

# Evidence Brief: Apps, sensors, and wearable technologies

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### Key publications – the big picture

#### An introduction to Internet of Things in health

NHS England – Digital, 9 March 2025

This guidance provides an overview of the health applications and potential benefits of Internet of Things (IoT) devices, and getting the best out of existing infrastructure and wireless connectivity.

#### Innovating for Independence: a win-win for health and social care

Reform, January 2025

The adult social care system is in crisis. The population is ageing, with people living longer in poorer health, combined with a local government system at financial breaking point. Without innovation and reform, this crisis will only worsen.

#### Digital Health Trends 2024

IQVIA Institute for Human Data Science, December 2024

This report examines trends across various segments of the digital health market, which are becoming increasingly defined. We examine digital diagnostics alongside maturing therapeutic product segments like digital therapeutics (DTx) and digital care (DCs) and look at consumer apps and non-prescription digital therapeutics that aim to reduce health symptoms. We also examine how life sciences companies are strategically deploying wearable sensors and other patient monitoring tools in research. See p. 11 "Consumer app trends" p. 44 "Sensor-based digital measures" and p. 52 "Digital diagnostics and other health assessment tools"

#### The future of digital health portals

Professional Record Standards Body; The Health Foundation; Patient Information Forum, May 2024

The use of digital health portals has expanded. Portals include websites, apps and online consultations. The pandemic and increasing public acceptance of digital tools has driven change. Our research found digital health portals may help people become more active in their care. This could improve health outcomes.

#### Digital tools for online consultation in general practice

Health Services Safety Investigations Body, April 2024

Following safety management system principles, this report describes the investigation of a potential hazard (something that could cause harm) that was highlighted to HSSIB by patients and general practice staff. Further information about safety management systems can be found in HSSIB's publication 'Safety management systems: an introduction for healthcare'.

#### Access denied? Socioeconomic inequalities in digital health services

Ada Lovelace Institute, September 2023

The UK's health and social care system increasingly relies on digital services and the flow of patient data to deliver care to tens of millions of people. Digital transformation is intended to fuel innovation and efficiency and improve patient experience.<sup>12</sup> However, there is a risk that digital healthcare can exacerbate existing health inequalities.

#### Answers in the App Store? Lessons from COVID-19 technologies

Ada Lovelace Institute, July 2023

This briefing examines the available evidence relating to the effectiveness, public legitimacy, inequalities and governance of 'COVID-19 technologies' – contact tracing apps and digital vaccine passports. We draw insights and lessons from this evidence that should guide policymakers in their response to future public health crises. They should also support

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policymakers in their decisions about whether to use data and AI technologies to support public health and social care provision.

### NHS Long Term Workforce Plan

NHS England, June 2023

See section 4 Reform – "digital and technological innovations"  
The first comprehensive workforce plan for the NHS, putting staffing on a sustainable footing and improving patient care. It focuses on retaining existing talent and making the best use of new technology alongside the biggest recruitment drive in health service history.

### Digital transformation in the NHS

House of Commons, June 2023

Successive Governments have recognised the importance of moving the NHS onto a digital footing. "Digital transformation" encompasses "digitising" services and processes that have traditionally been delivered physically, and greater use of innovative approaches to care that are enabled by advances in technology. Digital transformation is vital for the long-term sustainability of the health service: the Department of Health and Social Care (the Department) and NHS England believe that a shift to digital channels (such as the NHS App) is necessary to delivering priorities such as reducing care backlogs and improving access to primary care. Digital can also deliver improvements in care to patients, ranging from increased convenience to access to cutting-edge treatments and diagnostics.

### Digital apps and reducing ethnic health inequalities Driving progress through digital, design, and organisational transformation

NHS Race & Health Observatory, January 2023

TPXimpact was commissioned by the NHS Race & Health Observatory to deliver research that can shape future digital

health recommendations to reduce ethnic inequality in the usage of healthcare apps such as the NHS App, NHSBT Give Blood app, and other current and future healthcare apps. As health inequalities are shaped by wider determinants of health, addressing them requires a response beyond digital and even beyond the NHS. This report focuses on the role digital can play in understanding and addressing ethnic health inequalities. Throughout the report, when talking about 'digital', we are referring to healthcare services that are delivered through online and mobile channels. We also refer to 'digital' as an organisational strategy enabling how digital services are delivered.

