Workshop report

UCL Futures Forum on Health Inequalities

The UCL Policy Impact Unit (PIU) and the UCL Institute of Healthcare Engineering (IHE) convened policy makers and academics on the 12th of September 2023 to participate in a 'Futures Forum on health inequalities'. This was the first in what we hope will be a series of Futures Forums: a series that has been designed to provide policymakers and researchers with a space to think about possible future scenarios, free from any barriers that might inhibit free thinking in day-to-day work.

Background

The UK faces stark health inequalities, and these have become more evident in the aftermath of the COVID-19 pandemic. Across some societal groups there is still a 20-year life expectancy gap which has remained virtually unchanged over many decades. Healthcare engineering and medical technologies have the potential to narrow this gap and help contribute towards the delivery of better outcomes for all. However, they also risk exacerbating existing inequalities if they fail to account for the diversity of people they are intended to serve, and the complexity of the systems in which they are deployed.

This report is relevant for policy makers and those developing future actions to tackle health inequalities, to anyone who is developing a new healthcare technology and also to the clinical workforce and those adopting tools to improve inequalities.

About the workshop and report

The workshop prompted participants to explore their hopes and fears for the future of health inequalities and the role that engineering and technology solutions might play in shaping possible futures.

We have summarised the insights from participants in this report, dividing them into three themes: People, Technology and Systems. Throughout the workshop participants had access to examples of UCL research to serve as inspiration for discussions. These examples are included as an annex to this report. Three speakers provided flash presentations at the beginning of the workshop, which set the scene on health inequalities, and these are also summarised at the end of the report.

Key points

People

- Digital literacy, which is related to trust in technology, is still quite low for many societal groups. Participants highlighted the importance of having **education programmes to improve public understanding of health technologies**, which recognize that there are in fact "multiple publics" have different understanding of technology and its role in healthcare.

- Current institutions are not structurally set up to include all groups and communities in strategy development and decision-making, including those that are traditionally underrepresented. Participants suggested that **inclusive policy making** in combination with transparent messaging about the use of health data can result in a boost of trust in institutions.

- Participants highlighted the importance of **keeping future generations engaged** in tackling health inequalities. New models that integrate health with libraries, leisure centres or other workspaces were mentioned as a good example to positively influence local economies, increase employment opportunities and address health inequalities by encouraging inclusive design.

Technology

- Not including a diverse set of communities in the research design and implementation process may propagate inequalities by focussing only on specific conditions whilst overlooking others. Participants reflected on the importance of adequately compensating members of the public **to incentivise a more diverse participation in research.**

- Participants reflected on the importance of defining what a successful outcome of the application of a specific technology is when tackling health inequalities and that **new technologies should follow clear accountability frameworks for development and implementation**, and that these operate in a continuous cycle.

- A final thought highlighted that although in the future there is a hope of achieving truly representative datasets that enable technology to work for all, there must also be a **conversation about understanding what limited datasets can offer if used with caution**.

Systems

- **The deployment of certain technologies is having a massive impact on the way that healthcare is delivered and organised**. Centralisation of services may lead to exclusion of certain communities and the introduction of virtual wards and other telemedicine approaches requires a much more active role for communities in order to deliver their full potential.

- Building up a more holistic view of health and taking a proactive stance may allow problems to be discovered early, leading to a future where prevention is the norm. However, there is a lack of data quality, interoperability, and appropriate systems to adequately address health inequalities. Shared **understanding is needed across sectors of how health-relevant data can be used to improve outcomes.**

- Although new models of collaboration across sectors are emerging, **effective collaboration across sectors** is still not the norm – and it is important to recognise **mixed incentives and create positive improvements in research, innovation and practice.**

People

Are we heading towards a future where all individuals - both those receiving healthcare and those providing it - understand the power of data and feel empowered to take ownership of their health? Or are we heading in a direction where increased mistrust in institutions and polarisation in society leads to more exclusion and deepening of the health inequalities gap?

Education about health data and technology is not one-size-fits-all

Digital literacy, which is related to trust in technology, is still quite low for many societal groups. For minoritized and seldom heard groups in particular, this can lead to a lack of trust and to people being naturally averse to the 'system', technological advances, or opting in to sharing data. Without trust, the delivery of innovations will be hampered, and trust needs to start with education and prioritisation of people first (not tech first). Participants highlighted the importance of having education programmes to improve public understanding of health technologies, including artificial intelligence (AI). Current initiatives ignore the vast diversity of the public and that in fact "multiple publics" have a different understanding of technology and its role in healthcare.

The health and care workforce's attitudes and understanding are also important in terms of the use of data and more advanced technologies[1]. In particular for the application of AI tools, there is a risk of a reduction of knowledge because of overreliance on tech. Health workers should also be better prepared to discuss openly with patients the implications of sharing their data. Health and care workers are one of the most trusted groups in society and so have a key role to play in addressing some of the issues around public attitudes mentioned earlier. Such training can enable health professionals to manage the diversity of the public[2], eliminating bias and microaggression and communicating to all individuals in a language and format (and in a place where they live their digital lives) they can understand and engage with[3].

Promoting agency and identifying the gatekeepers for health data

Clear communication, appropriate legal frameworks (including of redress), and actions to reach all members of different communities, will foster futures where there is more public trust. Cascading messages about medicine and healthcare in plain language is important, as currently too little information about healthcare and medicines is understood by the average person. Unfortunately, the reasons why personal data is collected and what it is being used for are not always clear. There may be a scenario where tech companies and the media have more presence in terms of providing health messages, and if these trends are combined with a reduction in social/face to face contact in healthcare, it risks leaving people vulnerable to misinformation, and to a widespread public mistrust about healthcare messaging.

