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Building a Digital Health Innovation Ecosystem: Tech-Push, Demand-Pull, and Government Policy

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ABSTRACT

Health and social care are at a pivotal point, encountering complex and multifaceted systemic and workforce-related challenges. Governments have identified the need to redefine health and social care services to address the evolving needs of both patients and service providers. Yet, there is a struggle to balance the interrelatedness of the social and technical aspects of sector-wide change initiatives, and little is known about the dynamics of the technology-push and demand-pull nexus when scaling effective healthcare initiatives beyond the incremental pilot phase, to national levels. This paper addresses this knowledge deficit by drawing on insights gained through the formation and launch of the Health and Social Care Innovation Wales ecosystem. It introduces an innovation impact matrix to support public policy advisors and innovation strategists in understanding how interactions between economic value and healthcare value can impact the ecosystem. The paper provides policy makers, innovation leads, and health and social care managers with a set of recommendations to mitigate the strategic and operational challenges of orchestrating and scaling a digital health innovation ecosystem.

1 | Introduction

> *Innovation in adult social care is like innovation in healthcare: it often fails to deliver. There are many ideas and innovations with great potential, but there can be difficulties in their national spread* (Wilson 2021, 35).

Digital innovations potentially play a transformative role in the design and delivery of the United Kingdom's (UK) health and social care services (Jones 2024). However, the healthcare sector has historically struggled to systematically develop and adopt evidence-based innovation, at scale. Several factors contribute to this challenge: (i) systemic complexity issues within the UK's National Health Service (NHS) regarding innovation, (ii) a top-down, overly product-focused approach to innovation, (iii) risk aversion linked to patient safety considerations, (iv) insufficient delegation of authority, (v) lack of co-design with stakeholders involved in the supply and demand of technologies (vi) facilitating commercialisation and industry access to the NHS and (vii) an emphasis on system change over the generation of new ideas (Wilson 2021; UK Parliament 2024). For instance, it is commonly reported that relatively straightforward innovations with demonstrated high clinical and cost effectiveness face adoption difficulties across the NHS (The King's Fund 2018). To address these challenges and harness digital innovation to revolutionise service design and delivery, healthcare organisations are investing in innovation ecosystems. This approach promises to allow access to unique resources within the ecosystem and the implementation of mutually beneficial activities (Deloitte 2020).

An innovation ecosystem is the nexus "where people, culture and technology, [...] form the essential building blocks to meet and interact to catalyse creativity, trigger invention and accelerate innovation across scientific and technological disciplines, public and private sectors and in a top-down, policy-driven as well as bottom-up, entrepreneurship-empowered fashion" (Carayannis and Campbell 2009, 202–203).

Contemporary research on innovation ecosystems is exploring the dynamics of innovation 'demand-pull' (i.e., identifying customers' most pressing problems and then figuring out how the company's technological innovation solution can solve them) and 'technology-push' (i.e., developing technological innovations and then identifying a market or customer) (Pisano 2015). Such research focuses on features that include the diversity of actors, the type of collaborations and relationships between those actors and how they integrate with the ecosystem across the innovation push-pull nexus (Boyer and Kokosy 2022). The push-pull nexus guides government decisions by stimulating investment through new or growing markets (Nemet 2009). Effective policy requires understanding how technology-push and demand-pull interact and differ in impact (Hötte 2023). This knowledge helps policymakers create effective public policies. Technology-push policies include government research and development (R&D) funding, R&D tax credits, enhancing knowledge exchange, and supporting education and training. Demand-pull policies include protecting intellectual property (IP), government procurement, technology mandates, and regulatory standards (Nemet 2009).

Several practitioner-oriented studies (e.g., Pisano 2015) offer guidelines and frameworks to align innovation projects with strategic goals. However, these frameworks are primarily based on a single outsider-researcher perspective and do not originate from a real-life problem situation where practitioners and researchers collaborate in a state of "in-betweenness," wherein researchers are neither complete insiders nor outsiders (Jimenez et al. 2022).

The development of a coherent health and social care innovation ecosystem in Wales serves as a notable case study, successfully balancing technology-push and demand-pull innovations to achieve the goals outlined in 'Wales Innovates', the Welsh Government's cross-portfolio Innovation Strategy[1] for Wales. This strategy is supported by three key themes: (i) a strong policy framework and national innovation infrastructure (i.e., national support programmes, digital platforms, innovation frameworks, funding mechanisms, collaborative networks), (ii) a flexible innovation ecosystem that allows stakeholders to effectively coordinate activities across the push–pull spectrum, and (iii) the utilisation of digital innovations to expand and maintain the ecosystem.

This paper draws on a study of the formation and coordination of the national health and social care innovation ecosystem in Wales, UK, which was officially launched in March 2025. The author team comprises senior practitioners from the Welsh Government and NHS Wales with extensive expertise in healthcare, innovation management, information systems, and policy development. It also includes an academic research team, who have been involved in this cross-sector, multi-disciplinary funded project since the inception of the innovation ecosystem in 2021. With its distinct positioning in the project, the research team was able to both identify the challenges that influenced the development of the innovation ecosystem and offer recommendations for addressing these challenges.

The recommendations outlined in this study, although primarily developed for a health innovation ecosystem, are equally relevant for decision-makers in similar contexts. These recommendations support recent initiatives that advocate for a shift from a 'unidirectional' flow of expertise, innovation, and technology to 'bidirectional flows' of knowledge and experience, aiming to enhance health equity (Sors et al. 2023).

The remainder of the paper is structured as follows. A synthesis of the literature on innovation in, and by, practice is presented, followed by an overview of Wales' health and social care innovation ecosystem. Next, the research methodology and the data collection techniques are outlined. The paper concludes with a discussion of the key challenges and recommendations.

2 | Innovation in and by Practice

Innovation involves applying new or different ideas that provide value to customers, consequently promoting organisational growth (Alblooshi et al. 2021). It may adopt a "bottom-up" approach that is process-based and influenced by organisational culture, or a "top-down" approach characterised by visionary leadership (Deschamps 2005). The bottom-up approach generally accommodates greater risk tolerance, with creative ideas often generated by technical employees aiming to enhance existing products and processes or introduce new ones (Borins 2002).

The determinants of innovation include contextual factors such as how the organisation manages and performs related activities and leadership styles (see Table A1) that impact organisational innovation. These leadership styles were observed at various times and by different stakeholders throughout the formation and coordination of the Health and Social Care Innovation Wales ecosystem. In this study, leadership is defined as a "process whereby an individual influences a group of individuals to achieve a common goal" (Northouse 2012, 6). Control and decision-making in such systems depend on the innovation's type and scale.

Innovation management requires balancing core activities (e.g., optimizing current products for existing clients), adjacent activities (e.g., expanding from existing businesses into new areas for the company), and transformational innovations (e.g., developing breakthroughs and creating solutions for markets that do not yet exist) (Nagji and Tuff 2012). Maintaining this balance is essential to ensure that innovation efforts align with strategic objectives while providing flexibility to respond to emerging opportunities. Innovation management also entails understanding the context and problem, staying updated on technological advancements, and using innovation models.

Managing innovation in healthcare is, however, difficult due to complex systems, limited experimentation, and challenges in

spreading ideas (Mossialos et al. 2018). For successful innovation strategy implementation, leaders must acknowledge that strategies evolve, encourage IT innovation mindfulness, support risk-taking, and learn from failures (Pisano 2015). In the context of this project, achievement was contingent not only upon effective goal setting and strategic leadership, but also on valuing diverse perspectives and synthesizing insights from multiple disciplines.

