Roundtable Discussion: Clinical Use Cases for Extended Reality in Mental Health

Summary and Recommendations Paper

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Acknowledgements

Innovate UK and the Health Innovation Network South London would like to thank all participants in this roundtable, and our UK wide collaborators who identified, recommended and introduced potential attendees. The list of participants and contributors are provided on page 7.

This paper was written as a synthesis of the roundtable discussion by Health Innovation South London.

Executive summary

Innovate UK's (IUK) £20 million Mindset-XR programme is driving the growth of extended reality (XR) digital mental health solutions in the UK[1]. IUK have partnered with the Health Innovation Network South London to lead the Mindset XR Innovation Support Programme which aims to support XR projects for mental health to develop their innovation toward adoption by the health system. IUK funded Mindset-XR projects currently include tools for people with severe mental illness, wellbeing and prevention, education and training for the health and care workforce[2].

The Mindset-XR Innovation Support Programme has a commitment to stimulate wider discussion about the barriers and enablers for immersive technologies, in part through conducting a series of roundtable discussions. The first in the series focused on investment in XR for mental health sector. This report summarises the second roundtable discussion and is intended to support clinical teams, innovators, investors and other stakeholders to gain an understanding of most significant XR opportunities in mental health.

Clinicians were invited to join the roundtable from across the UK and throughout mental health clinical settings to ensure a broad range of perspectives, as well as to stimulate an inter-professional discussion.

There is scope for application of XR across all age groups, and particular reference was made to the potential within:
- Care homes and dementia care
- Workforce and return to work
- Education including in schools
- In-patient care
- Transition, for example, between secure, medium secure and community settings
- Community care, staying-well and self-management
- Training of mental health professionals

There are considerations around:
- Use of XR being balanced against facilitating the integration of service users into real life settings
- The cost, infrastructure and support of staff required to ensure XR is fully usable in health and care settings and in the community

There is widespread support and hopefulness over the potential use of XR in mental health, and it was noted that XR offers some unique benefits in terms of personalisation, immersion and a safe, controllable, potentially shared experience. However, there remains some way to go yet in gathering evidence of clinical safety and efficacy as well as overcoming infrastructure and behavioural change obstacles, before the full benefits, and adoption and

spread can be realised.

Introduction

Innovate UK's (IUK) £20 million Mindset programme is driving the growth of extended reality (XR) mental health solutions (e.g., virtual reality, augmented reality[3]) in the UK. Since 2023, UKRI have funded 53 XR for mental health projects which address a range of mental health conditions, life course stages and settings[4].

IUK have partnered with the Health Innovation Network South London to support XR projects for mental health to develop their innovation toward adoption by the health system. This Mindset-XR Innovation Support Programme (MISP) aims to:

- **Support** innovators of XR tools for mental health
- **Stimulate** growth of the surrounding ecosystem and community
- **Scale** up promising innovation for spread and adoption
- **Share** knowledge about developing innovation and evidence

Included within this remit, specifically '**Scale**', is a commitment to conduct a series of roundtables, bringing together a range of experts to discuss key systemic challenges faced by innovators of XR tools for mental health. This roundtable discussion titled 'Clinical Use Cases for Extended Reality in Mental Health' is the second in the series, following a roundtable discussion on investment, and aims to inform clinical teams, innovators, investors and other stakeholders where the most significant opportunities for XR in mental health may lie.

Context

The evidenced need for new ways of approaching (and offering choice of) mental health interventions is extensive and includes:

- The increasing prevalence of mental health issues and increasing complexity of presentations[5]
- The asymmetrical impact of mental health on underserved groups[6]
- The existing pressure on the health system and workforce[7]
- The requirement to align with UK wide National Health Service strategy(s), objectives and core commitments on mental health and access to digital[8]

A 2021 report into the Growing Value of XR in Healthcare highlights the opportunities within the UK XR sector to address some of the evidenced challenges and opportunities listed above[9]. This includes:

- World leading research and innovation capabilities, including around XR and healthcare.
- The growing evidence of increased acceptability of the use of XR amongst the general public, with a 350% increase in use of XR at home, which is expected to grow rapidly[10]
- The significant increase in number of innovators developing XR technology - there has been an 83% growth in XR companies between 2016 and 2021[11]
- Health has seen the highest growth in immersive tech application in recent years and within mental health, XR has developed notably in the treatment of Post-Traumatic Stress Disorder, phobias, and social anxiety disorder.
- The opportunity for real world clinical use cases for mental health abound. The *"Evidence for [XR's]*

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[3] See Appendix 4. Definitions of XR
[4] IUK, 2023; IUK, 2024

[5] MIND, 2017 and HoC, 2024
[6] ONS, 2022; Samaritans, 2021, MIND, 2024, Kings Health Partners 2024; and NICE 2021
[7] National Audit Office, 2023; NHS, 2022 and BMA, 2023
[8] (Digital Health and Care Scotland, 2024; Scottish Government, 2023; Department of Health, 2021; NHS, 2019; Welsh Government, 2024
[9] XRHA, 2021
[10] PWC, 2024 ; IET, 2020
[11] IUK, 2022

effectiveness has been found within several conditions including neurodevelopmental disorders, psychotic disorders, depression, anxiety disorders, and eating disorders".

- The opportunity to grow the evidence base of XR solutions in health whereby XR has been in use for clinical education and other purposes for some time and is gaining momentum. Application for mental health therapeutics/diagnostics is less explored but shows enormous potential.

Challenges to stimulating the XR market and embedding solutions into mental health care include bringing creative and highly technical industries into clinical settings in ways that support the health system to be confident working with multiple sectors, and supporting the innovators to pivot their creative or technical skills towards the health and care system's procurement requirements.

Aims and objectives

The aim of this roundtable was to bring together a small group of mental health professionals with expertise across mental health fields and settings to discuss which areas (if any) stand to gain the most from use of XR tools.

The objectives were to use this discussion to inform a published paper that articulates the most significant opportunities for XR as a solution/choice of intervention in mental health clinical settings and populations, and to make recommendations for interested parties to support their future development and adoption.

Attendance

Attendees from across the UK were invited, via individual recommendation from MISP regional collaborators (all 15 Health Innovation Networks, Digital Health and Care Innovation Centre Scotland, Life Sciences Hub Wales, Health Innovation Research Alliance Northern Ireland).

In particular, health or care professionals (eg: psychologists, psychiatrists, GPs, social workers, occupational therapists, nurses, peer workers, education workers etc) who work in the fields and settings below, or other suitable fields and settings. The suggested list was not exhaustive. Participants were not required to currently be working with XR, but were required to have expertise in mental health and awareness of the potential for digital technology to offer solutions:

Example mental health clinical themes invited:	Example settings invited:
- Older adults and dementia Anxiety and depression - Behavioural and emotional disorders - Bipolar affective disorder - Dissociation and dissociative disorders - Eating disorders - Obsessive compulsive disorder - Paranoia - Personality disorders - Phobias - Post Traumatic Stress Disorder - Psychosis - Schizophrenia	- Children and young people - Forensic / prisons - Education (schools, college, university, home school etc) - Older adults and care homes - Physical health within mental health - Social care - Mental health Inpatient ward - Mental health community rehab - Emergency departments/crisis care - Mental health and care workforce

The roundtable event took place on 26th September, 8.30am – 10am via Zoom meeting. An online approach was taken to support attendance from across the UK and remove geographical barriers to attendance.

Dr James Woollard, Chief Clinical Information Officer (CCIO) at Oxleas NHS Foundation Trust, was invited to chair. James has significant experience in digital transformation as a CCIO, is a CAMHS Consultant Psychiatrist, and has a deep understanding of national strategy through a national advisory role to NHS England, and is a member of the MISP Advisory Board.