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[1] Research highlight: understanding how new medical technology is used by its intended user within the context of their work and then providing iterative design suggestions to improve usability. (For more info see ANNEX 3.1)

2 Research highlight: Fertility care and reproductive medicine, including investigating at the 3D structure of super early human embryos in IVF treatment, attempting to reduce the intrusiveness of fertility care for patients and improving fertility care for LGBTQ+ people and amplifying the voices of LGBTQ+ patients. (For more info see ANNEX 3.2)

[3] Research highlight: evaluation of ethnic inequalities within the health and care workforce, in the selection, education and training of doctors, as well as in the experiences and outcomes throughout COVID-19. (For more info see ANNEX 3.3)

There are also positive instances of healthcare messaging, for example, the Zoe Health App was used successfully used during the pandemic to collect self-reported symptoms from and open questions from the wider population (despite not being fully representative). This empowered the public to discuss and share insights regarding their health which were effectively interesting policy insights[4].

The future of data also brings concerns about privacy in terms of recording new information, and every use needs to be transparent so that people are confident that their data isn't going to be misused. Companies which are using data must be held to account within a legal framework that holds data collectors to a high standard. Moreover, there needs to be acknowledgment by developers and industry about the negative impacts of technologies and that there is more access to systems of redress.

Participants suggested that a way forward and good future would be one where all groups and communities are included in strategy development and decision-making, including those that are traditionally underrepresented, such as the traveller community. However, current institutions are not structurally set up to deliver this ambition, with entrenched modes of governance and cultural acceptance of status quo. If people are involved and feel consulted, especially in digital healthcare, there may be a boost of trust in institutions.

Keeping future generations engaged

It's important that the focus on risks and fears about the future does not disenfranchise younger people, especially future generations of engineers and scientists, where it is important to maintain messaging that their work has the potential to change the world for the better. Therefore, it is very important for young people to have the opportunity to find their voice at schools, regardless of their background and to invest early on promoting healthy lifestyles. This means helping young people realise that they hold the power to take positive choices, but also to help others in the community to do so.

For example, the intersection between civil engineering, urban planning and health outcomes is an area reflected in UCL current research, and an area that offers significant opportunities to find new ways of allowing individuals to manage their own health. Other initiatives such as "Health on the High Street", which makes use of empty high street units that are repurposed as health facilities or wellbeing hubs, are also a good way of engaging many generations at the same time. The combination of these hubs with libraries, leisure centres or other workspaces can positively influence local economies, increase employment opportunities and address health inequalities by encouraging inclusive design. The challenge is that these types of initiatives have not been scaled far or fast enough, and there is insufficient evidence on how to sustain resulting behavioural changes and how incentives work differently in different populations.

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[4] https://www.gov.uk/government/publications/technical-report-on-the-covid-19-pandemic-in-the-uk/chapter-4-situational-awareness-analysis-and-assessment

Technology

In the future, will technology always be designed and developed with the best interest of patients and the public in mind? Can research act as a true vehicle of change where everyone helps shape important societal problems to solve? Or are we heading towards a future where technology and data drive health outcomes and health planning, rather than individual health needs? A future where people and their data are seen as commodities, the uses of technology are not transparent and there is a risk of surveillance of historically marginalised groups where tech developers become all powerful? In this section, we summarise participants views on the development of research and technology more widely.

Design

Researchers and technology developers sometimes lack awareness of how biases can be perpetuated through the tools and solutions they create. One way to address this issue in the future is to develop research with and for communities, whilst maximising the impact technologies may have in people's lives. Investing in a user-centred design and an open communication between research (tech) community and the general public, especially people with living conditions and lived experience (inclusive research representatives)[5]. These actions will also help to address issues of trust covered in the previous section.

Not doing this may lead to interventions that do not learn from and adapt to the evidence-base. Not including a diverse set of communities in the research, design and implementation process may mean that there are self-selecting participants for research, and that inequalities in technology development are propagated by focussing only on specific conditions and overlooking others. Participants reflected on the importance of offering financially compensation for time of (pay) under-represented participants and that other incentives to participate in research can be proposed.

Embed considerations about health inequalities in the way that technology is evaluated

Participants hoped that new technologies will follow clear accountability frameworks for development and implementation, and that these operate in a continuous cycle. An example is the proliferation of commercial routes outside of the NHS to get health checks. If patients get inaccurate test results as a result of these commercial routes, there are currently no accountability frameworks in place for the public to make claims on that commercial provider. Moreover, there is a hope that researchers and developers will have a better understanding of metrics and alignment with what policy makers need; and that the technology being developed is evaluated with a 'full' range of users, including across race, ethnicity, socio-economic background and location. For example, service provision accounts for the different impact of treatments on different population groups based on their existing health conditions. In this more positive view of the future, tackling health inequalities is built into measures of success for new health technologies.