The innovation ecosystem approach builds networks to drive healthcare innovation, supporting cultural and activity changes needed for innovative practices (Wilson 2021). In the context of this study, the Welsh Government's strategic push towards fostering innovation has bridged critical policy gaps, creating a synergy between healthcare demands and emerging technological solutions. Through collaborative efforts, the ecosystem has successfully aligned actors across sectors, setting the stage for a dynamic exchange of ideas and resources. This alignment not only addressed existing systemic challenges but also cultivated a fertile ground for sustainable and scalable solutions. Through the cultivation of an adaptive environment, Wales demonstrated how innovation ecosystems could serve as a transformative model for healthcare advancements globally. This approach aligns with research suggesting governments can foster innovation in two ways: by reducing the private cost of producing innovation (*technology-push*) and by increasing the private payoff to successful innovation (*demand-pull*) (Nemet 2009).

Emerging from this study is the innovation impact matrix (see Figure 1) that illustrates four types of value that influence the push-and-pull nexus of the innovation ecosystem, namely:

Value void: Neither a defined system problem or need—(that could create a new market) or an associated economically viable technology-based product or service solution, exists.

Value prematurity: Technology-based product or service is developed and exists, but does not meet a defined, or realised need in the system—that could lead to a new market.

Value opportunity: A system problem or need exists, that could lead to a new or adjacent market creation, but a viable and scalable technology-based product or service solution does not yet exist to meet that need.

Value abundancy: A system need or problem, that creates its own market, exists and is amply met by an appropriate solution, resulting in both healthcare and economic value.

'Healthcare value impact' refers to the outcomes that matter to patients (e.g., improved health outcomes and improved patient experience) in relation to the efficiency of resources used to achieve those outcomes (e.g., reductions in cost and clinical time). 'Economic impact' refers to the financial effect of intervention on the ecosystem.

To achieve maximum value impact (i.e., value abundancy), a high 'market readiness' and high 'technology readiness' are required. Conversely, a low 'market readiness' and low 'technology readiness' lead to no value impact.

The four types of value (i.e., value void, value prematurity, value opportunity, value abundancy) represented in the innovation impact matrix highlight the importance of balancing economic value and healthcare value to create a sustainable innovation ecosystem. The innovation impact matrix can be a useful tool for public policy advisors and innovation strategists. It helps them comprehend the interactions between economic value and healthcare value and their effects on the ecosystem, facilitating consensus-building to support the development of the ecosystem.

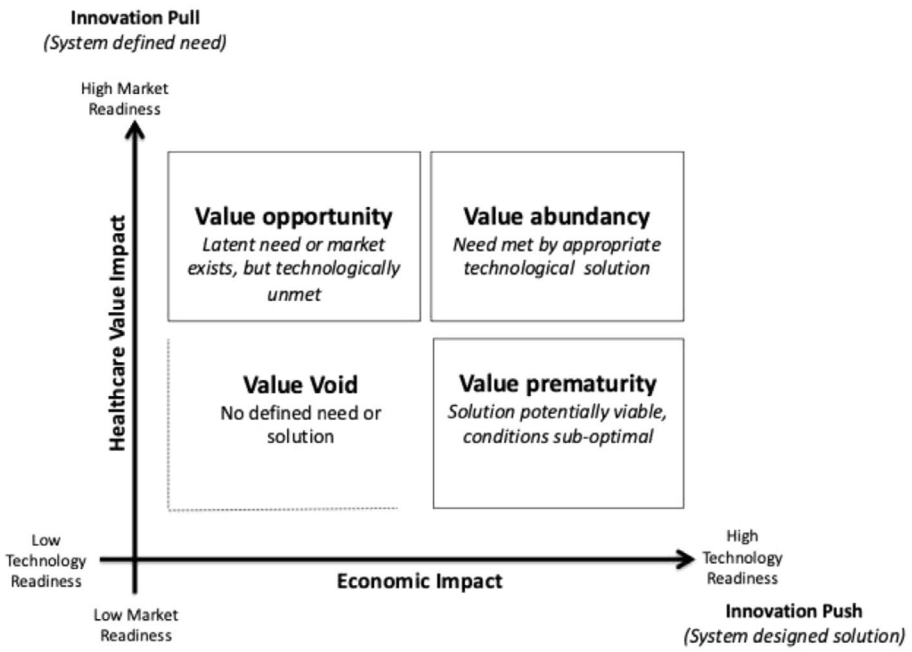

FIGURE 1 | Innovation impact matrix.

3 | Background to the Welsh Health and Social Care Innovation Ecosystem

The Welsh health and social care sector, which includes all NHS Wales organisations, has faced significant challenges because of Brexit and the wider-ranging impacts of the Covid-19 pandemic. Throughout this period, it was recognised that the pandemic represented a pivotal moment,[2] necessitating workplace changes and the need to enhance collective capability for more effective future pandemic responses. Concurrently, Welsh Government policy officials established a national innovation task team responsible for managing the formation and coordination of the national digital health innovation ecosystem for health and social care. In February 2023, the Welsh Government launched the '*Innovation Strategy for Wales*' (ISW), which emphasises three objectives deemed essential for transforming the health and social care sector in Wales.

1. To establish a robust policy framework and supporting national infrastructure that can create optimal conditions for a national patient-centric innovation ecosystem.
2. To create an agile innovation ecosystem that enables actors to coherently orchestrate activities across the pull and push nexus of innovation.
3. To leverage digital tools and platforms that can facilitate the adoption and scaling of innovative approaches and solutions.

This ecosystem includes 10 regional Research and Innovation Coordination Hubs across NHS Wales, the Bevan Commission, Health Technology Wales, the SBRI Centre of Excellence Wales, and the Life Sciences Hub Wales. *A Healthier Wales*, the Welsh Government's long-term health and social care plan, aims to expand local innovations and develop seamless care models through innovative adoption strategies. Within the Welsh Government, the Department for Health and Social Care and Early Years Group is tasked with providing strategic policy leadership and management of the NHS in Wales and overseeing social services. HSCEYG sets all aspects of health and care policy for Wales. Additionally, two new health authorities were established (i.e., Digital Health and Care Wales, Health Education Improvement Wales) to oversee digital, education and improvement functions on behalf of NHS Wales.

Although stakeholders of the proposed innovation ecosystem supported the initiative, they raised concerns that could impede the successful formation and coordination of the ecosystem.

First, the transfer of legislative power to Wales by the UK Government resulted in challenges related to legacy infrastructure. The existing centralised system did not fully meet the health and social care needs of Welsh patients or service providers. For example, the Head of Innovation, Welsh Government stated that "In a post Covid and post Brexit environment that is volatile, uncertain, complex and ambiguous, we desperately need a new national approach to innovation that can work across all our sectors to realise citizen benefit. Specifically, we need usable applications of new knowledge to transform and replace the significant impact of lost EU funding."

Second, there was a strategic policy and practice mismatch between the priorities of NHS Wales organisations and their capacity and capability for innovation, resulting in inconsistent adoption of new innovations within the wider innovation ecosystem. For example, the Head of Economy and Skills, Torfaen County Borough Council stated that "Local authorities have struggled to innovate in the past, we require a usable, practical and applied strategy and policy framework for innovation, where in the past we haven't had that direction from Government."

Third, research on scaling digital innovations focused mainly on specific medical use cases like diagnostic imaging or drug discovery, typically within a single healthcare provider such as a hospital, based on its patient population. For example, the Head of Innovation, Velindre University Health Trust stated that "Innovating in the NHS can feel like a lottery, there is nothing [i.e., a strategy or policy framework] that sets out in detail or in a consistent way, a rule book or process for innovation, it can feel very haphazard."

4 | Research Methodology

The author team adopted an action research approach for this study as its methodological strength enables (i) a collaborative approach between researchers and practitioners to address complex real-life problem situations while simultaneously contributing to knowledge (Davison et al. 2004), (ii) synergy between research and practice, so research informs practice and vice versa (Avison et al. 2018), and (iii) harmonious intertwining of the impact and relevance of the research (Davison et al. 2021). Action research is also a suitable method to explore innovation management issues like changing governance structures, and seeking practical improvements (Ollila and Yström 2020).