Attendees:

Name	Organisation	Role
Dr Amanda Begley	Health Innovation Network South London	Director of Digital and Transformation
Dr Matteo Cella	Kings College London/South London and Maudsley NHS Foundation Trust	Clinical Psychologist – Adults Serious Mental Illness (SMI)
Dr Frances Duffy	Northern Health and Social Care Trust	Consultant Clinical Psychologist – Older Adults
Aileen Jackson	Health Innovation South London	Social Worker and Head of Mental Health
Prof Dan Joyce	University of Liverpool	Professor of Connected Mental Health – Psychiatrist / Data Scientist
Dr Nagore Penades	NHS Greater Glasgow and Clyde	Consultant General Adult Psychiatrist
Andrew Reid	Middlesborough Access Team	Community Psychiatric Nurse
Jools Smithies	Tees Esk and Wear Valleys NHS Foundation Trust	Senior Nurse/Practice Placement Facilitator
Syed Rasheeq	NHS Greater Glasgow and Clyde	Industry Collaboration Manager
Joe Norton-Jones	Royal Borough of Greenwich	Assistant Head Teacher, Virtual Schools
Dr Jade Thai	Merseycare NHS Foundation Trust	Programme Manager for Neuroscience and Mental Health
Alison Walshe	Merseycare NHS Foundation Trust	Assistant Chief Executive
Dr Amanda Thompsell	NHS England	Consultant Old Age Psychiatrist
Dr Matthew Tovey	Midlands Partnership University NHS Foundation Trust	Consultant Forensic Psychiatrist
Gavin Williams	Cheshire and Wirral Partnership NHS Foundation Trust	Specialist Community Practitioner
Dr James Woollard - CHAIR	Oxleas NHS Foundation Trust / NHS England	Chief Clinical Information Officer and CAMHS Consultant Psychiatrist / Specialty Adviser

Discussion

Discussion was centred around 3 key questions:

1. Based on your understanding of XR, in what ways could its use improve upon or enhance existing diagnostics and therapies?

2. In your view, what mental health clinical fields, settings, and life stages could benefit the most from use of XR?

3. What would you need to do in order to consider XR as a viable alternative or complement to traditional diagnostics or therapies?

Question 1: Based on your understanding of XR, in what ways could its use improve upon or enhance existing diagnostics and therapies?

- Key to XR's unique offer in mental health is its high capacity for personalisation. Whether this is to address specific points of anxiety on a child's walk to school, reminiscence therapy for a person with dementia, a person's unique life journey, or an immersive experience which is uniquely soothing to the individual.

- There are some situations in which XR can provided a more pleasant diagnostic or therapeutic experience for service users when contrasted against some traditional treatments.

- XR provides opportunity for this highly personal and immersive experience to be shared with others. Whether this is a shared educational experience among health professionals who can reflect together afterwards, or a treatment journey with a patient safely overseen – and potentially remotely controlled - by a therapist.

- XR provides an opportunity to safely encounter environments which may otherwise be unsafe, unfamiliar or inaccessible. For example, a person transitioning from high security care through their treatment journey back into the community may need to experience daily life tasks, such as shopping for groceries, which they are unable to practice in real life at that point.

- Use of XR to carry out what was previously an offline diagnosis or treatment gives potential for the collection of data which can inform improvements to treatment or give clues as to a diagnosis. Using continuous performance tests, psychometric measurements, or eye tracking for example whilst observing someone carrying out a shopping task can provide clues as to their cognitive function or neurodiverse need.

- Opportunities for crossovers between diagnosis and treatment, using an experience which is both relaxing or pleasant whilst observing evidence of behaviours for diagnosis, or using XR to 'fast-track' people on to a further stage of treatment by observing indications of readiness.

- Clinicians currently use many techniques to draw out memories or thoughts and there is potential for XR to be used to make people feel safe, soothed or appropriately stimulated.

- The immersive experience of virtual and mixed reality provides advantages where distraction is an inhibitor to full engagement. Being mentally and emotionally transported to another environment without interference from distracting sensations was thought to have potential to improve some therapies.

- It was noted with caution, that whilst there are circumstances in which extended reality provides unique benefits, it is not always an improvement on traditional methods. Indeed sometimes, as with the introduction of any digital aspect, it can add unnecessary complication, cost or resource pressure.   An opportunity was noted to have a mixed or evolving approach where XR can complement or enhance traditional therapies rather than replace them.

