

Patient Journeys in Health: Bringing AI Along for the Ride

Event Programme 2 February 2026

The Catalyst, 3 Science Square,
Newcastle Helix, Newcastle upon Tyne



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Welcome



Nick Reynolds



Mike Barnes

Co-lead investigators of AI-MULTIPLY



We're delighted to welcome you to **"Patient Journeys in Health: Bringing AI Along for the Ride"**, our end-of-project conference for **AI-MULTIPLY**. At today's event we will be highlighting the progress, insights, and impact achieved over the past three and a half years. Through our keynote speaker Prof Avan Sayer and a series of workshops, we also aim to place our work in the context of on-going research in multiple long-term conditions (MLTCs) and data science.

AI-MULTIPLY is funded by the **NIHR Artificial Intelligence for Multiple Long-Term Conditions (AIM) Programme**. Building on our initial Development Award, we secured a full NIHR Collaboration Award running from **September 2022 to March 2026**.

Our mission:

"Using the collective expertise of patients, clinicians, researchers, and artificial intelligence to improve care for people living with multiple health conditions and medicines."

Living with MLTCs and taking many medicines (polypharmacy) is common and linked to poorer health outcomes, reduced quality of life, and higher healthcare costs. Yet how these conditions and medicines interact remains poorly understood.

Our research uses AI to uncover these relationships and support better prevention, treatment, and decision-making, aligned with the NHS vision for future care. Through interdisciplinary teamwork, patient involvement, and innovative methods, we aim to transform care for people with complex health needs.

Finally, we look to the future, that the AIM programme marks the start of an era in which AI and data science can meaningfully improve the lives of people with MLTCs across diverse populations.



12:30 – 13:00 **Light Lunch and Registration**

13:00 – 13:05 **Welcome**
Nick Reynolds and Mike Barnes

13:05 – 13:10 **Introductory Remarks**
Frances Mair

13:10 – 13:35 **Keynote**
Avan Aihie Sayer
MLTC and the Health of the Nation: Why Research Collaboration Matters

13:35 – 14:05 **PPIE**
Olivia Grant, Victoria Bartle and Ceri Durham
The Patient Perspective on AI Research in Healthcare

14:05 – 14:40 **AI insights into Health Data**
Alisha Angdembe and Mike Barnes
Introducing a New Concept of Bursty Dynamics in Healthcare
Mike Barnes and Ceri Durham
An Intersectional Inequalities Scorecard: A Practical Framework for Equity-Focused Healthcare AI
Rafael Henkin
Polypharmacy Workbench: An Interactive Research Tool to Better Understand Polypharmacy

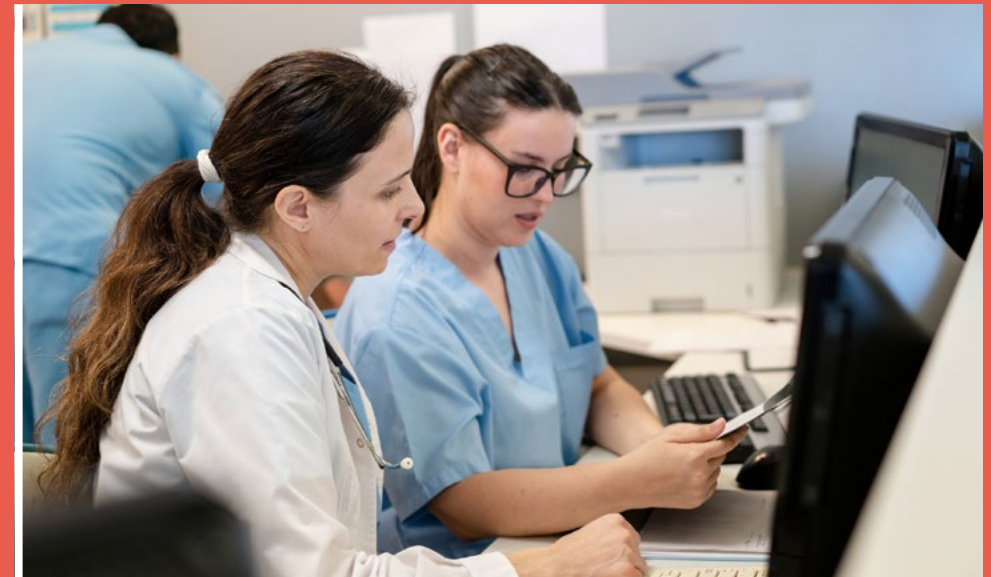
14:40 – 15:20 **Parallel Workshops**
Adam Todd and Anum Iqbal
Translation to Patient Benefit
Nick Reynolds and Paolo Missier
Data and Holistic Health
Claire Hills-Wilson and Fiona Cammack
Scaling Transformative PPIE
Duncan Reynolds
Interdisciplinarity and Capacity Building