Action research encompasses many types of action-oriented methods that belong to two streams of research, namely, the 'problem-solving' stream (i.e., canonical, participatory observation, action learning, action design research, and grounded) and the software and systems development methods' stream (i.e., collaborative practice research, participatory, information systems prototyping, and multiview). The 'problem-solving' stream is for organizational change and consulting and the 'software and systems development methods' stream is for the analysis and design of systems and software (Davison et al. 2021). This study employs the 'canonical action research' method (Davison et al. 2004). See Appendix A.1 for an explanation of the five principles and associated criteria when conducting canonical action research and its application in this study.

As a member of the author team, who was a senior policy leader from the Welsh Government and directly involved in all phases (i.e., inception, formation and coordination, and launch), the research team had direct access to public consultation analysis, policy papers, ministerial reports, departmental documents, minutes of stakeholder meetings, and PowerPoint presentations

used for project reporting and decision making at the most senior levels of Government.

Semi-structured interviews were conducted with 30 practitioners and academics who were actively engaged in forming and scaling the digital health innovation ecosystem. Interviewees varied in terms of their role, affiliation, and experience (see Table A2). Interviews lasted between 35 and 55 min. The interviews were recorded, and the transcripts were systematically coded (see Figure A1). The analysis of the data was conducted following the Gioia method (Gioia et al. 2013), which is known for its rigorous approach to uncover novel insights by meticulously examining the diverse perspectives of various actors involved in organizational processes.

Both the primary and secondary data were used for evidence-based reporting to Welsh Government leadership and Ministers by the same senior member of the Welsh Government, who was also completing his Ph.D. in innovation management.

The author team used the 3U framework of practice impact to organize the data into a list of 'intellectual bins' (Miles and Huberman 1984). From a practice perspective, the 3U framework of practice impact enabled the author team to assess, measure, and demonstrate the impact of the innovation ecosystem across three dimensions of impact:

- *Usable impact*: research outputs are translated and ready for practical application, making an impact by increasing beneficiaries' awareness and knowledge of affordances available for improvement.
- *In-use impact*: research outputs are transferred for appropriation in practice, and their impact lies in mobilising actions towards improvement.
- *Useful impact*: research outputs make a transformational and observable impact on the bottom line or aspects that beneficiaries seek to improve (Pan and Pee 2020, p. 407).

5 | Key Challenges

The challenges reported in this section are based on the data collected from interviewees and participant observations and are framed from a practitioner perspective (author 2) for practitioners. The resolution of the challenges required collaboration among stakeholders of the innovation ecosystem to identify, develop, and implement sustainable solutions.

5.1 | Challenge 1: Misalignment Between the Strategic Policy Framework for Innovation and the Current Stakeholders, Programmes, and Best Practices Within the Existing Ecosystem

This misalignment initially led to fragmented efforts, reduced efficiency, and missed opportunities for dynamic relationship building within the innovation ecosystem. For example, while the strategic policy promotes cross-sector partnerships, many programmes operate in isolation without mechanisms for coordination.

Aligning the strategic policy framework for innovation with the existing activity processes and best practices of the ecosystem would ensure coherence and that the technological (innovation push) solutions developed are focused on system needs (innovation pull). This significantly enhanced the impact (i.e., usable impact, in-use, useful) of the digital innovations to achieve a maximum value impact (i.e., value abundancy) that required a high market readiness and high technology readiness as illustrated in the innovation matrix framework.

> "A new Government Strategy can support innovation across all our devolved sectors of responsibility, meaning huge value and impact, if we create the right conditions. [It] needs to help us practically apply innovation in the real world – impacting on our system priorities."
>
> (Head of Innovation, Economy Skills & Natural Resources Group, Welsh Government)

> "We need to hardwire innovation strategy and policy into changed and improved practice on the ground."
>
> (Innovation Lead, Bevan Commission)

> "We should focus innovation through a strategy and policy supported set of platforms that are provided digitally."
>
> (Chief Executive, NHS Innovations Southeast Wales)

This challenge overshadowed the inception phase of the Health and Social Care Innovation Wales ecosystem as it was acknowledged by government officials and NHS Wales staff that digital innovation within the ecosystem must be guided by a comprehensive strategic policy framework that promotes (i) best practices at all levels, (ii) to clearly shape system priorities, and (iii) align stakeholder efforts. It was anticipated that a well-defined national strategy could offer reassurance to key actors responsible for enabling innovation within their organisation and across the broader ecosystem. This enables a consistent approach to the integration of the framework driven nationally by innovation leads from NHS Wales organisations, Digital Health and Care Wales, Life Science Hub Wales, the NHS Executive, Research, Innovation and Improvement Hubs and other key players.

5.2 | Challenge 2: Tensions Arise From Policymakers, Healthcare Practitioners, and Innovation Partners Lacking a Shared Vision and Understanding of Each Other's Goals and Actions

These tensions manifested as misaligned priorities, conflicting strategies, and difficulties in collaboration between stakeholders. For example, there was a lack of understanding about the real-world challenges of implementing digital innovations in a complex health and social care system with a range of competing priorities, differing roles and contributions, and the discrete benefits for organisations within the ecosystem.

Despite buy-in from all stakeholders and a high sense of national pride around the formation of the Health and Social Care Innovation Wales ecosystem, tensions existed between those policymakers (i.e., Government officials) trying to develop an innovation ecosystem based on aligning healthcare system need (innovation pull) with an appropriate system offer (innovation push), and who are responsible for implementation in practice.

> "Whilst we have a policy framework and national programme to support improvement, we do not have one for innovation."
>
> (Assistant Director of Improvement, Aneurin Bevan University Health Board)

> "My clients approach me with a specific support request to apply innovation within their field of expertise; a new strategy or detailed framework needs to help us apply innovation in the real world and practically."
>
> (Director, Hudson Coaching & Consultancy Ltd)

This challenge was significantly problematic for the practitioners who were responsible for applying the digital innovation in their specific domains. The absence of a national strategic approach that included practical, real-world and transferable implementation guidelines specific to the health and social care context, heightened the risk of haphazard ecosystem coordination. Alongside real-world implementation guidelines and scaling is the lack of practical impact which is a requirement of the policy framework (Welsh Government 2021).

> "The public and private sectors in Wales have looked to Government to demonstrate leadership around innovation, any new innovation strategy has to have a new vision for innovation but also what is in it for specific sectors and stakeholders."
>
> (Head of Innovation & Industry Engagement, Welsh Government)

Addressing this challenge required a strategy that was not only aspirational, but also provided practical, user-led mechanisms (i.e., governance, funding, reporting, impact capture metrics, IP) to generate tangible results and achieve maximum value impact (i.e., value abundancy) for the Health and Social Care Innovation Wales ecosystem.

5.3 | Challenge 3: Lack of Established Innovation Communities of Practice and Limited Cross-Sectoral Knowledge Sharing

This challenge hindered the spread of best practices and slowed down collaborative problem-solving across the innovation ecosystem. For example, without established communities of practice, stakeholders sometimes missed opportunities to learn from each other's experiences of implementing digital innovations and lessons learned.

Due to the fragmented and often insular nature of NHS Wales organisations and the lack of consistent innovation processes and practices, the facilitation of cross-sectoral learning and knowledge sharing was at best, disjointed, in the formation phase of the Health and Social Care Innovation Wales ecosystem.

The absence of communities of practice and cross-sectoral knowledge sharing impeded the effective implementation of best practices emerging from evidence-based research and undermined the feasibility of the ecosystem. Communities of practice need to prepare their members to meet the continuous need for skill adjustments (Tona et al. 2025; Neeley and Leonardi 2022). For example, in England, there is the overarching Health Innovation Network (HIN), which consists of 15 sub-networks, all of which are regional partnerships connecting various organisations to foster and accelerate innovation in healthcare. These sub-networks strive to improve health care outcomes and stimulate economic growth by scaling the adoption of innovative solutions, that provide cross-sectoral knowledge sharing.