### Building our future digital workforce

Health Education England

Key to our work is establishing a [workforce planning model](#) for our health informatics workforce – those who work in data, digital, technology and knowledge - so we can understand both our current workforce, the demand for our future workforce and to develop a comprehensive plan to bridge the gaps.

### Digitally-enabled primary and outpatient care will go mainstream across the NHS

NHS Long Term Plan, June 2019

Digital technology will provide convenient ways for patients to access advice and care. For patients and staff the starting point is interoperability of data and systems, as set out in [Chapter Five](#). Then, building on progress already made on digitising appointments and prescriptions, a digital NHS 'front door' through the [NHS App](#) will provide advice, check symptoms and connect people with healthcare professionals – including through telephone and video consultations.

### The Digital, Data and Technology Playbook

UK Government, March 2022

This document sets out key policies and guidance for how digital projects and programmes are assessed, procured and delivered.

### Shaping the future of digital technology in health and social care

The King's Fund, April 2021

The potential of digital technology to transform the health and social care system has still not been realised, though the Covid-19 pandemic has caused a rapid shift towards the remote delivery of care through online technologies.

### The Topol Review

Health Education England, February 2019

The Topol Review outlined recommendations to ensure the NHS is the world leader in using digital technologies to benefit patients. It will involve implementing technologies such as genomics, digital medicine, artificial intelligence and robotics at a faster pace and on a greater scale than anywhere else in the world.

## NICE Guidance

### Digital health

All NICE products on digital health. Includes any guidance and quality standards.

## Case Studies

### How to sustain, scale and expand technology-enabled care across pathways and providers: supporting people to be at home and outside of hospital in Leicester, Leicestershire and Rutland

FutureNHS log in required to view

Future NHS – Leicester, Leicestershire and Rutland, 2023

Teamwork between health and care providers in Leicester, Leicestershire and Rutland (LLR) means an increasing number of patients have the option of accessing digitally-enabled support from the comfort of home.

### Supporting people and optimising services through digital care pathways: key regional and national learning from musculoskeletal and gastroenterology Adoption Fund projects

FutureNHS log in required to view

Future NHS – NHS England adoption fund, 2023

Health and care teams across England are transforming services for people living with some of the country's most prevalent, chronic health conditions by realising the potential of digital innovation to improve choice, experience and outcomes.

### Bringing holistic services within reach for people with severe mental illness: how digital, data and people are combining in Greater Manchester to enrich lives and reduce inequalities

FutureNHS log in required to view

Future NHS – Primary Care Networks Greater Manchester, 2023

The city region is championing a PCN-led grass roots approach to service design, supporting teams to offer annual physical health checks for people with severe mental illness (SMI) through point-of-care testing (POCT) digital devices that return results within minutes rather than days.

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Trust, tech, and teamwork: how Essex's health and care professionals are using technology-enabled remote monitoring to protect health and prevent hospital admissions FutureNHS log in required to view

Future NHS – Mid and South Essex, 2023

Thousands of residents in Mid and South Essex (MSE) are being supported at home and protected against the development of serious health infections by staff using technology-enabled remote monitoring.

Confidence around the clock: how technology-enabled remote monitoring is empowering patients and transforming lives in Yorkshire and beyond FutureNHS log in required to view

Future NHS - Bradford District and Craven, 2023

Thousands of people living with Chronic Obstructive Pulmonary Disease (COPD) across Bradford District and Craven are managing their condition from the comfort of their own home, with life-changing assurance and support from a nurse-led digital service. Based at Airedale NHS Foundation Trust, within the Digital Care Hub, the MyCare24 COPD service is supporting an increasing number of people through technology enabled remote monitoring, with patients, families, clinicians and health and care staff reporting positive and in some cases lifechanging results.