- In contrast there is potential for XR to allow for support to be provided by a variety of roles freeing up cost and time of more senior clinicians, through a new role like 'Virtual Reality Healthcare Assistants'.

- Some parties to the discussion have used or observed use of XR for mental health over the years with

positive impact. An example was given of one team using an augmented reality for professional training. Staff trained on the XR tool were said to have experienced a 51% increase in knowledge and 63% increase in confidence over the five days of using the tool, over the traditional methods.

- XR can be a valuable addition to using goal-based outcomes with service users, (rather than using traditional psychometrics), driven by what is important to the individual service user and the outcomes they are seeking.

Question 2: In your view, what mental health clinical fields, settings, and life stages could benefit the most from use of XR?

A broad case was made across the life-course, diagnoses, and settings, with use cases for staff wellbeing as well as care for patients and carers.

Diagnostic fields:

- XR can be transdiagnostic and could provide an opportunity to treat the 'problem' or symptoms (i.e. the discomfort) with a less siloed approach to specific diagnosis. An example could be treating insomnia which can be a symptom of a variety of mental health conditions.

- Current methods of diagnosis do not work for everyone. For example, existing cognitive tests for a dementia diagnosis may not be as sensitive for a particularly educated or affluent population. Therefore, XR has potential to offer more creative, more interactive and more immersive methods of diagnosis, as mentioned previously alongside third-party observation and data collection where appropriate and necessary.

- Existing treatment or diagnosis of mental health conditions can inherently present risk of surfacing trauma and XR presents the possibility of safely and/or more rapidly finding effective pathways to treatment. An example could be in differentiating between nightmares, night terrors or hallucinations to provide the most appropriate treatment pathway.

Life stages:

- There is an increasingly ageing population in the UK and significant potential for XR in older people's mental health care. For people living with dementia there is the opportunity for reminiscence therapy across settings. One example given was Liverpool based charity 'House of Memories' which has a bus with virtual reality headsets which goes out into the community.

- Older adults do not access psychological therapies to the same degree as younger adults, but they still have the same mental health conditions. XR offers the possibility of more immersive remote treatment for those who for physical health or other reasons cannot attend therapies in person. There is also increased loneliness in older adults for which XR could provide benefits.

- XR provides potential opportunity for diagnosing or screening for dementia, tackling the long wait lists and giving the benefits of treatments for which it is important to get a timely diagnosis.

- Children experiencing school avoidance, anxiety and trauma often have multiple services involved in their care. In many cases school attendance itself can have a protective effect on student mental health and wellbeing. XR could support young people with understanding their own behaviours (fight/flight etc) and provide a safe environment to gently test and develop their resilience. However, it was noted XR may influence people not to engage in real world social activities, and risk exacerbating issues such as school avoidance.

Settings:

- Inpatient care is a potential area where XR can be used in mental health treatment, noting that people in inpatient care are acutely unwell and initially require stabilisation via well evidenced therapies and treatments. Given the severity of illness for inpatients the need XR could serve may be clinically impactful.

- Outpatients and community care are an area of opportunity, where patients are less acutely unwell and

the focus is on staying well. Greater numbers of people accessing mental health services (at a ratio of around 3 to 1) are in outpatients/community care settings, such as, their own home, supported accommodation, or a care home in the community

- The care home population - who currently have limited options of activities to engage them mentally and physically, which in itself can have an impact on mental health - could benefit from XR. Challenges with accessing care appointments outside of the care home setting could be complimented by XR.

- The mental health workforce is a further potential area for XR use. Incorporating XR into medical /nursing and allied health student training has the benefit of creating a safe environment in which students can make mistakes and learn from them, or stop at any time if they don't know what to do next. Trainers and peers can observe and reflect about how it made them feel and why they made certain decisions.

- Carers of service users, whose own mental wellbeing is often overlooked, could benefit from a flexible technology with remote capabilities which can be accessed according to the user's schedule. This provides a further opportunity for use of XR in mental health.

Question 3: What would you need to do in order to consider XR as a viable alternative or complement to traditional diagnostics or therapies?