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[5] Research highlight: Developing person-centred wellbeing engagement methods to support lived experiences for healthy lifestyles. (For more info see ANNEX 3.4)

However, creating these frameworks is not trivial, nor is determining the impact of a new technology on health inequalities and how different technologies impact different groups. Evaluation of technology should be supported by continued innovation, where the wider community can be consulted and question what is being developed and why[6]. Participants hoped for a future where technologies are fit for purpose, where technology is seen as an enabler to provide access and there is appropriate reflection about whether additional technology is really needed. An important part of this process will also be to define successful outcomes in terms of the application of a specific technology, and what that means in terms of reducing health inequalities. Processes for the evaluation of technology would therefore influence how technology is developed and applied to reduce health inequalities.

Can biased data still be useful if adopted safely?

There are many lessons to be learned from the adoption of standards for what a good dataset looks like to achieving more rigorous data for research in the future. Current clinical data is not very clean and representative so AI that relies on this data might not always work well in real world settings, making mistakes and perpetuating bias built into algorithms[7]. These biases can translate into less effective decisions for triaging treatment than humans, either by failing to diagnose or recommending excessive diagnosis and treatment of disease.

The "Standing Together" initiative, a Patient and Public Involvement (PPI) group that is fully voluntary, aims to challenge individual and team assumptions connected to data and technology, whilst also addressing more technical and managerial aspects, such as how systems can facilitate data sharing and improve data quality. In the meantime, as we hope for a future where most tech developed will use perfectly curated and representative datasets (example diverse data initiative with genomics), it is important to recognise that there is still something to be gained from biased datasets. An acceptable outcome can be one where data looks worse before it looks better.

Changing the narrative about what success looks like and engaging in conversation to evaluate the perception of what makes a dataset valuable is important. The conversation should not just be about eliminating biases in data, but also about understanding what limited datasets can offer us and how we can use them with caution. Furthermore, it is important to move beyond purely using checklists and considering the context and specific subjective nature of a particular community / disease. This approach will be very important to ask uncomfortable questions about assumptions about data that are important to unpack when considering the social aspects of its use.

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[6] Research highlight: Developing transparent and reproducible AI innovations for Healthcare and Surgical Sciences using state-of-the-art software and hardware technologies, including open-source software tools that can be used and accessed by anyone anywhere). (For more info see ANNEX 3.5)

[7] Research highlight: sing MRI computational methods for diagnosing and characterizing the brain and developing AI tools for use in patients with tumours, dementia and epilepsy. (For more info see ANNEX 3.6)

Systems

There is a risk of technology being overly emphasised as the solution to current pressures on the healthcare system, in a way that means we make insufficient progress on other necessary reforms (including funding and workforce reforms). Furthermore, tackling inequalities goes beyond addressing the provision of health services. In the future, will we able to leverage the power of data social innovation to not only treat, but prevent disease and unnecessary loss of live? Will the systems of the future elevate the role of social innovation to enable a holistic view of health? Or will we fail to set up infrastructures to work collaboratively across different sectors of society and risk slowing down the pace of technology, innovation and of its benefits? And as a result, fail to provide access to technology to all that need it? This section summarises participants hopes and fears regarding the structure and ways of working of the systems that underlie health provision.

Abundant technology which serves the few vs technology for all if and when it is needed

Participants hoped for a future where health services are available to all irrespective of background, personal characteristics or positions in society, employment status, ability to meaningfully engage in decision-making/to advocate, health status, and geographical location[8]. However, as it stands, access to healthcare technology in the UK can be seen as a postcode lottery, as regional variances continue to be entrenched. The deployment of certain technologies (such as specialised surgical robots) is having a massive impact on the way that healthcare is delivered and organised, including in the home with the introduction of virtual wards and other telemedicine approaches[9]. Another example is the use of MRI and CT scans in hospitals. Participants highlighted one study that reported that rather than putting in place new innovative MRI and CT scanners in hospital, it is first needed to address an unequal provision of existing scanners. Overly centralised means of accessing population need may be less adept at addressing these kinds of imbalances.

In addition, if technologies rely on tools that not everyone has (e.g. a smartphone) there is a risk that inequalities are exacerbated. Moreover, participants reflected on the possibility that access to healthcare becomes restricted for certain communities – especially those who have fewer opportunities to pay for services outside of the NHS, like genetic testing. If this becomes a significant trend, there will start to be a further demand for private healthcare solutions and the time may come where an unbreakable vicious cycle will lead to a two-tier health system. As the wealthiest access private screening and then come back into the NHS and effectively are able to queue jump as they have a diagnosis to work with, we may reach the point of no return where inequalities can only get worse.

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[8] Research highlight: adaptive radiotherapy, which adjusts the planned treatment for cancer, adjusting patient's anatomy changes to what was designed at the planning stage, when the decision about which parts of the patient's body should be treated and which should avoid treatment. During the treatment patients are scanned again by devices integrated in the radiotherapy delivery and Artificial Intelligence methods are used to improve the quality of those scans. (For more info see ANNEX 3.7)

[9] Research highlight: creating and testing virtual reality and robotic systems for patients who suffer from short- and long-term pain conditions. Currently the system is a clinic-based system but there are plans to develop a home-based system. (For more info see ANNEX 3.8)

Prevention and holistic health / invisible boundaries and poor data

Participants hoped for a future where health systems are joined up but designed around local needs. This will require not just increasing availability of access in itself (though this is also important) but also shifting the focus towards screening and prevention. Building up a more holistic view of someone's health and taking a proactive stance may allow health problems to be discovered early and bring a future where prevention is given as much focus as treatment and people will stop dying of preventable disease[10,11]. Health provision in itself accounts for only 20% impact on outcomes. There are many other sources of data and information that could provide invaluable insights about someone's health, e.g. from social care, indoor environmental quality data for housing or even shopping habits[12]. For example, there could be better recognition of the interconnectedness of demographic change (an ageing population), employment, mental health issues, drug and substance abuse, and the patients that will frequent the ICU.