Culture, capability, and co-design: how technology-enabled remote monitoring is helping move the dial towards empowered personal care in Dorset FutureNHS log in required to view

Future NHS - Dorset, 2023

Hundreds of people in Dorset are being supported to take control of their long-term conditions from the comfort of home thanks to a step-change digital programme expanding across the region. NHS Dorset's Digital Access to Services at Home (D@SH) programme is shaped by a multidisciplinary team of clinical and non-clinical specialists, thinking differently about how to best care for and empower communities.

Developing a digitally-enabled remote oximetry monitoring service across Hampshire and the Isle of Wight FutureNHS log in required to view

Future NHS – Hampshire and Sile of Wight, 2023

This case study focuses on a project underway across the Hampshire and the Isle of Wight region, which became one of the early areas in the country to develop a fully digitally-enabled COVID Oximetry at Home (CO@H) service at the beginning of this year.

Case Study Hospital@Home - Prevention of Admission and Remote Monitoring Services FutureNHS log in required to view

Future NHS - Hertfordshire Community NHS Trust, 2023

In March 2020, Hertfordshire Community NHS Trust developed various pathways to avoid unnecessary admission and enable patients to recover in their own homes, with Same Day Emergency Care Model support, within the community. This was in response to pressures on acute trust colleagues caused by Covid-19 and the wish to manage patients at home to reduce chances of infection with Covid-19, if it was safe to do so. The team were able to achieve this objective, through the 'Hospital@Home' concept, which created capacity within the system.

Empowering people in Surrey Heartlands: how a multi-disciplinary team approach to technology-enabled remote monitoring is enhancing long-term condition care and inspiring healthier living FutureNHS log in required to view

Future NHS – Surrey Heartlands, 2023

People with long term conditions in Surrey Heartlands are being supported to manage their health and wellbeing at home with greater choice, knowledge, and confidence thanks to a multi-skilled collaboration of professionals enabled through digital innovation.



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[Hearts, minds, and original thinking: scaling a technology-enabled remote monitoring hub to support thousands of people at home across Cheshire and Merseyside](#) FutureNHS log in required to view

Future NHS – Cheshire and Merseyside, 2023

Engagement, insight, evidence and original thinking in Liverpool has paved the way for the rapid expansion of a remote monitoring hub that now supports thousands of people in nine localities across Cheshire and Merseyside.

### [Supporting care with remote monitoring](#)

The NHS continues to work on delivering more care to people in their homes.

NHSX is working with all 7 NHS regions in England to scale digitally enabled healthcare at home for people with long term conditions. This includes both physical and mental health, for people for whom home is a care home, and for acute COVID-19.

- [Rehabilitation after knee replacement surgery using remote monitoring and wearable technology](#)
- [A digital follow-up care model providing remote monitoring to reduce the need for unnecessary hospital appointments for patients](#)
- [Remotely monitoring electrolyte imbalance in patients receiving haemodialysis for end-stage kidney disease](#)
- [Development of an app based integrated prehabilitation, perioperative pathway management and patient assessment platform](#)
- [Remote ECG monitoring to support mental health patients in the North East and Yorkshire](#)
- [Remote monitoring for care home residents across London](#)
- [Remote monitoring for patients with chronic conditions in the Midlands](#)

- [Managing long term conditions remotely in the North West](#)
- [Developing a digitally-enabled remote oximetry services across the South East](#)
- [Improving the health and wellbeing of people with learning disabilities in the South West](#)
- [The role of remote monitoring in the future of the NHS](#) – South East London

### ['Smart' tech to change the way patients are monitored](#)

Oxford Health

Oxford Health is trialling the use of smart monitors known as 'wearables' with some of its [Hospital@Home](#) patients so that clinicians can check vital signs remotely, enabling them to act if a condition deteriorates.