- Service users with decreased dexterity, mobility, sensory perception, strength or other support needs may find the technology particularly difficult to use. There is a need to explore how the user interface can accommodate as many service users as possible, mindful that some of those with increased physical support needs may also experience increased mental health challenges. Different ways to approach XR can be found, which could overcome some of the infrastructure, hardware and other challenges. Examples include immersion rooms which do not require headsets or uploading libraries of software to hardware with multiple uses.

- Transformative technology may require a transformative approach to how health services utilise existing staff, in less costly and less labour-intensive ways. For example, XR use in mental health could enable a safe way to reduce time consuming home visits where appropriate, or could enable other health care professionals such as health care assistants to conduct some assessments freeing up consultant time for other activities. Staff need to be bought along in the development journey and adequately trained, to enable the adoption and scaling up of XR in mental health.

- Evidence is emerging and needs to be further developed. When considering whether XR is a viable addition or alternative therapeutic intervention it is important that an evidenced or hypothesised mechanism of action in a psychiatric disorder is clear, with measurable patient impact. In addition to clinical validation, real world validation and health economic evaluation will support the case for transformation using XR for mental health.

- Clarity around commissioning pathways for XR in mental health requires improvement. Publicly funded health and care organisations have complex procurement structures which can be challenging for innovators to navigate.

- There needs to be a smoother translation of academic and clinical research into commercialisation via real world implementation and scaling up. This is not unique to XR in mental health. However, given the novelty of the technology and the variety of sectors involved, the health system will need to work with innovators to support engagement with regulatory bodies and drive sustainable adoption and scaling up. Importantly innovators need to request guidance from commissioners and clinicians as to what evidence to collect during pilots and trials to provide the evidence to other commissioners and clinicians which will drive further adoption.

- Clinicians may consider where the traditional distinction between diagnosis and intervention is more permeable than previously realised, and whether the diagnostic approach itself can constitute a part of the therapeutic process. For example, a more calming and soothing diagnostic experience which collects the information the clinician requires to make a diagnosis.

- Whilst cost is a consideration, XR technology is becoming more affordable. At present equipment such as

virtual reality headsets present a significant investment for health and care systems. The focus needs to be on optimising value from any hardware procured with potential for shared upload libraries of software using the same hardware. Increased use will reduce the cost, and XR technology is already significantly cheaper than it was a decade ago. XR technology is appearing in schools, homes and public places, galleries, retail etc. at a rapid rate, demonstrating potential for acceptability, increasing XR skills among the general population and potential to be used by patients at home (i.e. a precedent is set by app use whereby a patient's own smart phone is used).

- Regardless of the increasing normalisation of XR technology among the population, there will still be significant numbers of people unfamiliar with the technology. Depending on the innovation and hardware needs, it may be the case that service users need support from healthcare teams to use the equipment, reversing some of the potential for more hands-off clinical approaches.

Summary

Roundtable participants were enthusiastic overall about the potential for XR to be used in mental health care at all life stages, across diagnoses and throughout a wide variety of settings. This enthusiasm was moderated by a recognised need to encourage 'digital wisdom' as to when XR provides unique benefits, and when similar clinical outcomes can be achieved with lower tech solutions.

A patchy innovation map emerges at presence, with some areas having little or no existing implementation of XR in mental health settings, and some areas already having significant investment. For example, in the North West of England one of the largest mental health and community service providers already have immersive therapy rooms and have been working with immersive technology for some years, whilst some other regions were not aware of XR having yet been implemented in mental health settings locally. However, regions which have seen little existing implementation to date were eager to explore how XR for mental health could align to local needs and priorities.

A theme of the discussion was around liminal boundaries, such as blending traditional service models with new service models, blending diagnosis with treatment, clinical settings with home or community, and essential observations with a more pleasant experience for patients. This offers potential for a more subtle, nuanced and personalised approach to mental health care aligned to service users' self-defined goals and personal choice.

The familiar benefits of XR come with an advisory note, that comfort and discomfort may sometimes need to be managed in equilibrium. XR can provide a safe environment to explore school avoidance, agoraphobia, PTSD, transition into a community and much more, however this must be in ways which allow the user to ultimately move toward enjoyment and participation in 'real life' as far as possible to support recovery with human social interactions and confidence to face an unpredictable, uncontrollable world.

