**Bridging intelligent health systems into the Accelerated National Innovation Adoption (ANIA) pathway**

Before attending MIE2025 my experience in the field of medical informatics was highly limited. Therefore, I went to the conference with an open mind looking to open this new field to me. The first talk that stuck with me was from Professor Charles Friedman and the concept of learning health systems (LHS); 'A system in which science, informatics, incentives, and culture are aligned for continuous improvement and innovation, with best practices seamlessly embedded in the care process, patients and families as active participants in all elements, and new knowledge is captured as an integral by-product of the care experience.' This system was novel to me but perfectly conceptualised the process of discovery to implementation and I appreciated the versatility of the system that could be applied to multiple complex problems. He discussed how difficult the transition of knowledge to implementation is, highlighting that it can take 17 years to bridge the gap. This presentation made me consider ways to help shorten the gap.

Linking this problem to my own work it made me think how the Accelerated National Innovation Adoption (ANIA) pathway, and my own part in the pathway, could facilitate a reduction in this gap. For context, ANIA was launched in June 2022 and aims to fast-track the adoption of proven technological innovations across Scotland, focusing on medical technologies (MedTech) that can diagnose, treat, and improve health and wellbeing. Previously, the deployment of innovative technologies varied across the 14 Scottish Health Boards, leading to inconsistent access. ANIA addresses this by identifying, assessing, and implementing high-impact technological innovations on a "Once for Scotland" basis, ensuring alignment with Scottish Government priorities. ANIA includes partners across NHS Scotland from NHS Delivery, Public Health Scotland, Healthcare Improvement Scotland and the Centre for Sustainable Delivery. These partners contribute their expertise to accelerate the adoption process, enabling joint planning with territorial NHS Boards for rapid implementation.

There are multiple stage gates to the ANIA pathway summarised below:

- **Horizon scanning (stage 0)**: Identifies new innovative technologies, assesses them against ANIA criteria, and presents them for shortlisting and approval by the Innovation Decision Authority (IDA).

- **Strategic case (stage 1)**: Provides a detailed evaluation of the technology, covering the research evidence, compliance, indicative costs, initial stakeholder views, proposed key performance indicators and the project governance.

- **Value case (stage 2)**: Acts as a final value case for approval that is proportionate to the level of investment being sought.

- **Implementation (stage 3)**: Monitors the progress of the technology delivery against programme milestones, budgets and mitigation of risk.

- **Benefits realisation (stage 4)**: The formal post implementation benefits which reviews achievements of agreed outcomes, have stakeholder expectations been realised, impact of service change and improvements delivered.

Each stage gate can embody the principles of a LHS and help move the process forward. To begin with, horizon scanning utilises data-informed prioritisation, where LHS emphasises using real-world data to identify gaps and opportunities. ANIA could leverage tools like large-language

models and patient safety data pipelines to detect emerging needs (discussed further below). The strategic case is a rigorous but rapid evidence synthesis review of a certain health problem that mirrors LHS and turns data into actionable knowledge. The value case then formalises the importance of translating knowledge into system-level change. Implementation becomes a learning opportunity, where monitoring and adaptation ensure innovations are effectively embedded. Finally, Benefits Realisation closes the loop by capturing outcomes and feeding insights back into future cycles. In this way, ANIA can evolve into a dynamic, self-improving system that continuously learns from practice and accelerates the adoption of high-impact innovations across NHS Scotland.

Beyond the LHS there were many other opportunities for learning about different aspects of the ANIA pathway. Translating knowledge into a pathway that can facilitate implementation.

### Horizon scanning (stage 0)

Horizon scanning involves the detection and assessment of hundreds of technologies per year, with limited human resource. The use of large language models (LLMs) to scan and prioritise data could provide a useful advancement to process more technologies. A couple of examples can be found in the conference proceedings: 'Leveraging data pipeline and LLM to advance patient safety event studies' demonstrates how a database of unstructured reports (similar to ANIA horizon scanning in unstructured nature) can be analysed by LLMs. In addition, the reports can then be prioritised where innovation is most urgently needed. This could be used to continuously scan NHS data sources to find drives for innovation, tailoring the process to the most pressing needs in NHS Scotland. 'AI-powered affiliation insights: LLM-based bibliometric study of European Medical Informatics Conferences' can set the work earlier by using LLMs to identify emerging research themes, technologies and leaders for ANIA to be aware of and stay ahead of the innovation landscape. This could then be used in line with NHS Scotland priorities then identify relevant technologies earlier and possibly allow ANIA to steer the incubation of these technologies into NHS Scotland at earlier phases of development.