### [Managing heart failure @home: an opportunity for excellence](#)

NHS England, 19 July 2022

Following a successful launch event for professionals on the 18 July, National Clinical Director Nick Linker outlines an innovative approach supporting people to manage heart failure at home, using remote monitoring and self-management tools. Living with heart failure is becoming increasingly common due to our ageing population and improving medical care. In 2018, 920,000 people were living with heart failure in the UK, with around 200,000 new diagnoses made annually. People living with heart failure require significant input from NHS services. [Caring for heart failure patients](#) accounts for 2% of the total NHS budget and for 5% of all emergency hospital admissions in the UK.

### [More support for surgery patients on virtual wards](#)

Barts Health NHS Trust, June 2022

The technology allows NHS clinicians to monitor patients at home, give advice on how to prepare for surgery and spot those

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who may need to be treated sooner. It's the brainchild of consultant cardiologist Dr Debashish Das and has been rolled out to eight specialist heart centres in the capital, including at St Bartholomew's Hospital. Patients using the system will answer questionnaires and submit data such as blood pressure to a virtual ward monitored by hospital clinicians.

### [Trial of wearable health technology for cancer patients opens](#)

Manchester University NHS Foundation Trust, 26 January 2022  
A new trial opens in Greater Manchester today which is to test cutting-edge wearable technologies involving patients who have received cancer treatment. The commercially-available health sensors and devices produce a digital fingerprint of vital signs that could allow doctors to assess the progress of their patients.

### [Remote monitoring of Healthcare in the North East](#) FutureNHS log in required to view FutureNHS – North East, 2021

Delivering care through remote monitoring, where technology and apps enable patients and clinicians to receive and deliver care within the home, is more important in the current climate. Reducing the need for a face to face contact and thus the risk of COVID-19 infection.

### [Wearable sensor trialled for remote Covid-19 monitoring](#)

Imperial, April 2020

Wearable technology to remotely detect signs that a patient's condition is worsening is being trialled to support the ongoing COVID-19 response. Led by Imperial College London, in partnership with NHS organisations in northwest London, the sensor is being used to monitor people in quarantine at a special NHS facility near Heathrow airport, for example travellers from abroad or those wishing to travel to return home.

### [Managing Long Term Conditions \(LTC\) remotely in the North West](#) FutureNHS log in required to view

FutureNHS – North West, 2020

Being diagnosed with a long term condition such as diabetes, chronic obstructive pulmonary disease or heart failure can have a huge impact on a person's life. This includes the symptoms associated with illness, as well as psycho social impacts such as loss of confidence, anxiety about managing their condition if it changes and impact on work/education, family and leisure.

## The Star for workforce redesign

More resources and tools are available by searching for "technology" in [the Star](#)

## National Data Programme

Workforce, Training and Education staff can look at the [National Data Warehouse \(NDL\)](#) SharePoint site to find out more about datasets and Tableau products.



# Published Peer Reviewed Research

## Apps: implementation and effectiveness

### A systematic umbrella review and meta-meta-analysis of eHealth and mHealth interventions for improving lifestyle behaviours

Npj Digital Medicine 7(179), 2024

The aim of this meta-meta-analysis was to systematically review randomised controlled trial (RCT) evidence examining the effectiveness of e- and m-Health interventions designed to improve physical activity, sedentary behaviour, healthy eating and sleep.

### Uptake and adoption of the NHS App in England: an observational study

British Journal of General Practice 73(737), 2023

Background: Technological advances have led to the use of patient portals that give people digital access to their personal health information. The NHS App was launched in January 2019 as a 'front door' to digitally enabled health services.

### Analysis of mHealth research: mapping the relationship between mobile apps technology and healthcare during COVID-19 outbreak

Globalisation and Health 18(67), 2022

Frequent authors' keywords have formed major 4 clusters representing the hot topics in the field: (1) artificial intelligence and telehealthcare; (2) digital contact tracing apps, privacy and security concerns; (3) mHealth apps and mental health; (4) mHealth apps in public health and health promotion.