15:20 – 15:45 **Mid-Afternoon Break and Refreshments**

15:45 – 16:10 **Workshop Feedback**
Adam Todd
Nick Reynolds
Paolo Missier
Claire Hills-Wilson
Duncan Reynolds

16:10 – 16:50 **Towards Clinical Translation**
Rebeem Hamad, Paolo Missier and Nick Reynolds
Readmission Prediction using Self-Supervised Learning
James Wason and Ellen Moss
Trial Emulation using Real-World Data to Bridge the Evidence Gap
Duncan Reynolds and Megan Clinch
Lurking, Soaking, Reflecting and Collaborating

16:50 – 17:00 **Closing Remarks**
Mario Moroso



Speakers



Nick Reynolds

Project Co-Lead

Professor of Dermatology and Director of Diagnostics at Newcastle University and a practising clinician at Newcastle Hospitals NHS Foundation Trust



Olivia Grant, OBE

PPIE Co-Lead and lay member co-applicant



Victoria Bartle

PPIE Co-Lead and PPIE Representative



Alisha Angdembe

Data Scientist and Researcher at the William Harvey Research Institute, Queen Mary University of London



Ceri Durham

PPIE Co-Lead and CEO at Social Action for Health, London



Rafael Henkin

Postdoctoral Researcher at Queen Mary University of London



Adam Todd

Professor of Pharmaceutical Public Health at Newcastle University



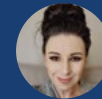
Anum Iqbal

Office of the Chief Pharmaceutical Officer, NHS England



Paolo Missier

Professor of Computer and Data Science at University of Birmingham



Fiona Cammack

PPIE Representative



Claire Hills-Wilson

Creative Methods Specialist and PPIE representative



Duncan Reynolds

Research Associate at Queen Mary University of London



Megan Clinch

Reader in Anthropology of Public Health at Queen Mary University of London



Rebeen Hamad

Research Associate in Health Data at Newcastle University



James Wason

Professor of Biostatistics at Newcastle University



Ellen Moss

Research Associate in Biostatistics at Newcastle University



Mike Barnes

Project Co-Lead

Professor of Bioinformatics and Director of the Centre for Translational Bioinformatics at Queen Mary University of London



Frances Mair

Norie Miller Professor of General Practice and Head of the School of Health and Wellbeing, College of Medical, Veterinary and Life Sciences, University of Glasgow, Chair of the AI-MULTIPLY Research Steering Group



Avan Aihie Sayer

Director NIHR Newcastle Biomedical Research Centre (BRC), William Leech Professor of Geriatric Medicine and BRC Theme Co-Lead for Ageing, Sarcopenia and Multimorbidity

Keynote

Avan Aihie Sayer



MLTC and the Health of the Nation: Why Research Collaboration Matters

Avan is William Leech Professor of Geriatric Medicine, Co-Lead of the **AGE Research Group** and Director of the **NIHR Newcastle Biomedical Research Centre (BRC)**. She is recognised internationally for her research on ageing, sarcopenia and multiple long-term conditions. She champions collaborative leadership, team science and capacity building in translational ageing research. She is an NIHR Senior Investigator and gave the **2024 Royal College of Physicians Harveian Oration**.