Patient safety will always - rightly - be foremost in the minds of clinicians, yet obstacles to widespread adoption of XR for mental health are surmountable, efforts to increase evidence, accessibility, usability and infrastructure are already in place through the IUK Mindset XR funding programme   The curiosity, excitement and open-mindedness clinicians demonstrate toward this technology is encouraging.

Recommendations

- Innovators, researchers and clinicians, need to continue developing and sharing evidence to support deployment of XR for mental health in terms of health economics, real world validation, and patient impact. One way to do this would be to use opportunities presented by existing or developing centres of excellence to pilot XR innovation in appropriately safe ways.

- Clinical teams need to work with innovators at the early stages of development to meaningfully codesign (alongside service users). This will ensure innovation meets the requirements of clinicians and of end users. This includes finding time to speak with innovators about their needs and being explicit about their priorities, whilst managing expectations of stages of readiness/budget. Working with innovators on funding bids, such as Innovate UK's Mindset-XR programme, provides an opportunity to financially derisk shared ventures.

- When implementing XR for mental health staff training, mindfulness of existing pressures, principles of behavioural change, and appropriate distribution of roles need to be considered. Good implementation of any digital technology through an agreed implementation pathway with associated governance, including XR for mental health, will minimise burden on already stretched clinical teams. Teams could consider training some staff to be expert in the technical aspects, and potentially spreading the load of transformation by examining where healthcare support staff can be utilised rather than consultants, physicians, and nursing teams.

- Clinical teams within health and care settings to communicate with one another on the use of XR, and consider where cost and infrastructure economies could be made. Shared hardware or immersive rooms used by a number of teams on a bookable basis, jointly presenting a business case for improved wifi or cloud-based storage, collaboration in writing protocols for data security and infection control and other opportunities to forgo siloed working will support a fiscal case for use of XR in mental health.

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Appendices

Appendix 1. Agenda

Time	Item	Lead
08:30	**Welcome and introductions**	Chair Dr James Woollard
08:45	**Setting the scene** • **XR** • **Real world clinical use cases**	Amanda Begley Aileen Jackson
08:55	**Questions and attendees' opening thoughts**	Chair
09:10	**Question 1 – discussion** *Based on your understanding of XR, in what ways could its use improve upon or enhance existing diagnostics and therapies.*	Chair facilitating
09:25	**Question 2 – discussion** *What mental health clinical fields, settings, and life stages could benefit the most from use of XR?*	Chair facilitating
09:40	**Question 3 – discussion** *What would you need to do in order to consider XR as a viable alternative or complement to traditional diagnostics or therapies?*	Chair facilitating
09:55-10:00	**Summary reflections from the chair** **Next Steps** **Close**	Chair

Appendix 2. Case Studies – a small sample of IUK Mindset XR in mental health funded projects

Anagram Goliath - Anagram (weareanagram.co.uk)
Award-winning Goliath: Playing with Reality is a 25-minute animated VR experience about schizophrenia, gaming and connection. Already in use in several Medical Schools /University's in England in discussions with several mental health trusts. Used as a training tool for health care professionals to create empathy and understanding of a person with schizophrenia.

Animorph (https://www.animorph.coop/work/stayingwell-xr/)
StayingWell utilises a mixed reality (MR) environment to help individuals with mental health conditions such as bipolar disorder, psychosis, depression, and anxiety to self-identify relapse signs. The feasibility study has resulted in operational software that integrates MR with a desktop interface, enabling users to choose applicable symptoms, express them via the MR headset, and examine their 'relapse signatures' with a therapist. When service users are well and their condition is in 'remission', a key NICE recommendation is relapse prevention, supported by various interventions including 'Staying Well Plans'. The app combines the established early warning signs (EWS) card-sort exercise with cognitive behavioural therapy (CBT) and trauma-informed therapy. Developed in partnership with Dr. Fergus Kane, (UCL) StayingWell helps individuals understand and change negative thought patterns, develop coping strategies, and regain control over their lives.