There are examples of this approach already, for example Japan, where there are recurring health checks for the whole population. Participants also felt that this sort of intervention focussed on population health can help build trust in the healthcare system and put in place actions that can deter adverse health outcomes. However, these interventions should promote a holistic view on health, for example, education provision that provides healthy school meals, exercise facilities, nutrition advice, and health interventions for marginalised communities. In this way, the complexity of health inequalities is recognised in government, and we can capitalise on meaningful engagement with other sectors that work with health (for example to improve regulation of the food industry).

Participants recognised that it will be difficult to have a holistic view of health in the current fiscal environment, where austerity contributes to the government focus on quick and technology-focussed interventions. There is lack of data quality, interoperability, and systems to adequately address health inequalities, and we do not understand how health-relevant data can be collected from different providers to improve health outcomes. We need good quality, local and real time data, in addition to methods to integrate it in a way to support Integrated Care Systems decision making, for example. Technology will succeed in addressing health inequalities only if implemented alongside and in support of wider system improvements.

Poor collaboration and breaking down silos vs efficient allocation of resources

Although new models of collaboration across sectors are emerging, further work is needed to develop effective methods of engagement between academia, national and local government, the NHS, patient groups, commercial companies and third sector organisations. It is important for those fostering

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[10] Research highlight: personalising the prostate cancer pathway, which includes developing new MRI pathways to offer men in the population a screening test for prostate cancer, as well as developing new MRI-led ways to monitor or treat prostate cancer. (For more info see ANNEX 3.9)

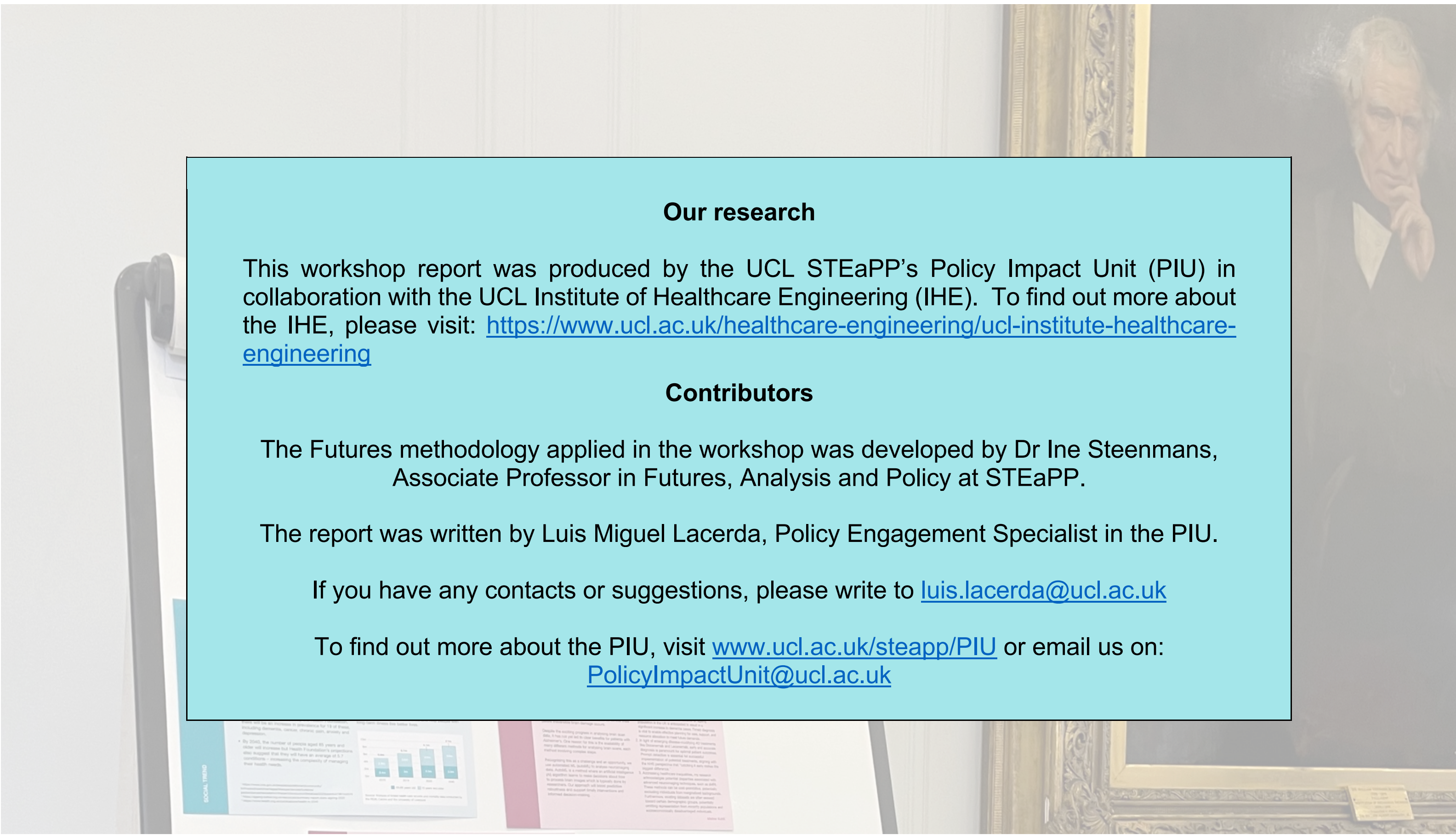
[11] Research highlight: using artificial intelligence algorithms to automatically process brain images of patients with Alzheimer's. Diagnosing and monitoring Alzheimer's disease in its early stages is very important to be able to identify appropriate candidates for clinical trials before irreversible brain damage occurs. (For more info see ANNEX 3.10)