Avan co-chairs the **Multiple Long-Term Conditions Cross NIHR Collaboration (MLTC CNC)**. This was established in December 2022 and is hosted by Newcastle University in partnership with the University of Leicester. This innovative initiative aims to bring together NIHR translational, applied and policy research infrastructure for the first time to identify common research priorities, work together to tackle key questions and maximise impact in MLTC research.

Multiple long-term conditions (MLTC, also known as multimorbidity) have been defined by the Academy of Medical Sciences as the co-existence of two or more chronic physical, mental health or infectious disease conditions in a single person and this remains the most commonly used overarching definition. MLTC matter because they are common and costly both to the individual and to the health of the nation, and this has been recognised by their central position in two important 2025 government documents: the 10 Year Health Plan for England and the Life Sciences Sector Plan. MLTC research is starting to pick up pace with national funding initiatives such as the UKRI-NIHR Strategic Priorities Fund and the NIHR Artificial Intelligence for MLTC (AIM) Programme which supports AI-MULTIPLY. Looking ahead, there is the opportunity to bring together existing research expertise for collaboration and impact at scale, for example through the MLTC Cross-NIHR Collaboration, so that real progress can be made in transforming the lives of people living with MLTC.

The Patient Perspective on AI Research in Healthcare

Olivia Grant, Victoria Bartle and Ceri Durham (PPIE Co-Leads)



Created with AI, inspired by original artwork by Woven Ink and the SAfH art workshop participants

Olivia, Victoria and Ceri will share will share an overview of the Patient and Public Involvement and Engagement (PPIE) within AI-MULTIPLY. This has been a PPIE contributor led workstream which has exceeded expectations by creating and delivering innovative PPIE activities. These have been embraced, supported and enjoyed by the research team, the large PPIE group and external collaborators.

This presentation will cover:

- The plan for PPIE within the AI-MULTIPLY project.
- Devising and delivering the reality of the PPIE involvement.
- Using continual evaluation to make improvements.
- Tracking impact and sharing best practices.
- Integrating creative methods.
- Innovative solutions and autonomy.
- Ideas to improve PPIE in similar projects in the future.

AI Insights into Health Data

Introducing a New Concept of Bursty Dynamics in Healthcare

Mike Barnes and Alisha Angdembe

Traditionally, health risk is assessed by counting diagnoses or healthcare events. In this work, we asked a different question: **does the timing of health events matter as much as their number?** Inspired by research in fields such as earthquake science and cyber-crime detection, we applied the concept of Bursty Dynamics to healthcare records. Using UK primary care data from over 2 million patients, we examined the timing of events related to more than 200 long-term conditions (LTCs). Rather than steady, evenly spaced events, some patients showed “bursty” patterns, where multiple diagnoses or healthcare interactions occurred in rapid succession. These bursts may reflect periods when health is becoming unstable and problems cascade. We found clear and consistent differences in survival between patients with highly bursty event patterns and those with more regular histories. This association was especially strong in older adults. Conditions such as coronary heart disease, diabetes, anaemias, some cancers, and alcohol addiction were particularly likely to appear during these intense periods of activity. Across many LTCs, burstiness was strongly linked to poorer outcomes, including higher mortality.

These findings suggest that the temporal structure of healthcare events carries important clinical information. How events cluster over time can reveal risk signals that are not visible from simple counts of diagnoses alone. Bursty Dynamics may therefore offer a new way to identify patients at elevated risk using routine health records, helping clinicians prioritise monitoring and intervene earlier when health begins to deteriorate.