SyncVR Medical (https://www.syncvrmedical.com/)
Artificial intelligence-based, virtual reality application to provide data-driven, patient-centred treatment for people with eating disorders. Decreasing waitlists for young patients with eating disorders through an evidence-based VR treatment, developed in collaboration between SyncVR Medical and South London and Maudsley NHS Foundation Trust.

Borderpoint Films (https://borderpointfilms.com/)
A virtual reality intervention to help young people who hear voices [Depict VR]. Currently developing Depict VR, a new VR application in response to the mental health crisis affecting young people. Over 1 million (12%) young people in the UK hear voices, and many choose not to disclose their experience for fear of being stigmatised. However, being able to share these experiences is the first step towards managing the voices and finding positive outcomes. Depict VR is designed to help young people share their voice hearing experience and build a more meaningful relationship with a trusted confidante, who could be a parent or close friend. Research shows that strengthening these relationships has a positive impact on mental health and can help young people reconcile their voice hearing experience.
Working with psychologist Dr Preethi Premkumar at London South Bank University to research and develop the concept.

Rescape (https://www.rescape.health/)
Rescape's is combining closed-loop Vagus Nerve Stimulation with Virtual Reality therapies to amplify the benefits of both treatments in reducing depression and anxiety in chronic pain sufferers.
Rescape's DR:VR Frontline was first introduced and rolled out in intensive care units within two hospitals during the pandemic. After using DR:VR, 88% of participants reported reduced feelings of stress, whilst 94% felt it was enjoyable and provided relief from their work.

Play well for life: Dragons Of Afterlands (playwellforlife.com) Dragons of Afterlands is an augmented reality board game for 2-4 players, aged 13 and over. It has been developed in partnership with clinical psychologists as Royal Holloway University to develop wellbeing skills and improve communication of adolescents. Secured contracts at Bristol Children's Hospital and Alder Hey Liverpool, in discussion with an NHS Mental Health Trust

Appendix 3. Report 'The Growing Value of XR in Healthcare in the United Kingdom – Executive Summary' (XRHA, 2021)

The time has come for a change of pace. The global face of XR in healthcare is evolving. The COVID-19 pandemic has ushered in the use of XR in healthcare as providers are forced to accelerate their digital transformation journeys and adopt novel and innovative solutions to navigate the impact of the pandemic. A unique opportunity presents itself for the UK to lead this expanding market.

AR and VR have been revolutionising the global healthcare market and demonstrating impact, value, and efficiencies for some time before the pandemic struck. The predicted growth of the AR healthcare market is expected to generate US$10 billion in revenues, with the VR Healthcare market reaching US$1.2 billion in 2024 (ABI Research Oct 7th, 2020). In the UK use-at-home market, The Times reported in January 2021 that the sales of VR headsets had risen by 350% as those trapped at home seek a safe way to escape the lockdown. At the start of last year, one in 17 UK households had a VR headset at home, according to Ofcom, up from one in 20 in 2018.

There is a nascent but world-class XR innovation emerging in the UK's healthcare market, as innovative research is undertaken in UK universities and ground-breaking innovation is happening in start-ups and SMEs. In addition, novel collaborations and trials are demonstrating the potential value and cost savings to be gained from the application of XR in healthcare and the impact on and improvement to people's lives. Despite the market potential for the UK, the evidence generated is not being measured efficiently and the benefits, although becoming clearer, are not being valued to the extent needed to trigger the funding, investment and strategic interventions needed to grow a sustainable and thriving UK XR healthcare sector.

One of the biggest drivers within the NHS is to provide value for money. The health economics in this report emphasises the potential that XR offers in supporting healthcare services to deliver highly effective outcomes in a more cost-effective way. XR can be used to help patients face operations and treatments that they would otherwise avoid, this could lead to £2 million of savings per year. Delivering therapies remotely via VR can be 2-3 times cheaper than traditional rehabilitation, cut wait times, improve engagement, and reduce the likelihood of symptoms exacerbating. Finally, XR can reduce costs to training, and improve overall surgical performance by as much as 230% versus traditional training methods. This evidence is a fundamental requirement for the health system, and it is unlikely any XR solution can be adopted into clinical practice or attract the investment needed to scale without the data to support its effectiveness.