### Smartphone apps in the Covid-19 pandemic

Nature Biotechnology 40, June 2022

Despite limitations, such as concerns around data privacy, data security, digital health illiteracy and structural inequities, there is ample evidence that apps are beneficial for understanding outbreak epidemiology, individual screening and contact tracing. While there were successes and failures in each category, outbreak epidemiology and individual screening were substantially enhanced by the reach of smartphone apps and accessory wearables.

### Beyond validation: getting health apps into clinical practice

Npj Digital Medicine 3(14), 2020

As work in digital health continues to expand, integrating health apps into clinical care delivery will be critical if digital health is to achieve its potential.

### Theme Trends and Knowledge Structure on Mobile Health Apps: Bibliometric Analysis

JMIR mHealth and uHealth 8(7), 2020

The co-occurrence cluster analysis of the top 100 keywords forms 5 clusters: (1) the technology and system development of mobile health apps; (2) mobile health apps for mental health; (3) mobile health apps in telemedicine, chronic disease, and medication adherence management; (4) mobile health apps in health behavior and health promotion; and (5) mobile health apps in disease prevention via the internet.

### Cardiology and respiratory care (including smoking cessation)

#### Effectiveness of cardiac rehabilitation with mHealth through smartphone functionalities: a systematic review protocol.

CJC Open 6(4), 2023

Smartphones are considered mHealth technology and have the potential to provide modalities for cardiac rehabilitation. This systematic review aims to examine these modalities and identify the most effective for improving exercise capacity, quality of life, and patient compliance.

#### Engagement With Gamification Elements in a Smoking Cessation App and Short-term Smoking Abstinence: Quantitative Assessment

JMIR Serious Games, 2023

This study highlights the likely positive effects of certain gamification elements such as levels and achievements on short-term smoking abstinence. Although more robust research with a larger sample size is needed, this research highlights the important role that gamification features integrated into mobile apps can play in facilitating and supporting health behavior change.

#### Virtual hospitals and digital doctors: how far are we from the CardioVerse?

European Heart Journal 44(1), 2023

Virtual reality, distant consultations, and telemedicine apps have already been introduced to healthcare with multiple different services. Nonetheless, a main limiting factor for the widespread adoption and diffusion of telemedicine has always been the need of several and different platforms for various medical purposes, making the patient-user often overwhelmed by the numerous divergent interfaces and physicians.

#### Efficacy of digital therapeutics in smoking cessation: A systematic review and meta-analysis

Medicine in Novel Technology Devices 17, 2023

This meta-analysis showed that DTs-assisted SC improved the prevalence of abstinence, PPA, and increased the participation of smokers in SC programs.

#### Implementation of a mHealth solution to remotely monitor patients on a cardiac surgical waiting list: service evaluation

JAMIA Open 4(3), 2021

The emergence of COVID-19 resulted in postponement of nonemergent surgical procedures for cardiac patients in London. mHealth represented a potentially viable mechanism for highlighting deteriorating patients on the lengthened cardiac surgical waiting lists.

#### Mobile health technology integrated care in older atrial fibrillation patients: a subgroup analysis of the mAFA-II randomised clinical trial

Age and Ageing 51(11), 2022

A mHealth technology-implemented ABC pathway is effective in reducing adverse clinical outcomes in older AF patients. The benefits obtained with mAFA intervention were attenuated at extreme ages.

#### Smoking Cessation Apps for People with Schizophrenia: How Feasible Are m-Health Approaches?

Behavioural Sciences 12(8), 2022

Smoking cessation apps could be acceptable and feasible for use in people with schizophrenia; Lack of motivation was perceived as the main potential barrier with regard to people with schizophrenia engaging with smoking cessation apps; In order to improve motivation of people diagnosed with schizophrenia, apps could include games, rewards, and/or social support; Smoking cessation apps with a simple interface seem to be

beneficial for this population; Apps may need to be tailored to consider this population's mental health needs.