An Intersectional Inequalities Scorecard: A Practical Framework for Equity-Focused Healthcare AI

Mike Barnes and Ceri Durham

AI has great potential to improve healthcare, but when it is trained on data that reflect only a narrow segment of society, it risks reinforcing existing health inequalities. In healthcare, this problem is acute: AI can only learn from what is represented in the data, and many datasets under-represent groups defined by ethnicity, deprivation, gender, geography, or combinations of these factors. We have developed an Intersectional Inequalities Scorecard to help address this challenge. The scorecard provides a simple, practical framework that researchers can use at two critical stages of AI development. First, it enables teams to assess datasets before AI training, identifying which population groups are well represented, where gaps exist, and what limitations or mitigation strategies should be considered.

Second, it supports the development of inequality-aware AI models by guiding systematic evaluation of model performance across different communities and intersectional subgroups, rather than relying on average performance alone. The scorecard encourages equity to be designed into healthcare AI from the outset, rather than added retrospectively. It is shaped by the lived experience of patient and public contributors within the AI-MULTIPLY programme, whose insights helped identify blind spots and set priorities that might otherwise be overlooked. The result is a scalable, transparent tool that strengthens trust, supports fairer model development, and helps ensure healthcare AI benefits the full population it is intended to serve.

Polypharmacy Workbench: An Interactive Research Tool to Better Understand Polypharmacy

Rafael Henkin

Using prescribing and primary care data from the Clinical Practice Research Datalink (CPRD), we have developed a **Polypharmacy Workbench** to help understand how medicines are prescribed over time and how taking multiple medicines relates to people’s broader health needs. Drawing on GP records, the tool links long-term conditions, prescribing patterns, and health outcomes in a single, interactive framework. The Workbench allows researchers and clinicians to compare groups of patients who experience a specific outcome, such as a fall requiring hospital admission, with similar patients who do not.

Users can explore how age, ethnicity, deprivation, health conditions, and prescribed medicines differ between these groups. The tool also makes it possible to examine common combinations of medicines and to explore whether particular drugs, or patterns of polypharmacy, are associated with higher or lower risks of adverse outcomes. Importantly, the Workbench can highlight inequalities by showing whether certain outcomes or prescribing patterns disproportionately affect specific population groups. By making complex prescribing data easier to explore and interpret, the Polypharmacy Workbench can inform future research, support safer and more equitable prescribing, and help guide care planning for people living with multiple long-term conditions.



“The swirl is my timeline, the dots are my pills, I started with 1 and now I take 6” – created by a patient with MLTCs at one of the SAfH art workshops held in July 2023

Parallel Workshops

Workshop 1: Translation to Patient Benefit Workshop

Facilitated by Adam Todd with Anum Iqbal



Workshop 2: Data and Holistic Health

Facilitated by Nick Reynolds and Paolo Missier



Artificial intelligence (AI) is transforming industries worldwide, yet its potential in the NHS remains underutilised. As part of the AI-MULTIPLY project, focus groups with healthcare professionals highlighted key insights:

- Technology is an integral, though imperfect, part of routine clinical practice in the NHS; However, AI is rarely used in routine practice.
- Decision-support alerts (such as drug interactions) often lack nuance, leading to “alert fatigue” and are subsequently over-ridden without further consideration.
- Risk assessment for older patients with multiple long-term conditions relies heavily on clinical judgement and healthcare professionals’ own experiences and knowledge, with limited use of prediction tools.
- Professionals are open to AI but cautious – calling for systems that are transparent, accurate, integrated, and preserve clinical responsibility.

Building on these findings, this workshop will explore the following questions to consider further how AI can be effectively translated into routine healthcare for the benefit of patients, and we invite you to join us on this discussion.

What must fundamentally change for AI to move from being an impressive tool with significant potential to a trusted partner in healthcare?

- How do we assess effectiveness of AI in healthcare? What metrics should be used?
- How do we ensure AI adoption does not worsen health inequalities?
- What research should take place in the next five years?

The NHS and social care systems generate a vast wealth of health data, yet we are only beginning to unlock its full potential in shaping care at both an individual and population level. The COVID-19 pandemic sharply highlighted the value of linked, timely health data and demonstrated how integrated national datasets can accelerate research, guide public health decisions, and ultimately save lives.