> "We undertake so much research in our Health Board, if an innovation platform to share that research existed, other NHS Wales organisations could immediately benefit from each other's knowledge."
>
> (Assistant Director—R&D, Betsi Cadwaladr University Health Board)

> "Coming from the private and procurement sector into health, the transfer of expertise is important, Health can be insular, other sectors have lots to offer, particularly where the motivations to innovate are different."
>
> (Assistant Director of Value Based Healthcare, Aneurin Bevan University Health Board)

> "We can learn so much from engineering systems and theory in academia, we just need to transfer that to a health context."
>
> (Consultant Clinical Scientist & Head of Clinical Engineering, Aneurin Bevan University Health Board)

As author two is a senior policy leader within the Welsh Government, the research team were in the unique position to develop, fund and promote knowledge sharing mechanisms to address this challenge. In this instance, by fostering open channels for knowledge exchange, facilitating cross-sector working groups, and advocating for a unified digital platform whereby stakeholders can co-create solutions, avoid duplication of effort and rapidly scale best practices across the ecosystem. For example, a new training module (i.e., An Introduction

to Innovation) provides access to the Health and Social Care Innovation Wales[3] resources (i.e., interactive framework and tool kits) and is hosted on the NHS Wales Electronic Staff Record, as one of the mandatory training courses required for all 90 000 NHS Wales staff.

5.4 | Challenge 4: Supporting, Achieving and Demonstrating Real-World Impact in the Health and Social Care Innovation Ecosystem

Supporting, achieving and demonstrating impact (i.e., usable, in-use, and useful) was critical throughout the formation, coordination and launch of the Health and Social Care Innovation Wales ecosystem. The infrastructure and mechanisms were required to provide a pathway where the innovations would evolve into 'usable' products and services that are aligned with the clinical and frontline operational needs of health and social care service providers. Impact was measured and monitored using key performance indicators including patient outcomes, service efficiency, and stakeholder satisfaction.

> "Local Authorities have struggled to innovate in the past, we require a usable, practical and applied strategy and policy framework for innovation."
>
> (Head of Economy & Skills, Torfaen County Borough Council)

> "There are no usable digital platforms that support innovation under our existing innovation regime."
>
> (Informatics Lead, Aneurin Bevan University Health Board)

To ensure both digital and non-digital innovations were adopted in practice, it was critical to achieve and clearly demonstrate 'in-use' impact. This was necessary to validate the effectiveness of new solutions and to mobilise stakeholders to commit to ongoing improvement.

> "A national strategy and policy framework would give assurance to the executives, clinicians and practitioners that I support to innovate across my organisation. It would also help me in my role as an innovation leader to frame the wide-ranging discussions that I have, particularly in relation to Intellectual Property and commercialisation."
>
> (Assistant Director of Innovation, Aneurin Bevan University Health Board)

> "We need to be able to apply innovation to real, in-use cases, not just in general policy terms but in specific areas such as wound care. Failing to apply it specifically can lead to a lack of attributable or useful impact."
>
> (Chief Operating Officer, Welsh Wound Innovation Centre)

Showcasing tangible in-use impact provided Government officials and NHS innovation leads with the assurance to scale innovations across their health board and the wider Health and Social Care Innovation Wales ecosystem. Achieving and demonstrating 'useful' impact was a crucial challenge in scaling the ecosystem. The innovations needed to result in transformative and observable impacts in terms of 'healthcare value impact' (e.g., enhanced patient experience) and the 'economic impact' (i.e., the financial effect of the intervention on the ecosystem).

> "We need to be able to apply innovation to real, in use cases, not just in general policy terms but in specific disease areas such as wound care. Failing to apply it specifically can lead to a lack of attributable or useful impact."
>
> (Chief Operating Officer, Welsh Wound Innovation Centre)

> "We need to ensure that any repurposed Strategy for Innovation in Wales is useful i.e., results in clear impact and value – for both society and our university. Have we achieved that in the past? I don't think we have."
>
> (Director, Innovation Lab, Cardiff University)

> "We simply must find new and different ways to look at our organisational problems that can result in transformational effects on our service."
>
> (Head of Strategy & Service Planning, Swansea Bay University Health Board)

Achieving and evidencing impact (i.e., usable, in-use, and useful) was critical throughout the formation, coordination, and launch of the Health and Social Care Innovation Wales ecosystem. Providing the right infrastructure and mechanisms were required to a provide clear pathway for innovations to mature into 'useful' products and services, directly aligned with the clinical and frontline needs of health and social care providers and patients.

6 | Recommendations

The recommendations presented in this section are framed by a practitioner (author 2) for policy makers, innovation leads, and health and social care managers engaged in the formation, coordination, and launch of innovation ecosystems. The recommendations presented in this section are mapped to the timeline of the challenges reported in this study (see Figure 2). The recommendations emerging from this study reflect the Government's leadership role to create the right conditions for large-scale sustainable innovation through strategic direction and policy setting, and to enable practitioners to develop new ways of working from within their organisation. The key activities and mechanisms deployed to address these challenges and to scale impact (i.e., useable, in-use, useful) within the context of this

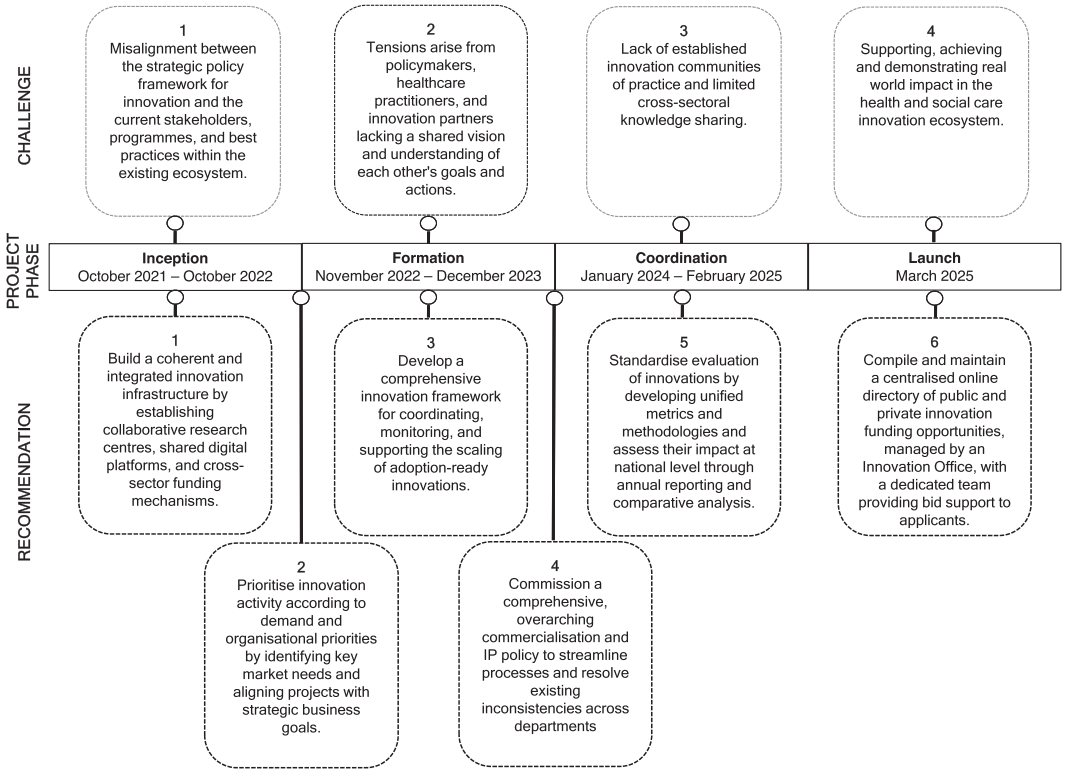

FIGURE 2 | Infographic of the reported key challenges and mapping with the recommendations.

study are instantiated in the 3U framework of practice impact (see Figure A2). These mechanisms underpin the Health and Social Care Innovation Wales infrastructure that includes the digital Innovation Framework and knowledge bank,[4] developed as a specific commitment made in Wales Innovates: the Welsh Government's 2023 Innovation Strategy for Wales.