### Apps for smoking cessation through Cognitive Behavioural Therapy. A review

Addiciones 33(4), 2021

Only three apps were identified as using CBT, and the techniques most commonly used were the recording of smoking history, progress visualised through graphics, psycho-educational videos, motivation, social support through social media, and elements of gamification to reinforce adherence and abstinence behaviour. The results recommend the inclusion of smoking behaviour analysis in these types of apps, as not all of them do so, as well as an interface between the health professionals and the users to provide a personalised treatment.

### Management of cardiovascular disease using an mHealth tool: a randomized clinical trial

Npj Digital Medicine 4(165), 2021

This randomized controlled, single-center, open-label trial tested the impact of a mobile health (mHealth) service tool optimized for ASCVD patient care.

### Mobile Health for Smoking Cessation Among Disadvantaged Young Women During and After Pregnancy: User-Centered Design and Usability Study

JMIR Formative Research 5(8), 2021

The user-centered design and usability testing of the mHealth app Kindle yielded useful insights. The involvement of end users, specifically socioeconomically disadvantaged women during and after their pregnancy, resulted in a prototype that met their needs and requirements (eg, mHealth app, secure communication between nurses and clients, easy-to-use interfaces, inclusion of game elements, and tailoring to the early stages of change in smoking cessation) to achieve readiness for smoking cessation.

### Mobile health applications for the detection of atrial fibrillation: a systematic review

EP Europace 23(1), 2021

Although the evidence for clinical effectiveness is limited, these devices may be useful in detecting AF. While mHealth is growing in popularity, its clinical, economic, and policy implications merit further investigation. More head-to-head comparisons between mHealth and medical devices are needed to establish their comparative effectiveness.

### Mobile health for walking on the tightrope of optimal physical activity to reduce the risk of atrial fibrillation

European Heart Journal 42(25), 2021

Risk factor and lifestyle optimization has public health relevance for the prevention of atrial fibrillation (AF) due to the high number of affected individuals and the high morbidity and mortality of the disease. In this context, the relationship between physical activity and AF has been of interest for a long time, but the potential benefit and harm derived from different levels of regular physical activity are still largely unknown.

### Has the SARS-CoV-2 outbreak influenced the uptake of a popular smoking cessation app in UK smokers? An interrupted time series analysis

JMIR mHealth and uHealth 8(6), 2020

In the UK, between 1 January 2020 and 31 March 2020, and between 1 January 2019 and 31 March 2020, there was no evidence that the SARS-CoV-2 outbreak has been associated with a large step change or increasing trend in downloads of a popular smoking cessation app. Findings on the association of the SARS-CoV-2 outbreak with a small step change or increasing trend were inconclusive.

### A Mobile Health Solution Complementing Psychopharmacology-Supported Smoking Cessation: Randomized Controlled Trial

JMIR mHealth and uHealth 8(4), 2020

The proposed mHealth solution complementing psychopharmacological therapy showed greater efficacy for achieving 1-year tobacco abstinence as compared with psychopharmacological therapy alone. It provides a basis for artificial intelligence–based future approaches.

### Mobile cardiology during the COVID-19 outbreak

Cardiovascular Research 116(12), 2020

The digital revolution is everywhere, influencing almost every part of our lives and it is here to stay, redesign, and disrupt. Healthcare is quickly becoming digital, as society is leveraging mobile applications (apps) for consultation, first diagnosis, physical fitness, improving adherence to therapies, obtaining medications, amongst many others.

### Big data, AI, and mHealththe digital evolution of Cardiology

Heart and Metabolism, 2020

We now acquire data in free-living people through direct-to-consumer wearables (eg, Apple Watch) and diagnostics (eg, AliveCor). These changes have been accompanied by a transition to digital electronic health records, wholegenome sequences, and footprints of our everyday social and commercial behaviors.

### Use of gamification strategies and tactics in mobile applications for smoking cessation: a review of the UK mobile app market

BMJ Open 9(6), 2019

The findings of this review show that a high level of gamification is adopted by a small minority of smoking cessation apps in the UK.