Several major UK initiatives are now working to join up electronic health records securely and responsibly, including:

- **OpenSAFELY** – a secure analytics platform enabling researchers to run transparent, audited code on pseudonymised primary care records without removing data from NHS environments.
- **Secure Data Environments (SDEs)**, built on top of established Trusted Research Environments (TRE) technology, these are highly secure platforms designed to allow approved researchers to access linked health and care data safely while ensuring privacy and public trust.
- **Health Data Research (HDR) UK** has been commissioned to support the creation of a UK’s national Trusted Research Environment (TRE) network and ensure common technical and governance standards, interoperability between regional TREs, shared accreditation and training, and coordinated researcher access frameworks.

These initiatives are happening against the backdrop of the AI Opportunities Action Plan, and the AI for Science strategy paper,

published by the Department for Science, Innovation and Technology (DSIT) in January 2025, and November 2025, respectively. Notably, both identify Sovereign Data as one of the pillars that make AI-based science possible, and both include pledges to support the development, storage, curation (according to FAIR principles) and use of nationally critical datasets. This strategy includes the establishment of a National Data Library (NDL), and aligns with the announcement in April 2025 of the Health Data Research Service, backed by £600 million funding through the NIHR, to “enable world class R&D in medical research”.

These developments offer significant benefits but also raise important questions around risk, transparency, and public trust. Our PPIE group has played a central role in shaping our approach to accessing national and local datasets.

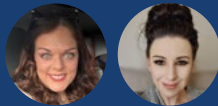
During this workshop we will consider:

- How can access to health data be streamlined across current initiatives to improve care and research?
- What are the key risks of accessing large-scale health data, and how can they be mitigated?
- What additional considerations arise when commercial organisations access health data?
- How should the public be kept informed about the use of health and social care data?

Parallel Workshops

Workshop 3: Scaling Transformative PPIE

Facilitated by Claire Hills-Wilson with Fiona Cammack



The PPIE that has been delivered within this project has resulted in recommendations for future projects, with ideas to incorporate into their work. The PPIE team want to hear views on how this could be achieved on a much larger scale.

During this workshop we will consider the following questions:

- Regular sessions were held where Early Career Researchers (ECRs) discussed work in progress with PPIE contributors. These sessions aimed to embed PPIE early in research decision-making while giving ECRs practical experience in delivering meaningful involvement activities. Both ECRs and PPIE contributors found the sessions valuable: ECRs developed confidence and skills in PPIE, and contributors were able to influence research decisions at an early stage. This model could benefit researchers with limited PPIE experience and strengthen the role of PPIE across projects. How can we best demonstrate the impact of these sessions and encourage wider adoption?
- PPIE representatives have been involved in areas of research, that were previously off-limits to patients e.g. paper design, data engineering and whiteboard meetings. How do we encourage and support researchers and PPIE professionals to include us in these conversations in other AI and big data projects?
- A recommendation from the PPIE evaluation is to have an effective and strong PPIE lead. How do we identify people who can or who already do this? How do we influence researchers to recruit and hire effective PPIE leads, especially for large projects? Is there a training/career route for PPIE contributors to develop into these roles? Is there an academic career pathway?

Thoughts, alternative opinions, ideas or potential routes to implementation for PPIE in research are all wanted and welcomed.

Workshop 4: Interdisciplinarity and Capacity Building

Facilitated by Duncan Reynolds



A central assumption of the NIHR call that funded AI-MULTIPLY was that bringing together clinicians, data scientists and social scientists will enable more comprehensive understandings of multiple long-term conditions.

To better understand how interdisciplinary work happens in practice, social scientists have worked as part of the AI-MULTIPLY team to help make the assumptions, commitments, and values of different disciplines and professionals explicit. We hope and expect that by clearly articulating what happens in practice we can influence other interdisciplinary AI health collaborations to work more smoothly together. This is guided by the aim that clear articulation of this work will inform guidance for future interdisciplinary AI-in-health collaborations.