6.1 | Recommendation 1: Build a Coherent and Integrated Innovation Infrastructure by Establishing Collaborative Research Centres, Shared Digital Platforms, and Cross-Sector Funding Mechanisms

Establishing a coherent and integrated innovation ecosystem requires clear direction, delineation and understanding of roles, responsibilities and accountability among every partner, fostering collaboration through a publicly accessible ecosystem map. The map should detail the stakeholders involved, their contributions (demand-pull or technology-push), and support resources. This includes, clear delineation of responsibilities by Government, organized by role, that ensures all stakeholders are aligned in their objectives and contributions. This transparency fosters collaboration and minimizes conflicts, facilitating a smoother integration of diverse expertise. Regular communication, shared goals, and an interactive platform enhance transparency are essential for maintaining this coherence, enabling the ecosystem to function efficiently and adapt to emerging challenges and respond to innovation opportunities. This approach not only enhances overall productivity but also streamlines innovation activities, enabling all actors to align efforts to maximize healthcare, technical and economic benefits across the entire health ecosystem.

6.2 | Recommendation 2: Prioritise Innovation Activity According to Demand and Organisational Priorities by Identifying Key Market Needs and Aligning Projects With Strategic Business Goals

Directing innovation efforts towards organisational priorities and needs is crucial for generating meaningful 'demand pull' in the innovation process that creates new markets and opportunities for 'technology push'. By aligning innovation activities with strategic goals, organisations can ensure that digital and non-digital solutions address real-world challenges. This targeted approach increases the likelihood of successful implementation and adoption—which results in increased healthcare and/or economic value, as the resulting innovations developed are inherently relevant and necessary. Engaging stakeholders in identifying these priorities fosters a sense of ownership and commitment, driving collaborative efforts towards achieving shared objectives. Announcing and confirming these priorities at the highest organisational or policy level ensures that innovation focus is targeted, purposeful and directly contributes to sustained growth and efficiency within organisations and the wider innovation ecosystem.

6.3 | Recommendation 3: Develop a Comprehensive Innovation Framework for Coordinating, Monitoring, and Supporting the Scaling of Adoption-Ready Innovations

Developing a comprehensive innovation framework including evaluation criteria, and partnership guidelines will accelerate the scaling of proven adoption-ready innovations,

foster collaboration among stakeholders, and maximise the societal impact of new technologies. For example, an innovation framework, based on ISO56000, the international standard on innovation management (International Standards Organisation, 2020), would outline all stages of the innovation development pathway from ideation, to development to procurement and scaled adoption. This framework and pathway will offer support and advice to health and care practitioners, linked to every stage of their innovation development journey. Provision of a structured pathway brings collective knowledge and expertise to one place—enabling practitioners to navigate the complexities of innovation development more effectively and consistently, ensuring that each phase is approached in a systematic evidence-based way, making best use of the support the ecosystem can provide. A rigorous approach will encourage continuous innovation and improvement, leading to the development of high-quality solutions that are integrated and embedded into the healthcare system. The framework includes deployment of accessible ISO5600-aligned innovation skills and knowledge programmes for innovation actors by the four Intensive Learning Academies (ILAs) across Wales. The framework will also enhance collaboration among stakeholders by providing a publicly available framework for industry and academic partners, demonstrating where, when and how technology push and demand pull partners can collaborate, ensuring delivery of healthcare value, technical value and economic impact.

To effectively enact this approach and scale adoption-ready innovations, a national innovation programme team should be established to represent the 'demand pull' component of innovation adoption. This team would typically be chaired by the overseeing or governing body, include the innovation leads within healthcare practitioner organisations and key opinion leader clinicians and academics. A stakeholder forum of 'technology push' organisations would be linked to the outcomes of this programme team. Their collective expertise will guide the development and implementation of scalable solutions. By overseeing the innovation process, this team can ensure that innovations are not only ready for adoption but are also implemented efficiently and disseminated across the health system. This coordinated approach helps in addressing potential barriers, facilitating integration, and maximising the impact of innovative solutions on a large scale. By balancing technical value and economic impact, it harnesses both push and pull dynamics for sustained innovation.

6.4 | Recommendation 4: Commission a Comprehensive, Overarching Commercialisation and IP Policy to Streamline Processes and Resolve Existing Inconsistencies Across Departments

Developing a unified and Government-sanctioned commercialisation and IP policy for Wales enables healthcare organisations and innovation teams to consistently capture, protect and exploit successful innovation to generate income from internally created or co-created products and services that have commercial or income-generating potential. This strategy and model will provide a framework for identifying and exploiting commercial opportunities, offering guidance on market analysis, business development, and revenue generation. A unified IP policy will support this strategy by providing standardised approaches to managing IP, ensuring consistency and encouraging innovation. It will provide a clear and consistent approach to the management of IP and commercialisation activities to protect and leverage innovation. The strategy should include market analysis and revenue generation frameworks, while the IP policy standardises agreements and royalty sharing. By supporting the protection and commercialisation of innovations, this initiative will create new revenue streams, fostering financial sustainability and encouraging continuous innovation. This strategic approach will also help in maximising the impact of innovations, ensuring that they deliver value both within and beyond the healthcare system. By balancing push and pull elements, the strategy will ensure that commercial ventures achieve both technical excellence and economic viability, contributing to increasing value for healthcare patients and organisations.

6.5 | Recommendation 5: Standardise Evaluation of Innovations by Developing Unified Metrics and Methodologies and Assess Their Impact at a National Level Through Annual Reporting and Comparative Analysis

Standardising the evaluation of innovations and assessing their impact at a national level would ensure consistent quality, facilitate best practice sharing, and inform policy decisions. In the context of this innovation ecosystem, developing an online interactive digital platform for assessing digital innovations standardised the evaluation process across the health and social care ecosystem, based on the innovation framework. The platform includes functionality to apply criteria such as cost, development time, ease of adoption, and clinical buy-in to assess the feasibility, desirability and viability of innovations. It also supports an agile innovation culture where the overall impact of innovation value can be assessed at a national scale. This can demonstrate to political leaders the return on investment of public funding into the innovation ecosystem.

Integrating push-pull dynamics will also ensure balanced evaluations that consider both technical value and economic impact. By compiling expertise from various innovation platforms, the tool will provide a comprehensive and balanced assessment framework for healthcare value and economic impact, driving improved healthcare value through resource efficiency and increasing the direct and indirect economic impact when procured. This standardisation will ensure that innovations are evaluated consistently, thereby facilitating adoption and integration. Although, balancing the sometimes contradictory dimensions of healthcare value and economic impact can lead to difficult conversations between stakeholders. These tensions, were however, the vehicle for collaboration, incremental improvement and change, not just from a technical standpoint, but to enable stakeholders of the innovation ecosystem to continue reframing and refining their roles and contributions (demand-pull or technology-push) within this context. The tool will also help in identifying the most promising innovations, thereby enhancing the overall efficiency and effectiveness of the innovation ecosystem.

6.6 | Recommendation 6: Compile and Maintain a Centralised Online Directory of Public and Private Innovation Funding Opportunities, Managed by an Innovation Office, With a Dedicated Team Providing Bid Support to Applicants

Compiling a comprehensive directory of innovation funding sources at national and international levels will provide innovators with crucial information on funding opportunities, linked to the relevant stage or stages of the innovation framework partners are working within. This directory should include details such as eligibility and application timelines, which will enable innovators to secure any necessary financial support. A bid function will support the projects at filter and business case stages to improve the chances of success. By streamlining access to funding information, the directory will encourage more innovators to pursue their projects, knowing that they have a clear understanding of the resources available to them. By reducing the access and capability barriers to financial resources, a more dynamic and well-supported innovation environment is fostered, driving continuous development and implementation of new solutions. The directory will support both technology-push and demand-pull initiatives by ensuring that funding is aligned with both technical value and economic impact.