## Clinical support and decision tools

### Handheld Computer Devices to Support Clinical Decision-making in Acute Nursing Practice: Systematic Scoping Review

Journal of Medical Internet Research 25, 2023

The extant literature is varied but suggests that HCDs can be used effectively to support aspects of acute nursing care. However, there is a dearth of high-level evidence regarding this phenomenon and studies exploring the degree to which HCD implementation may affect acute nursing care delivery workflow.

### Cloud-based COVID-19 disease prediction system from X-Ray images using convolutional neural network on smartphone

Multimedia Tools and Applications 82, 2022

The performance of these models was compared, and it was found that the CNN model performs very well. The CNN-R achieved a 98.41 per cent validation accuracy, 98.75 per cent AUC and 98 per cent F1 score, which was small in size (49.28 MB) and had fewer parameters (6,447,138) and had an execution time of 2650 s for 50 iterations.

### A survey of mHealth use from a physician perspective in paediatric emergency care in the UK and Ireland

European Journal of Pediatrics 180, 2021

The British National Formulary (BNF/BNFc) app was installed on the personal mobile device of 96% of respondents that use medical apps. Forty percent of respondents had patient confidentiality concerns when using medical apps. Thirty-eight percent of respondents have used consumer instant messaging services, 6% secure specialist messaging services, and 29% smartphone photography when seeking patient management advice.

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### [The use of smartphone-application based medical photography for open fractures: A national survey of orthoplastic affiliated Major Trauma Centres in England.](#) Abstract only\*

Injury 53(6), June 2022

Plastic surgery is a highly visual specialty and clinical photography complements patient care. In the era of COVID-19 where resources are finite and professional photography not always available, this national survey highlights a demand for integrating smartphone app-based photography to improve guideline compliance, inter- and intra-disciplinary team communication and patient care.

### [Effects of a mobile phone application for graduate nurses to improve central venous catheter care: A randomized controlled trial.](#)

Journal of Advanced Nursing, 2021

Mobile app instruction for graduate nurses on central venous catheter care increased specific knowledge and skills compared with conventional methods of instruction. Impact statement: Implementation of mobile phone application technology can be considered a feasible means to proactively provide training and education. Mobile phone apps could be developed for a range of clinical procedures and various settings.

### [Designing a mHealth clinical decision support system for Parkinson's disease: a theoretically grounded user needs approach](#)

BMC Medical Information and Decision Making 20(34), 2020

Based on our approach, we could formulate the following principles of mHealth design: 1) enabling shared decision making between the clinician, patient and the carer; 2) flexibility that accounts for diagnostic and treatment variation among clinicians; 3) monitoring of information integration from multiple sources. Our approach highlighted the central importance of the

patient-clinician relationship in clinical decision making and the relevance of theoretical as opposed to algorithm (technology)-based modelling of human judgment.

### [How accurate are digital symptom assessment apps for suggesting conditions and urgency advice? A clinical vignettes comparison to GPs](#)

BMJ Open 10(12), 2020

The utility of digital symptom assessment apps relies on coverage, accuracy and safety. While no digital tool outperformed GPs, some came close, and the nature of iterative improvements to software offers scalable improvements to care.

### [The role of medical smartphone apps in clinical decision-support: A literature review](#)

Artificial Intelligence in Medicine 100, 2019

Clinical decision-support apps have considerable potential to enhance access to care and quality of care, but the medical community must rise to the challenge of modernising its approach if it is truly committed to capitalising on the opportunities of digitalisation.

### [Developing an acute oncology support smartphone app for Wales.](#)

Future Healthcare Journal 6(Suppl 1), 2019

Acute cancer emergencies present to a wide range of healthcare professionals and ensuring widespread access to acute oncology guidelines for busy non-cancer specialists is challenging. The development of a simple, easy to use, free to download app giving offline access to acute oncology guidelines aimed at non-specialist healthcare professionals has resulted in many downloads and user episodes suggesting that it is valued by staff.