[12] Research highlight: Developing a digital smell training programme that can help recover smell function, by taking a holistic, user-centred, built environment approach as the first step towards the creation of a new smell care culture and policy framework. (For more info see ANNEX 3.11)

engagement to consider mixed incentives and create positive improvements in research, innovation and practice. When there are successful examples, there can remain poor understanding of how to sustain projects/partnerships/collaborations in the long-term and there are benefits of having accelerator sites focussed on rapid implementation that builds on past lessons (for example COVID-19 vaccination campaign).

Improved data would be one of the main goals of increased cross-sector collaboration. There are existing examples of rich and valuable data, e.g. patient ethnography/longitudinal studies, but often this kind of data is held by big pharma companies, rather than being widely available. The UK also lacks structures to implement solutions and data systems cannot be scaled: data quality, systems and interoperability are not good enough to scale and roll out interventions. Many solutions are incubated, but not rolled out. Solutions also tend to operate as black boxes, where there is a lack of understanding of what the process entails and how different population groups might be impacted. This may lead to a risk that health professionals don't feel confident to monitor the application of specific technologies and slow down delivery.

Better engagement and connection between different sectors could unleash data to support the ability to understand the drivers behind individual health that exist in different communities and individuals. This would create a strong foundation for the development and implementation of new technologies.



Our research

This workshop report was produced by the UCL STEaPP's Policy Impact Unit (PIU) in collaboration with the UCL Institute of Healthcare Engineering (IHE). To find out more about the IHE, please visit: https://www.ucl.ac.uk/healthcare-engineering/ucl-institute-healthcare-engineering

Contributors

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To find out more about the PIU, visit www.ucl.ac.uk/steapp/PIU or email us on: PolicyImpactUnit@ucl.ac.uk

ANNEX 1: Participant list

- Adam Szmul, Postdoctoral researcher, UCL
- Alice Mortlock, Director of Strategy & Operations (UCL Office for Vice Provost for Health)
- Anna Studman, Senior Researcher, Ada Lovelace Institute
- Aoife Molloy, Senior Clinical Advisor, NHS England
- Ashley George, Visiting Professor Digital Transformation, UCL
- Ava Fatah, Professor of Media Architecture and Urban Digital Interaction, UCL
- Caroline Moore, NIHR Research Professor and Head of Urology, UCL
- Charles Lowe, CEO, Digital Health and Care Alliance
- Chloe He, Postgraduate Teaching Assistant, UCL
- Christina Madla Angeles, UCLB, UCL
- Clare Elwell, Professor of Medical Physics (and Vice-Dean), UCL
- Ellen Coughlan, Programme Manager, Health Foundation
- Emma Cowan, Graduate, NHS England
- Ilse Bosch, Deputy Director, NHS Confederation
- Jeremy Opie, Postdoctoral researcher, UCL
- Katherine Woolf, Professor of Medical Education Research, UCL
- Leila Varley, Strategy Manager, British Heart Foundation
- Maitrei Kohli, Research Fellow in Machine Learning Tools for Huntingdon's Disease, UCL
- Marzena Nieroda, Lecturer in Marketing and Commercialisation in Healthcare, UCL
- Matthew Grech-Sollars, Associate Professor in Quantitative Neuroradiology, UCL
- Melanie Smallman, Associate Professor, UCL
- Michelle Reeves, Head of Strategy, Greater London Authority
- Miguel Xochicale, Research Software Developer, UCL
- Paul Allen, Head of Integrated Commissioning, NHS (North London ICS)
- Peter Snow, Lecturer (Teaching) in Minimally Invasive Surgery, UCL
- Rebecca Shipley, Professor of Healthcare Engineering, UCL
- Richard Sloggett, Founder and director, Future Health
- Rob Coster, Strategy and Policy Lead, Virtual Wards, NHS England
- Shania Pande, Policy officer, The Physiological Society
- Yohanna Salberg, Specialist, Health and Social Care Committee

ANNEX 2: Description of each flash presentation

Melanie Smallman – Associate Professor, UCL Department of Science & Technology Studies

“Health Inequalities: Why technology might be the problem not the solution”

Technology (such as Artificial Intelligence) is seen as a tool for improving health, but it also shapes society and health services in specific ways. For example, expensive surgical robots result in a centralised healthcare system that limits access across population groups and different geographical regions, without significant clinical benefits. Current ethical evaluations of health technologies fail to account for these ‘sociological’ effects, and as a result, decisions that are usually subject to democratic scrutiny get hidden within technical decisions. If we want to prevent technology exacerbating inequalities, we need to think carefully about the ethics of technologies at different scales – from individuals, to institutions and society as whole.