Research and development of XR is hampered by a fragmented ecosystem and the lack of opportunities for cross-sector collaboration. Pockets of innovation sit in industry, isolated from the clinicians or researchers needed to turn ideas into reality. There is, as yet, no marketplace for efficiently distributing XR in healthcare solutions. It is extremely difficult for

products or experiences to convert into clinical trials to substantiate the value and impact. It is even harder to get in front of commissioners, procurers, or purchasers. Funded and market-ready solutions struggle to find a route to market, as, in order to get onto a procurement platform, XR solutions have to meet standards and assurances which currently are not fit for purpose for the unique applications of XR.

The aim of this report is to outline what we mean by XR in healthcare and how it is being implemented in the UK. It identifies the potential value of XR, explores the evidence that demonstrates its impact on human health and estimates the potential cost savings to the UK healthcare system. The report delves into use cases of XR in healthcare across several key application areas, including mental health and wellbeing, physiotherapy and rehabilitation, pain management, healthcare professional clinical skills training and patient education. Our goal is to showcase the people and projects innovating in this space and to demonstrate the potential value XR could bring to clinical and non-clinical settings. The report also highlights the unique collaborations emerging on the clinical front line, bringing clinicians, academics, gaming and XR companies and others together to address real needs within the health system.

More importantly, this report brings together for the first time a snapshot of XR in healthcare in the UK today, outlines the barriers to its growth and makes recommendations that will help government and public health services make informed decisions on future strategies. This will ensure the UK is in the best position to unlock the potential of XR in healthcare and improve patient outcomes and quality of life.

The report proposes three key recommendations to move XR healthcare in the UK into a world leading position:

1. Undertake a comprehensive mapping and analysis of the businesses, healthcare organisations and universities working with XR in healthcare to better understand the UK's capacity and capabilities, the size and scale of the market, its potential value and future growth.

2. Develop collaborative 'Centres of Excellence' (CoEs) in healthcare XR to create a development pipeline which enables a clear pathway from concept to investment and scaling to market. Working in partnership, CoEs would facilitate the production of clinically robust, engaging, marketable products to be made available on national platforms for secure purchase to healthcare providers, improving patient experience, quality, and value in health intervention. Vitally, CoEs will also act to further develop a body of evidence.

3. Establish a representative and impartial alliance network that facilitates the connection of academic institutions, researchers, healthcare providers, clinicians, XR, digital and creative industries to support new collaborations, inform, signpost, and share insights and expertise.

XR (XR) is an umbrella term encapsulating AR, VR, MR, and everything in between.

Virtual Reality (VR) immerses users in a fully digital environment through a headset or surrounding display. This environment can be computer-generated or filmed in 360-degree video.

Augmented Reality (AR) presents digital information, objects, or media in the real world through a mobile device or headset. These elements can appear as a flat graphical overlay or can behave as a seemingly real '3D' object.
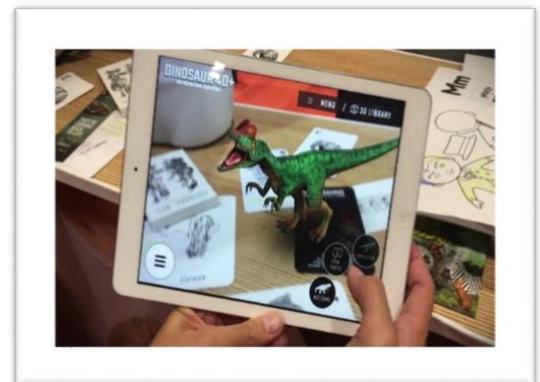
Mixed Reality (MR) is the latter form of AR described above where physical and digital objects co-exist – in other words, the digital objects appear anchored to the real-world environment.

Haptics assist in immersing the user in a virtual world through an enhanced sense of touch. Often taking the form of a pair of gloves or an articulated arm, haptic technology enables users to not only see and hear their environment but feel it through vibration and changes in temperature.