The recommendations address fundamental challenges such as commercialisation, IP management, and ecosystem coordination, which are not unique to healthcare ecosystems but are critical in many other industries and sectors (Cecchi-Dimeglio et al. 2022). While these recommendations are underpinned by mechanisms (see Figure A2) that can support the formation and coordination of innovation ecosystems in comparable contexts, their application requires adjustments to fit the unique priorities and regulatory landscape in those contexts.

7 | Discussion

This pioneering initiative, funded by the Welsh Government, established networks and deployed resources across the innovation ecosystem, enabling NHS Wales and social care staff to develop and apply innovations in key areas. This in turn enhanced patient outcomes and delivered better value (i.e., economic, healthcare). This initiative is consistent with the approach of the Welsh Value in Health Centre,[5] which aims to enhance value for patients using the health and social care system. The strategy involves collaboration among patients, clinical teams, operational management, informatics, and finance within healthcare organizations to improve outcomes.

This study shows that government plays a key role in the formation, coordination and scaling of the innovation ecosystem by balancing central oversight, devolved decision-making, and knowledge exchange with stakeholders in the ecosystem. In this instance, the Welsh Government set national strategic goals and created optimal conditions for innovation, including policies on IP, funding mechanisms, and commercialisation. As decisions move from the core of governmental control to stakeholders like universities or private sector R&D teams, the control becomes more decentralised. This approach leverages specialised expertise while aligning with national objectives, ensuring a dynamic innovation system.

The challenges encountered throughout this initiative provided opportunities for new learning and change, acting as a 'vehicle of change' to accelerate digital innovation by strengthening networks among cross-sector organisations (i.e., public services, academia, and companies). Rather than imposing uni-directional mandates, successful networking approaches should be bi-directional, focused on building capacity and capability, and designed to align incentives and goals of all stakeholders within the ecosystem. This compares to the NHS England model of Health Innovation Networks whose core objectives are to (i) generate a rich pipeline of demonstrably useful, evidence-based innovations, and (ii) support the scaled adoption of evidence-based innovations across England.

Building on the success of this project, the Health and Social Care Innovation Wales was launched in March 2025, providing NHS Wales and social care staff with a range of supporting innovation infrastructure. The Innovation Framework provides a structured and end-to-end approach to healthcare innovation, offering clear guidance on developing, testing, and scaling innovative ideas, products, practices, and services—providing relevant tools, advice, and connections at each framework stage.

Consequently, this study provides practical recommendations, actions and mechanisms that can be used as leverage to align public policies with the incentives for actors in the Health and Social Care Innovation Wales system which is essential for making well-informed decisions and the successful formation and coordination of a sustainable innovation ecosystem.

7.1 | Broader Implications

While this study has been situated within the Welsh context, the findings have broader implications for the governance and organisation of health and social care innovation systems internationally. Prior literature highlights that national and regional governments are increasingly called upon to act as orchestrators of innovation ecosystems (e.g., Ferlie et al. 2005; Demircioglu and Audretsch 2017). Yet, compelling rigorous empirical evidence on how such orchestration translates into sustainable outcomes has been limited. Our study contributes by showing how a balanced model of central coordination and distributed decision-making can support both innovation capacity and alignment with strategic objectives. This study also provides specific mechanisms that were deployed to scale impact (i.e., useable, in-use, useful) within the context of the Welsh innovation ecosystem that were not reported in prior studies. In doing so, it adds to comparative discussions in the literature on health innovation networks, policy-led innovation, and ecosystem governance.

The findings suggest that the success of government-led innovation ecosystems is contingent upon the creation of trust-based, bi-directional relationships among diverse stakeholders. This observation aligns with previous research on collaborative

governance (Ansell and Gash 2008) but extends it by demonstrating its applicability in health innovation contexts where resource asymmetries and differing institutional logics can otherwise inhibit collaboration.

7.2 | Opportunities for Future Research

Future research could explore several avenues that build upon our findings. Comparative studies across other national and regional health and social care systems could examine how variations in governance structures, political contexts, and health system configurations shape the formation and sustainability of innovation ecosystems. Such studies could assess whether balanced orchestration leads to comparable improvements in innovation capacity and strategic alignment. Longitudinal studies could investigate the durability of ecosystem impacts, including whether the value created can be sustained once initial government investment or political support changes. And finally, future research could explore the patient and citizen perspective in innovation ecosystems, as their engagement is often assumed but less frequently studied in empirical depth (Sanchez et al. 2022; van Leersum et al. 2024).

By situating this case within broader academic discourse, we show that while the Welsh experience offers unique contextual insights, it also provides transferable lessons for understanding how government and policy can effectively stimulate, coordinate, and sustain health and social care innovation ecosystems.

8 | Conclusion

The co-delivered approach led by the Welsh Government and cross-sector organisations has resulted in the newly established Health and Social Care Innovation Wales ecosystem. The findings indicate that, beyond initial stakeholder alignment, innovation management is a critical capability that enables public sector organisations to nurture creativity, stimulate sustainable growth, and maintain momentum within the ecosystem. Importantly, each innovation ecosystem is shaped by its historical, regional, and institutional context, as well as the distinct roles and motivations of its contributing actors. As a result, strategies and solutions, whether technological, procedural, or policy-based, must be tailored to the specific environment in which they will operate. This study concludes that innovation in government-led ecosystems is a dynamic, socially complex, and continuously evolving process. As innovations cascade through the ecosystem, they reshape both demand conditions and technological trajectories, creating new challenges and opportunities over time.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Endnotes

[1] https://www.gov.wales/innovation-strategy-wales.

[2] https://www.nhsconfed.org/publications/nhs-wales-covid-19-innovation-and-transformation-study-report.

[3] https://hsciw.wales.

[4] https://hsciw.wales.

[5] https://vbhc.nhs.wales.

References

Alblooshi, M., M. Shamsuzzaman, and S. Haridy. 2021. "The Relationship Between Leadership Styles and Organisational Innovation: A Systematic Literature Review and Narrative Synthesis." *European Journal of Innovation Management* 24, no. 2: 338–370.

Ansell, C., and A. Gash. 2008. "Collaborative Governance in Theory and Practice." *Journal of Public Administration Research and Theory* 18, no. 4: 543–571.

Avison, D. E., R. M. Davison, and J. Malaurent. 2018. "Information Systems Action Research: Debunking Myths and Overcoming Barriers." *Information & Management* 55, no. 2: 177–187.

Borins, S. 2002. "Leadership and Innovation in the Public Sector." *Leadership and Organization Development Journal* 23, no. 8: 467–476.

Boyer, J., and A. Kokosy. 2022. "Technology-Push and Market-Pull Strategies: The Influence of the Innovation Ecosystem on Companies' Involvement in the Industry 4.0 Paradigm." *Journal of Risk Finance* 23, no. 5: 461–479.

Carayannis, E. G., and D. F. Campbell. 2009. "'Mode 3' and 'Quadruple Helix': Toward a 21st Century Fractal Innovation Ecosystem." *International Journal of Technology Management* 46, no. 3–4: 201–234.

Cecchi-Dimeglio, P., T. Masood, and A. Ouderkirk. 2022. *What Makes Innovation Partnerships Succeed?* Harvard Business Review. https://hbr.org/2022/07/what-makes-innovation-partnerships-succeed.

Davison, R., M. G. Martinsons, and N. Kock. 2004. "Principles of Canonical Action Research." *Information Systems Journal* 14, no. 1: 65–86.

Davison, R. M., M. G. Martinsons, and J. Malaurent. 2021. "Research Perspectives: Improving Action Research by Integrating Methods." *Journal of the Association for Information Systems* 22, no. 3: 851–873.

Deloitte. 2020. *Reimagining Innovation Ecosystems for the Health Care Industry.* Deloitte.

Demircioglu, M. A., and D. B. Audretsch. 2017. "Conditions for Innovation in Public Sector Organizations." *Research Policy* 46, no. 9: 1681–1691.

Deschamps, J. P. 2005. "Different Leadership Skills for Different Innovation Strategies." *Strategy and Leadership* 33, no. 5: 31–38.