Richard Sloggett – Director at Future Health

“Health inequalities and technology – the challenge facing politicians”

It is important to recognise that there is a challenge in interconnecting the technology, government and health inequalities agendas as these all move at different speeds. Technology is moving quickly. UK politicians work on five-year electoral cycles. Health inequalities take many years to tackle. On top of that, it is challenging to align political policy priorities to the main drivers of health inequalities given the often-fragmented nature of central Government policymaking. A possible solution is to develop a cross-governmental model and operating framework that outlines the ambition in the long-term, whilst setting concrete targets and accountability mechanisms in place in the short-term to stay on track. The long-term ambition should reflect the current and future health needs of the population, particularly tackling deprivation and the growing challenge of multi-morbidity. It is important to recognise that tackling health inequalities will not primarily deliver short term returns on investment, but longer-term payback in various health, social and economic ways.

Aoife Molloy - Senior Clinical Advisor, National Healthcare Inequalities Improvement Programme NHS England

“Reducing healthcare inequalities: CORE20PLUS5 programme”

NHS England has been trying a new approach to support local integrated care systems (ICSs), in particular to improve access to innovative health technologies and medicines, in collaboration with local communities. As a complement to this approach, it has deployed funding to 38 ICSs to accelerate innovation in healthcare inequalities and also has set up 7 ICS accelerator sites which focus on sharing good practices across ICSs and rapid implementation that builds on lessons from the COVID-19 vaccination campaign addressing key priority areas. NHS has an important role to play, accounting for roughly 20% impact of health outcomes, and despite having several technological advancements that can improve health outcomes, there is still unwarranted variation in access to conventional treatments and diagnostics in the most deprived areas and in some minority ethnic communities. Realising good outcomes for all will therefore rely on fostering an equitable innovation system and there are quick wins we can undertake to achieve that.

ANNEX 3.1

Perceptions and feedback about the use of medical technologies by its intended users

What is my research about?

I conduct human factors research, which entails understanding how new medical technology is used by its intended users within the context of their work and then providing iterative design suggestions to improve usability. This will help ensure the user is able to perform the task effectively, efficiently, and safely whilst the device is easy to learn to use and easy to remember how to use (all while providing a good user experience so the users will want to use the new technology).

Are there links to health inequalities?

Human factors research has the reach to engage with users about their needs to develop and design assistive healthcare technology to support clinical decision-making processes. Currently, a lot of healthcare technology is designed with clinical teams that are already associated with research groups and exclude smaller clinical staff in the design process, which may result in future technology not being suitable for their clinical scenarios. My research looks to ensure that all healthcare technology is designed and developed by a wider scope of clinical professionals so that it can be implemented beyond large-scale hospitals.

Jeremy Opie

ANNEX 3.2

Engineering and imaging methods to explore fertility care and reproductive medicine

What is my research about?

My research is in the general area of fertility care / reproductive medicine.

1. Investigating at the 3D structure of super early human embryos in IVF treatment so we can pick the one most likely to lead to healthy pregnancy (hence lowering financial + emotional cost of treatment) [@ UCL WEISS]
2. Investigating the link between embryo development patterns and genetics [@ UCL WEISS / Women's Health]
3. Figuring out how to reduce the intrusiveness of fertility care for patients (e.g. developing UK's first at-home transvaginal ultrasonography service, reliable at-home semen analysis) [@ Apricity Fertility]
4. Improving fertility care for LGBTQ+ people and amplifying the voices of LGBTQ+ patients [@ UCL WEISS and Apricity Fertility]

I'm also working with a couple of researchers around UCL + industry to set up a trans healthcare innovation network.

Are there links to health inequalities?

Significant inequalities exist across reproductive healthcare encompassing various factors such as geographic location, sex, gender, economic status, and race. My primary focus in this field lies within the LGBTQ+ fertility space, which is relatively specialized due to the prevailing cisheteronormative nature of the field.

Currently, my work centres around gathering experiences and perspectives from LGBTQ+ individuals, including both patients and those contemplating treatment options. These insights serve as a foundation for developing more inclusive and tailored care pathways that can better cater to the needs of this patient population.

Moreover, the establishment of a trans healthcare innovation network could offer valuable expertise on transgender healthcare. Once operational, this network could serve as a valuable resource for policymakers, providing them with valuable insights and recommendations to address the specific healthcare needs of transgender individuals.

Chloe He

ANNEX 3.3

Investigating inequalities within the health and social care workforce

What is my research about?

My work focuses on inequalities within the health and social care workforce. This includes ethnic inequalities in the selection, education and training of doctors, as well as ethnic inequalities in the experiences and outcomes of healthcare workers throughout the pandemic and beyond.

Are there links to health inequalities?

Informing policy on improving experiences and outcomes for the healthcare workforce, which is extremely diverse in terms of ethnicity and nationality. For example, our most recent publication in the Lancet (August 2023) shows a link between staff leaving the healthcare workforce and their experiences of discrimination and feeling undervalued: Discrimination, feeling undervalued, and health-care workforce attrition: an analysis from the UK-REACH study – ScienceDirect.

Katherine Woolf

ANNEX 3.4

User-centred approaches to enhance positive social impact in a healthcare context

What is my research about?

My research aims to develop a participatory collaborative framework and online toolkit to mobilise all stakeholders to collaboratively support lived experiences for healthy lifestyles.

Lifestyle is a factor that needs to be addressed at national population level, as it could be a root cause for increased ill health, leading to poor quality of life and shortened life span for those groups that live in deprived areas and on low income.

