies. It also takes place in the organizational infrastructures that enable education, workforce development, and system capacity. This paper highlights that innovating the hidden mechanisms of the fragmented care pathways may provide a much better integrated delivery in the long term.

The sixth paper, Philipp Schütz, Oliver Gerstheimer, Beate Tertilte, and Isabelle Friedrich's (2026) *Privacy as Empowerment: UX Innovation for Telepresence Robots in Pediatric Education*, brings the issue to the intersection of healthcare, education, vulnerable users, and digital participation. The authors examine the PRIVATAR project, which develops privacy-centered UX concepts for telepresence robots that allow severely or chronically ill children to remain connected to school life. The paper's central contribution is the reframing of privacy from a regulatory constraint to an enabling condition for participation, trust, and psychosocial continuity. Through child-friendly privacy icons, the "Sendbox," no-go and no-view zones, role-based control rights, and AI-supported digital user twins, the contribution demonstrates how abstract principles such as privacy by default, data minimization, and transparency can be translated into concrete design patterns. Given the increasing potential of robotics and additive manufacturing in this space, this paper reminds us of the socio-technological systems context around that technology that needs to be taken into account at an early stage for successful integration.

The seventh paper, Neelofar Aleem, Breda Kenny, and Helen McGuirk's (2026) *Innovation Enhancement through Design Thinking Experiments: Implementing International Collaboration for Digital Health Entrepreneurs*, broadens the perspective from organizational and user-centered innovation to international entrepreneurial ecosystems. Using participatory action research and qualitative design thinking experiments, the authors examine how digital health entrepreneurs from Ireland, the United States, and Pakistan can co-design an international healthcare consortium model. The paper contributes to health entrepreneurship research by emphasizing cross-sectoral and cross-national collaboration, resource sharing, access, and innovation enhancement. It also demonstrates how design thinking can be used not only for product or service development, but also for building entrepreneurial infrastructures that connect actors across fragmented health innovation ecosystems. These designerly constructed international collaborations can fuel a dual process of research and education, which can ultimately generate an integrated healthcare value chain on a global level.

The issue concludes with the coffee paper *On the Discovery of a Certain Manuscript* (2026). In a satirical and speculative mode, the text reflects on the institutional difficulty of recognizing transformative ideas before their value becomes measurable. Through a fictional manuscript involving two disciples whose speculative insights are initially rejected because they lack predictable deliverables, the paper stages a broader critique of evaluation systems that privilege certainty, short-term impact, and procedural safety over curiosity and long-horizon inquiry. Its final moral — that societies investing only in certainty inherit only the

present — offers a fitting epilogue to the Special Issue. It reminds readers that experimental innovation requires not only methods, infrastructures, and evidence, but also institutional tolerance for uncertainty.

Read together, the eight contributions suggest that healthcare innovation and entrepreneurship should be understood as a multi-level transformation process from the unknown to the known and back. At the methodological level, innovation requires structured yet flexible approaches such as design thinking. At the professional level, it requires frontline participation, strategic co-design, and recognition of healthcare workers as innovators. At the systems level, it requires governance mechanisms that support not only implementation but also de-implementation. At the educational level, it requires pedagogies that cultivate meta-competencies: agency, imagination, and resilience under conditions of uncertainty (Koizia et al., 2026). At the infrastructural level, it requires digital tools that improve coordination and capacity. At the ethical and user-experience level, it requires technologies that make participation possible without compromising autonomy or dignity. At the ecosystem level, it requires international collaboration and entrepreneurial networks. Finally, at the cultural level, it requires a willingness to protect exploratory ideas before their value can be fully known.

This Special Issue, therefore, argues for a broadened understanding of health innovation. Healthcare transformation cannot be reduced to technological novelty, venture creation, or efficiency gains alone. It must be understood as an experimental, participatory, and ethically situated practice of designing better futures under conditions of complexity. In this sense, health innovation and entrepreneurship are not merely about bringing new solutions into healthcare systems. They are about developing the capacities, infrastructures, and cultures through which healthcare systems can learn, adapt, and become more humane.

We sincerely thank all authors for their thoughtful, courageous, and interdisciplinary contributions. We are equally grateful to the reviewers for their careful reading, constructive feedback, and intellectual generosity. Their work has been essential in shaping this Special Issue into a coherent and meaningful contribution to the growing field of health innovation and entrepreneurship.

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