Ferlie, E., L. Fitzgerald, M. Wood, and C. Hawkins. 2005. "The Nonspread of Innovations: The Mediating Role of Professionals." *Academy of Management Journal* 48, no. 1: 117–134.

Gioia, D. A., K. G. Corley, and A. L. Hamilton. 2013. "Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology." *Organizational Research Methods* 16, no. 1: 15–31.

Hötte, K. 2023. "Demand-Pull, Technology-Push, and the Direction of Technological Change." *Research Policy* 52, no. 5: 104740.

Jimenez, A., P. Abbott, and S. Dasuki. 2022. "In-Betweenness in ICT4D Research: Critically Examining the Role of the Researcher." *European Journal of Information Systems* 31, no. 1: 25–39.

Jones, W. 2024. "AI-Powered 'Deep Medicine' Could Transform Healthcare in the NHS and Reconnect Staff With Their Patients." Conversation. https://theconversation.com/ai-powered-deep-medicine-could-transform-healthcare-in-the-nhs-and-reconnect-staff-with-their-patients-228475.

Miles, M. B., and A. M. Huberman. 1984. "Drawing Valid Meaning from Qualitative Data: Toward a Shared Craft." *Educational Researcher* 13, no. 5: 20–30.

Mossialos, E., A. McGuire, M. Anderson, E. Pitchforth, A. James, and R. Horton. 2018. "The Future of the NHS: No Longer the Envy of the World?" *Lancet* 391, no. 10125: 1001–1003.

Nagji, B., and G. Tuff. 2012. "Managing Your Innovation Portfolio." *Harvard Business Review* 90, no. 5: 66–74.

Neeley, T., and P. Leonardi. 2022. "Developing a Digital Mindset." *Harvard Business Review* 100, no. 5–6: 50–55.

Nemet, G. F. 2009. "Demand-Pull, Technology-Push, and Government-Led Incentives for Non-Incremental Technical Change." *Research Policy* 38, no. 5: 700–709.

Northouse, P. G. 2012. *Introduction to Leadership: Concepts and Practice*. Sage Publications.

Ollila, S., and A. Yström. 2020. "Action Research for Innovation Management: Three Benefits, Three Challenges, and Three Spaces." *R&D Management* 50, no. 3: 396–411.

Pan, S. L., and L. G. Pee. 2020. "Usable, in-Use, and Useful Research: A 3U Framework for Demonstrating Practice Impact." *Information Systems Journal* 30, no. 2: 403–426.

Pisano, G. P. 2015. "You Need an Innovation Strategy." *Harvard Business Review* 93, no. 6: 44–54.

Sanchez, R. H., L. Bergeron-Drolet, M. Sasseville, and M. Gagnon. 2022. "Engaging Patients and Citizens in Digital Health Technology Development Through the Virtual Space." *Frontiers in Medical Technology* 4: 958571.

Sors, T. G., R. C. O'Brien, M. L. Scanlon, et al. 2023. "Reciprocal Innovation: A New Approach to Equitable and Mutually Beneficial Global Health Partnerships." *Global Public Health* 18, no. 1: 2102202. https://doi.org/10.1080/17441692.2022.2102202.

The King's Fund. 2018. *Quarterly Monitoring Report. How is the NHS Performing?* King's Fund.

Tona, O., D. E. Leidner, N. van Der Meulen, et al. 2025. "The Deployment of AI to Infer Employee Skills: Insights From Johnson & Johnson's Digital-First Workforce Initiative." *Information Systems Journal* 35: 1516–1527. https://doi.org/10.1111/isj.12594.

UK Parliament. 2024. *Post: Horizon Scanning: Healthcare Technologies*. Department of Health and Social Care.

van Leersum, C. M., C. Jaschinski, M. Bults, and J. van der Zwart. 2024. "Citizen Involvement in Research on Technological Innovations for Health, Care or Well-Being: A Scoping Review." *Health Research Policy and Systems* 22, no. 1: 119.

Welsh Government. 2021. *A Healthier Wales—Our Plan for Health and Social Care*. Welsh Goverment.

Wilson, A. 2021. *Achieving Innovation in Health and Social Care: A Narrative Review*. Life Sciences Hub Wales.

Appendix A

TABLE A1 | Classification of leadership styles based on their impact on organisational innovation.

	Leadership style	Description (Alblooshi et al. 2021)
1	Paternalistic leadership	A multidimensional approach based on respect for orders and helps in building trust between team members and with their managers and motivates them for higher levels of cooperation and commitment.
2	Entrepreneurial leadership	Provide organisations with the vision and flexibility to change and thus foster the innovation process.
3	Developmental leadership	An employee-centred style in which leaders invest in providing their followers with the skills and knowledge needed to be more productive and to have higher levels of contribution to organisational success
4	Strategic leadership	The process of creating and then communicating a vision with organisational members and motivating them to work hard in order to achieve that vision.
5	Cluster leadership	Fulfil members' requirements and meet the cluster's innovation targets through a set of behaviours and capabilities, and driving the cluster's performance.
6	Integrative leadership	Refers to a dynamic ability that integrates leadership elements with strategic decision-making objectives in the firm, considering their relationships and other stakeholders through operational and secured communication and performance mechanisms in order to achieve shared goals.
7	Political leadership	Is about making some authoritative decisions in order to deal with social issues and find solutions for them. That can be done by either adjusting existing polices or developing new ones, which is not possible in isolation and requires public involvement and innovative thinking, a process called collaborative policy innovation

Canonical Action Research

Canonical action research distinguishes itself from other forms of action research through its iterative, rigorous, and collaborative nature to address organisational problems, while also contributing to scholarly knowledge (Davison et al. 2004). To assure both the rigor and the relevance of canonical action research, Davison et al. (2004) propose five principles and associated criteria for canonical action research (see table below).

Principle	Application of criteria in this study
Principle of Researcher—Client Agreement (CAR)	**1a** Did both the researcher and the client agree that CAR was the appropriate approach for the organisational situation? **Yes. Initially AR was deemed appropriate, and as the project evolved CAR emerged as the most appropriate method**. **1b** Was the focus of the research project specified clearly and explicitly? **Yes. Contractual funding agreements were signed between Swansea University, the NHS, and Welsh Government**. **1c** Did the client make an explicit commitment to the project? **Yes** **1d** Were the roles and responsibilities of the researcher and client organisation members specified explicitly? **Yes** **1e** Were project objectives and evaluation measures specified explicitly? **Yes** **1f** Were the data collection and analysis methods specified explicitly? **Yes**
Principle of Cyclical Process Model (CPM)	**2a** Did the project follow the CPM or justify any deviation from it? **Yes** **2b** Did the researcher conduct an independent diagnosis of the organisational situation? **Yes** **2c** Were the planned actions based explicitly on the results of the diagnosis? **Yes, to a certain extent**. **2d** Were the planned actions implemented and evaluated? **Yes** **2e** Did the researcher reflect on the outcomes of the intervention? **Yes** **2f** Was this reflection followed by an explicit decision on whether or not to proceed through an additional process cycle? **Yes** **2g** Were both the exit of the researcher and the conclusion of the project due to either the project objectives being met or some other clearly articulated justification? **Yes, project objectives were met by the research team**.
Principle of Theory	**3a** Were the project activities guided by a theory or set of theories? **Where appropriate. The authors drew on innovation theory, design thinking, and demand-pull, technology-push**. **3b** Was the domain of investigation, and the specific problem setting, relevant and significant to the interests of the researcher's community of peers as well as the client? **Yes** **3c** Was a theoretically based model used to derive the causes of the observed problem? **No** **3d** Did the planned intervention follow from this theoretically based model? **No** **3e** Was the guiding theory, or any other theory, used to evaluate the outcomes of the intervention? **Yes**