My research aims to address root causes of health inequalities grounded in community settings where lifestyles are formed. Through an in-depth cultural and community insight and design approaches, this project will develop person-centred wellbeing engagement methods to support lived experiences for healthy lifestyles. It will identify all stakeholders contributing to lived experiences and develop a participatory collaborative framework and toolkit to mobilise all stakeholders to collaboratively support lived experiences for healthy lifestyles.

Are there links to health inequalities?

Unlike the existing solutions that provide support predominantly with health requirements in mind, this tool will personalise support in consideration of place environmental, cultural, social, and natural factors that could support communities and help reduce health inequalities. It will support policy makers in enabling local authorities to facilitate community wellbeing and mental health resilience.

Developing new community engagement methods that are people-centred relies on technology and identifying and mobilising the relevant stakeholders could be a way to support digital skill building and healthcare education among communities. Focusing on improving lifestyles could mobilise the prevention approaches that the UK health system needs.

If this type of approaches could be supported by policy makers, this approach would have better chances of success and the burden or poor health could be lifted from some of the most disadvantaged groups.

Marzena Nieroda

ANNEX 3.5

Transparent and reproducible AI innovations for Healthcare and Surgical Sciences

What is my research about?

The aim of my research is to develop transparent and reproducible AI innovations for Healthcare and Surgical Sciences using the state-of-the-art software and hardware technologies.

To this end, I am developing open-source software tools that can be used and accessed by anyone anywhere with the purpose of not only impacting students, engineers, clinicians, industry stakeholders and academics but also contributing to the creation of guidelines for clinical translation of AI-based medical devices and guidelines to appropriately balance individual and institutional intellectual property of AI innovations.

Similarly, I am proud to share, as part of this summary, my most recent collaborative work available at the following links. The resources include code, open-source data, demo-data, Python-based libraries and one workshop with renowned speakers on open-source software for surgical technologies:
https://github.com/budai4medtech/midl2023,
https://github.com/budai4medtech/xfetus,
https://github.com/mxochicale/rami-icra2023,
https://github.com/mxochicale/rtt4ssa, and
https://github.com/oss-for-surgtech/workshop-hamlyn2023.

Are there links to health inequalities?

Adoption of AI technologies in software and hardware requires a continuous interaction among researchers, industry, clinicians, users and policy makers to integral and transparent development of AI innovations to be translated to the clinic.

My work on open-source technologies is addressing how to develop technology that impacts not only the clinic but also how we train the best engineers and scientist to address issues on (a) scarcity of data to address new diseases, (b) creating of guidelines to clinical translate AI tech, (c) and ensuring transparency, validation, reproducibility, and integrity of AI pipelines.

I picture three challenges for the future: (a) the creation of pathways for more transparent, reproducible and open-source pipelines for AI innovations; (b) the creation of appropriate funding schemes to incentivise the improvement of research transparency, reproducibility, replicability, and integrity; and (c) how to cultivate, attract and retain talented individuals who create AI innovations that impact everyone.

Miguel Xochicale

ANNEX 3.6

Clinical translation of MRI and Artificial Intelligence tools to decrease the variability in the interpretation of medical images

What is my research about?

I develop MRI computational methods for use in diagnosing, characterizing or following up patients, mainly with brain tumours but also developing AI tools for use in patients with dementia and epilepsy. Part of my role is around setting up internal policies within the department for the clinical implementation of computational tools.

One of my current projects is focused around using AI based methods for assessing the volume of a region of the brain known as the hippocampus, which is particularly affected in patients with epilepsy, but also in patients with dementia. In a separate project I am investigating AI based methods for creating synthetic contrast-based MR images for use in patients with brain tumours and multiple sclerosis.

By using such tools, we can help radiologists with their diagnosis and characterisation of disease by providing reliable quantitative measures and therefore decrease the variability that exists in radiological interpretation of images.

Are there links to health inequalities?

With reference to the project in epilepsy and dementia, by providing quantitative data to Radiologists, we'll reduce the variability that exists between Radiologists. This will address inequalities between patients whose images are reported within research-based hospitals with expertise in the disease vs local hospitals which may not have the same expertise.

Gadolinium based contrast agents are used routinely to MRI patients. They however can present an MR safety issue, particularly in pregnant patients, patients with renal failure and who have severe allergies. In each case contrast agents are contra-indicated unless absolutely necessary, which may lead to diagnostic healthcare inequality. Deep learning technologies to synthesize contrast enhancement have been developed and these could help address the inequalities by providing AI generated contrast-based images from the non-contrast MR images. Therefore, patients who are unable to receive contrast would be able to still have a diagnosis based on the correct set of images.

Matthew Grech Sollars

ANNEX 3.7

Adapting radiotherapy planned treatment to the patient's anatomy changes with artificial intelligence

What is my research about?

My main field of interest is how to help people suffering from cancer, which is one of the leading causes of death in the UK and worldwide. One of the most used methods of treating cancers is radiotherapy, which uses high energy beams to destroy cancer cells.

Before the treatment, the patient's body is scanned for radiotherapy planning to determine which parts of the patient's body should be treated and which should avoid treatment.

I work on adaptive radiotherapy, which adjusts the planned treatment to the patient's any anatomy changes which have happened since the planning stage. During the treatment the patients are scanned again by devices integrated in the radiotherapy delivery devices.

We use Artificial Intelligence methods to improve the quality of those scans. With the improved quality of the images the radiotherapy plan could be adjusted for the patient's anatomy changes while they are already on the treatment bed.