In this workshop, we will consider the following questions:

- What do you see as the importance of interdisciplinary working?
- Which cross-cutting skills, literacies, techniques, etc help foster meaningful collaboration and capacity building among clinicians, data scientists, social scientists, and public partners?
- What incentives or structures are present, and/or missing, to sustain interdisciplinary work across NHS, academia, and industry?

Towards Clinical Translation

Readmission Prediction Using Self-Supervised Learning (SSL)

Rebeen Hamad, Paolo Missier and Nick Reynolds

Hospital readmissions, premature deaths, and long periods of hospitalisation, place major strain on patients and healthcare systems. Predicting these outcomes early could help clinicians and healthcare professionals intervene and improve care. Traditional prediction models rely on large amounts of manually labelled data, which is costly and often incomplete. These labels are used to teach the AI about the outcomes of interest (for example, whether someone was re-admitted to hospital within a specified period of time). Our research in people with multiple long-term conditions, introduces a new approach using self-supervised learning (SSL), a type of artificial intelligence that learns patterns from electronic health records without paying attention to the outcome of interest. By analysing diagnoses, medications, and clinical events, SSL creates a detailed picture of a patient's health record.

These learned representations are then used to predict clinical risks such as 30-day readmission, mortality, and extended hospital stays. By leveraging the rich information embedded within routine patient data, this method enhances prediction accuracy while offering a highly efficient alternative to label-intensive approaches. This improved predictive capability can support better clinical planning and personalized treatment decisions. Ultimately, SSL provides a scalable and data-efficient pathway to enhance risk prediction models, with the potential to improve patient outcomes and reduce systemic healthcare burdens.



Trial Emulation Using Real-World Data to Bridge the Evidence Gap

James Wason and Ellen Moss

People with multiple long-term conditions often take many medicines, and doctors need evidence to guide decisions such as when to start or stop treatments. Randomised clinical trials (RCTs) provide high-quality answers but are expensive, slow, and sometimes impractical. Increasingly, healthcare data collected during routine care offers an alternative. Our research uses a method called target-trial emulation, which mimics the design of an RCT using existing patient data. This approach allows us to ask important questions, such as whether stopping statins after long-term use is safe, without running a full trial. We carefully account for factors that could bias results, like differences in patient health. This method can provide faster, more inclusive evidence to improve care for people with complex health needs. Target-trial emulation is a promising way to turn real-world data into actionable insights for better treatment decisions.

Lurking, Soaking, Reflecting and Collaborating

Duncan Reynolds and Megan Clinch

AI is often seen as purely a technical endeavour but its success in healthcare depends on people working together. Our research explored how clinicians, data scientists, social scientists, and public contributors collaborate when designing AI tools for patients with multiple long-term conditions. We observed meetings, interviewed team members, and ran workshops to understand what makes these partnerships effective. We found that creating AI is not just about coding. Rather, it involves ongoing conversations about ethics, fairness, and how to explain complex models. Decisions such as which diseases to include or which errors to tolerate have real consequences for patients. By studying these social processes, we developed practical guidance for future projects to ensure AI is transparent, ethical, and shaped by diverse expertise. This work shows that successful healthcare AI requires both technical innovation and strong collaboration.

Further Information

Email the Project Team: AI.MULTIPLY@ncl.ac.uk

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We warmly thank all those who contributed to the AI-MULTIPLY project and the end of project event. In particular, we acknowledge the valuable insights provided by Chair Frances Mair, Keynote Avan Aihie Sayer and Journalist Jeremy Armstrong, as well as the support of the Lawnmowers Association, and the hard work of the Project Management team. Important data resources were made available through UK Biobank, CPRD and NENC Secure Data Environment. This project is funded by the NIHR AIM Programme (NIHR203982). The views expressed are those of the authors and not necessarily those of the NIHR or the Department of Health and Social Care.