Principle	Application of criteria in this study
Principle of Change through Action	**4a** Were both the researcher and client motivated to improve the situation? **Yes. From the outset, there was a shared commitment to improve the health and social care ecosystem**. **4b** Were the problem and its hypothesised cause(s) specified as a result of the diagnosis? **Yes, to a certain extent. As the project evolved and knowledge exchange improved, other roots causes emerged**. **4c** Were the planned actions designed to address the hypothesised cause(s)? **Yes** **4d** Did the client approve the planned actions before they were implemented? **Yes** **4e** Was the organisation situation assessed comprehensively both before and after the intervention? **Yes, assessments were conducted throughout the lifecycle of the project**. **4f** Were the timing and nature of the actions taken clearly and completely documented? **Yes**
Principle of Learning through Reflection	**5a** Did the researcher provide progress reports to the client and organisational members? **Yes, project and ministerial reports and presentations were provided throughout the lifecycle of the project**. **5b** Did both the researcher and the client reflect upon the outcomes of the project? **Yes, when required, debriefing and reflection sessions were incorporated throughout the project**. **5c** Were the research activities and outcomes reported clearly and completely? **Yes** **5d** Were the results considered in terms of implications for further action in this situation? **Yes** **5e** Were the results considered in terms of implications for action to be taken in related research domains? **Yes, to a certain extent**. **5f** Were the results considered in terms of implications for the research community (general knowledge, informing/re-informing theory)? **Yes** **5g** Were the results considered in terms of the general applicability of CAR? **Yes, to a certain extent**.

TABLE A2 | Interviewee profile.

Job title	Affiliation
Head of innovation & industry engagement	Welsh Government
Deputy Director|Transformation Health & Social Care	Welsh Government
Head of Innovation|Economy Skills & Natural Resources	Welsh Government
Director	Bevan Commission
Innovation Lead	Bevan Commission
National Head of Business Development & Industry Engagement	Aneurin Bevan University Health Board
Head of Informatics Directorate	Aneurin Bevan University Health Board
Deputy Director of Planning	Aneurin Bevan University Health Board
Assistant Director Value Based Healthcare	Aneurin Bevan University Health Board
Assistant Director	Aneurin Bevan University Health Board
Informatics Lead	Aneurin Bevan University Health board
Grant and Innovation Manager	Aneurin Bevan University Health Board
Consultant Clinical Scientist & Head of Clinical Engineering	Aneurin Bevan University Health Board
Head of Strategy & Service Planning	Swansea Bay University Health Board
Service Planning Manager	Swansea Bay University Health Board
Assistant Director of Innovation	Cardiff & Vale University Health Board
Director | Y Innovation Lab	Cardiff University
Dean of Clinical Innovation	Cardiff University
Innovation Specialist & Project Manager	Cardiff University
Clinical Innovation Hub Manager	Cardiff University
Assistant Director R&D	Betsi Cadwaladr University Health Board
Director | Health Technology Wales	Velindre University Health Trust
Head of Innovation	Velindre University Health Trust
Innovation Manager	Cwm Taf Morgannwg University Health Board
Director of Improvement & Innovation	Cwm Taf Morgannwg University Health Board
Chief Executive	NHS Innovations South East Wales
Chief Operating Officer	Welsh Wound Innovation Centre
Director	Hudson Coaching and Consultancy Ltd.
Head of Economy & Skills	Torfaen County Borough Council

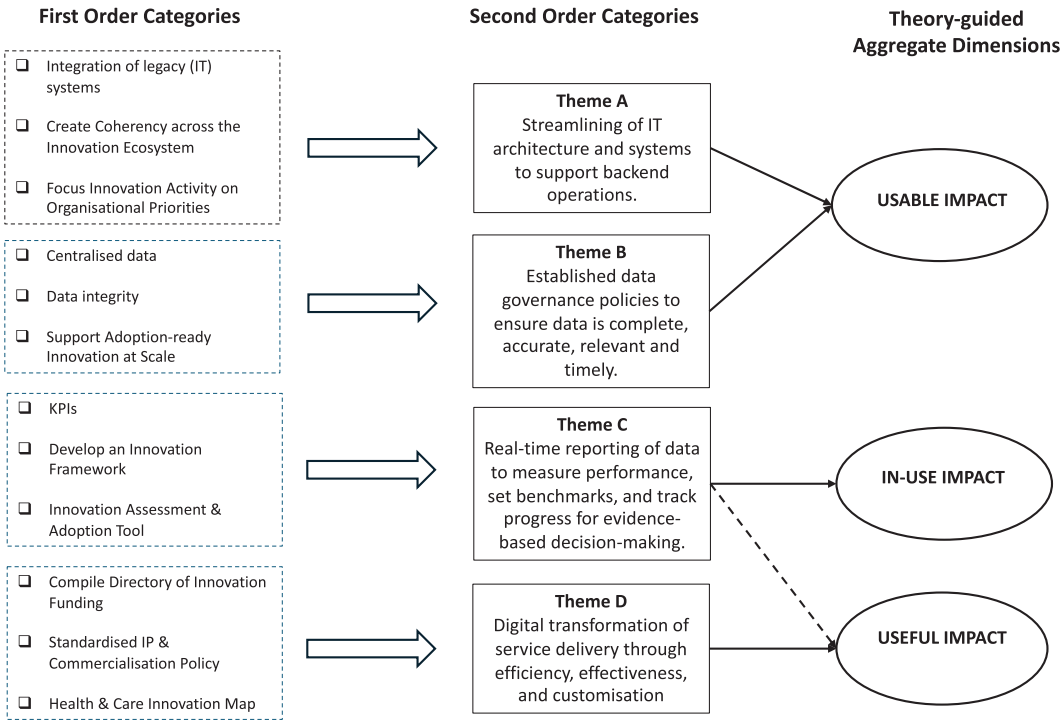

FIGURE A1 | Coding of interview data.

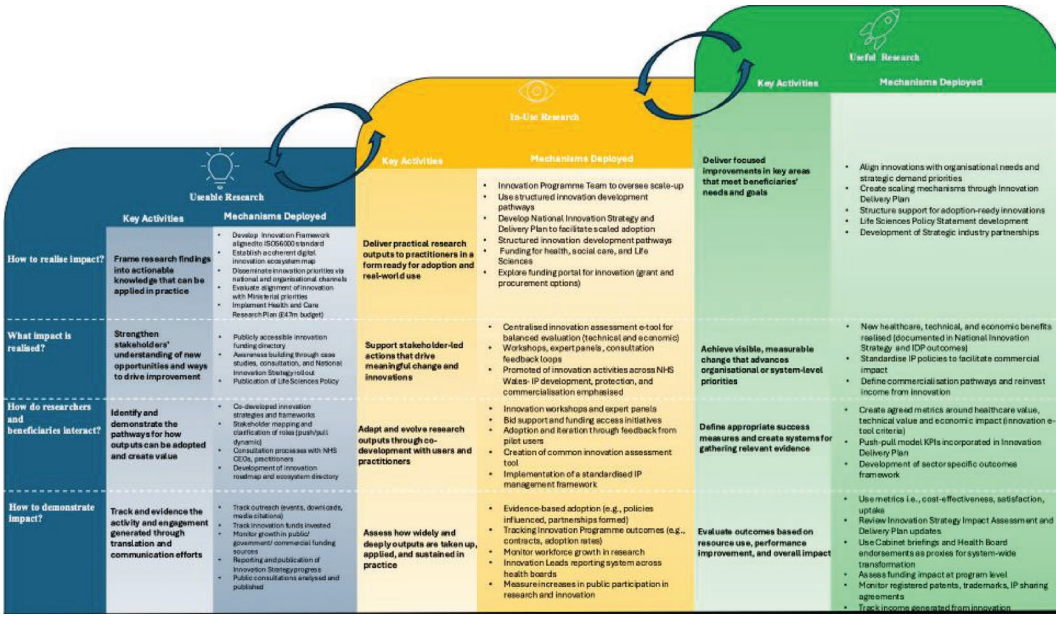

FIGURE A2 | Mechanisms deployed to scale impact of innovation ecosystem.