Are there links to health inequalities?

AI methods in radiotherapy but also in broader healthcare services create a great opportunity to address inequalities and exclusions. One of the most important is the access to the highest possible healthcare services around the country. The same method, developed on the best available data and evaluated by the experts in the field, can be deployed in every hospital around the country, making healthcare services equal for everyone.

I envision that several years from now, doctors around the country would have access to AI methods to assist them in clinical decision making, saving time and helping patients to get the best available healthcare, no matter where they live.

There are challenges to be addressed, such as access and management of the data or regulating AI. We need to work hand in hand to make sure that the methodology that we as researchers develop can be deployable in our healthcare environment.

Adam Szmul

ANNEX 3.8

Virtual reality and robotic tools to manage short- and long-term pain conditions

What is my research about?

Most of my work involves creating and testing virtual reality and robotic systems for patients who suffer from short- and long-term pain conditions. Currently the system is a clinic based system but we are looking at developing a home based system.

Are there links to health inequalities?

Moving from a clinical based system to a home base system requires significant planning, however could lead to benefits in terms of reducing hospital visits, freeing up time for clinical professionals to work with more vulnerable patients etc. Lowering the cost of such a system could enable those not just in the UK to benefit from high quality rehabilitation and pain relief but those from low/middle income countries.

Peter Snow

ANNEX 3.9

Using MRI to manage prostate cancer – from diagnosis to treatment

What is my research about?

I work on personalising the prostate cancer pathway and am currently funded as an NIHR research professor to do this. This includes developing new MRI pathways to offer men in the population a screening test for prostate cancer, as well as developing new MRI-led ways to monitor or treat prostate cancer.

Are there links to health inequalities?

We know that black men have twice the risk of prostate cancer as men of other ethnicities in the UK, and that using traditional screening invitations they are less likely to come forward for screening. We also know that there is geographical inequity across the UK in prostate cancer testing and treatment.

We are keen to address this be harnessing approaches to modern screening that would be accessible and appealing to men at highest risk of prostate cancer.

I am currently doing a day a week secondment to DHSC to improve my understanding of the links between research and healthcare policy, as part of my NIHR professorship.

Caroline Moore

ANNEX 3.10

Leveraging the power of artificial intelligence to manage Alzheimer’s disease

What is my research about?

Diagnosing and monitoring Alzheimer’s disease in its early stages is extremely important because it allows for better care, effective treatment planning, and the ability to identify appropriate candidates for clinical trials before irreversible brain damage occurs.

Despite the exciting progress in analysing brain scan data, it has not yet led to clear benefits for patients with Alzheimer’s. One reason for this is the availability of many different methods for analysing brain scans, each method involving complex steps.

Recognising this as a challenge and an opportunity, we use automated ML (autoML) to analyse neuroimaging data. AutoML is a method where an artificial intelligence (AI) algorithm learns to make decisions about how to process brain images which is typically done by researchers. Our approach will boost prediction robustness and support timely interventions and informed decision-making.

Are there links to health inequalities?

My research offers substantial relevance to policymakers for several reasons:

1. The ongoing demographic shift towards an ageing population in the UK is anticipated to result in a significant increase in dementia cases. Timely diagnosis is vital to enable effective planning for care, support, and resource allocation to meet future demands.
2. In light of emerging disease-modifying AD treatments like Donanemab and Lecanemab, early and accurate diagnosis is paramount for optimal patient outcomes. Prompt detection is essential for successful implementation of potential treatments, aligning with the NHS perspective that “catching it early makes the biggest difference.”
3. Addressing healthcare inequalities, my research acknowledges potential disparities associated with advanced neuroimaging techniques, such as sMRI. These methods can be cost-prohibitive, potentially excluding individuals from marginalized backgrounds. Furthermore, existing datasets are often skewed toward certain demographic groups, potentially omitting representation from minority populations and socioeconomically disadvantaged individuals.

Maitrei Kohli

ANNEX 3.11

Smell Care – Tackling loss of smell and its impact on wellbeing through digital smell training

What is my research about?

Smell training, a type of smell care, now has several studies showing it can help recover smell function. This is very true in older people, where people suffer a natural decline of the sense of smell. However, current smell training methods are limited to pens soaked in smells or jars of essential oils. A digital solution can overcome these drawbacks and enable digital smell training.

For the first time, and to our knowledge never attempted before, with the Smell Care project (https://www.smell-care.co.uk/home) we aim for a holistic, user-centred, built environment approach as the first step towards the creation of a new smell care culture and policy framework.

By showcasing the known links between smell disorders and conditions such as Parkinson's, dementia, this project underscores the significance of incorporating measures to support individuals affected by these disorders within the broader context of air quality legislation.

Are there links to health inequalities?

In the UK, there is a growing interest in the regulatory context about the idea of air quality -broadly defined – and well-being. We intend to shift from a focus on the negative impacts of the environment on health (i.e., air pollution) to a more positive attitude towards the possible benefits for wellbeing and quality of life, to design supportive places (i.e., air quality and smellscape identity).

By emphasizing the significance of indoor air quality within the built environment, its relationship to smell disorders, and its relation to human olfactory perception and experiences when it comes to the sense of smell, future provisions and guidelines should possibly target air quality within homes and other indoor environments.

We hope to inform policy makers on how to effectively incorporate smell disorder considerations and digital health solutions into comprehensive air quality management.

Ava Fatah gen. Schieck