### Strategic case (stage 1)

An important part of the strategic case is to begin stakeholder engagement and early KPI development. The article 'Modified extended FITT framework for digital tool adoption' supports the strategic case by demonstrating a structured method to evaluate how well an innovation fits with users, tasks and existing technology infrastructure. ANIA could integrate elements from the Non-adoption, Abandonment, Scale-up, Spread, and Sustainability (NASSS) framework, namely components relating to clinical and cost-effectiveness, stakeholder engagement and organisational readiness. This would enable a deeper understanding of potential barriers and enablers, to inform the development of realistic KPIs and strengthen governance planning. Further consideration for global ethical standards and regulatory considerations for AI technologies specifically can be found in 'Mapping Ethical Guidelines for AI in Healthcare'.

### Value case (stage 2)

The value case focuses on a full business case including public value, affordability and delivery planning. The article 'Healthcare Data Quality Language (HDQL): Translating Requirements into Software Attributes' provides a structured method to convert high level-healthcare goals into measurable software attributes. This directly supports the public value proposition section of the value case by ensuring that the innovation directly aligns with NHS Scotland's strategic priorities. Other aspects of the article such as defining data quality and system requirements

help reduce ambiguity in procurement and implementation planning which strengthens delivery and affordability sections of the value case. HDQL promotes standardisation in how innovations are described and evaluated, which is essential for national scaling and aligns with the adoption design section of the value case.

**Implementation (stage 3)**

Research articles in the implementation phase can be varied and contrasting, the conference proceeding include good cases of implementation which are useful to consider for ANIA. For example, 'Realist Evaluation of EPR Implementation at Airedale NHS Trust' is highly relevant to the implementation stage of the ANIA pathway. The article provided a detailed, context-sensitive analysis of how a complex digital innovation was introduced and embedded into NHS practice. Using a context–mechanism–outcome (CMO) framework, the study highlights key enablers, barriers, and adaptations made during rollout, offering valuable insights into project governance, stakeholder engagement, and risk mitigation. It also demonstrates how implementation progress can be monitored against milestones and how innovations transition into business-as-usual, aligning closely with ANIA's emphasis on best-practice project management and delivery assurance. A further case study can be found in 'Real-World Deployment of a ML Pipeline for Pressure Wounds Prediction'. The article outlines the use of MLOps to ensure reliable deployment, monitoring and updating of the model within hospital IT systems, which links to ANIA's emphasis on delivery assurance and risk mitigation.

**Benefits realisation (stage 4)**

Literature around the idea of benefits realisation can be sparse, therefore the articles that could relate to this topic for ANIA were welcoming to see. One such article 'Evaluation of FAIR Assessment Tools for Medical Data' focuses on ensuring that innovations deliver long-term value through high quality, reusable data. The FAIR principles: Findable, Accessible, Interoperable, and Reusable are essential for measuring and sustaining the benefits of digital health innovations. By comparing different FAIR assessment tools, the article provides practical guidance on how to evaluate whether the data generated by an innovation can support ongoing service improvement, research, and policymaking. This aligns with ANIA's goal of transitioning innovations to business-as-usual (BAU) while ensuring they continue to deliver measurable clinical, operational, and strategic benefits over time. Comparative insights into how different national health systems have sustained and scaled digital innovations over time can be found in "Digital Health System Adoption in Wales and the Netherlands'. The insights are a valuable resource for shaping ANIA's long-term impact and sustainability planning.

The MIE2025 conference offered a powerful lens through which to view the ANIA pathway. Expanding the idea not just as a structured process for innovation adoption, but as a potential embodiment of a Learning Health System. By aligning each stage of ANIA with the principles of continuous learning, stakeholder engagement, and data-driven decision-making, we can transform innovation adoption from a linear process into a dynamic, self-improving cycle. The integration of tools like large language models, structured evaluation frameworks, and real-world implementation insights strengthens ANIA's ability to bridge the gap between knowledge and practice. As we continue to refine and scale this approach, ANIA has the potential to become a model for how health systems can accelerate meaningful change; ensuring that innovations not only reach the front lines of care but also deliver sustained, measurable benefits for patients and the wider NHS.