### Cognitive Training for Robotic Arm-Assisted Unicompartmental Knee Arthroplasty through a Surgical Simulation Mobile Application

Journal of Knee Surgery 32(10), 2018

This randomized comparative study demonstrated that the TS app was better than traditional paper-based learning for both immediate posttest performance and long-term information recall of the Mako robotic arm-assisted unicompartmental knee arthroplasty. Surgical simulation apps may be an effective learning tool for surgical trainees.

### **Contact tracing and Covid-19**

### Innovative Methods Used in Monitoring COVID-19 in Europe: A Multinational Study

International Journal of Environmental Research and Public Health 20(1), 2023

Several innovative methods have been deployed worldwide to curb the COVID-19 pandemic. The aim of the study is to investigate which innovative methods are used to monitor COVID-19 health issues in Europe and related legislative and ethical aspects.

### A Review of Mobile Applications Available in the App and Google Play Stores Used During the COVID-19 Outbreak

Journal of Multidisciplinary Healthcare 14, 2022

The analysis revealed that various applications have been developed for different functions like contact tracing, awareness building, appointment booking, online consultation, etc. However, only a few applications have integrated various functions and features such as self-assessment, consultation, support and access to information. Also, most of the apps are focused on contact tracing, while very few are dedicated to raising awareness and sharing information about the COVID-19 pandemic.

### Public Adoption of and Trust in the NHS COVID-19 Contact Tracing App in the United Kingdom: Quantitative Online Survey Study

Journal of Medical Internet Research 23(9), 2021

While compliance on the part of the approximately 50% of participants who had the app was fairly high, there were issues surrounding trust and understanding that hindered adoption and, therefore, the effectiveness of digital contact tracing, particularly among BAME communities.

### Association between community-based self-reported COVID-19 symptoms and social deprivation explored using symptom tracker apps: a repeated cross-sectional study in Northern Ireland.

BMJ Open 11(6), 2021

Our findings indicate that social inequality, as measured by area-level deprivation, is associated with disparities in potential COVID-19 infection, with higher prevalence of self-reported COVID-19 symptoms in urban areas associated with area-level social deprivation, housing density and age.

### Observational study of UK mobile health apps for Covid-19

The Lancet Digital Health 2(8), June 2020

It is difficult to evaluate the effectiveness of COVID-19 apps because they have been implemented quickly to ensure they have a timely effect. We have carried out an observational study to evaluate the features of mobile phone apps released in response to the COVID-19 pandemic.

### **Dermatology and wound care**

### Improving Teledermatology Referral with Edge-AI: Mobile App to Foster Skin Lesion Imaging Standardization

Biomedical Engineering Systems and Technologies, 2023



## Evidence Brief: Apps, sensors and wearable technologies

This paper presents a new process for real-time automated image acquisition of macroscopic skin images with the merging of an automated focus assessment feature-based machine learning algorithm with conventional computer vision techniques to segment dermatological images.

### Remote assessment of surgical site infection (SSI) using patient-taken wound images: Development and evaluation of a method for research and routine practice

Journal of Tissue Viability 32(1), 2023

A simple, standardised and acceptable method for patients to take and transmit wound images suitable for remote assessment of SSI has been developed and tested and is now available for use in routine clinical care and research.

### AI-based smartphone apps for risk assessment of skin cancer need more evaluation and better regulation

British Journal of Cancer 124, 2021

Smartphone applications (“apps”) with artificial intelligence (AI) algorithms are increasingly used in healthcare. Widespread adoption of these apps must be supported by a robust evidence-base and app manufacturers’ claims appropriately regulated. Current CE marking assessment processes inadequately protect the public against the risks created by using smartphone diagnostic apps.

### Slack as a virtual undergraduate dermatology community: a pilot study

Clinical and Experimental Dermatology 46(6), 2021

A community-based online classroom can act as an enjoyable, acceptable and collaborative means of delivering dermatology education to undergraduate medical students. Its ease of use and supportive nature may also facilitate patient involvement. Such advances may provide vital safeguards against the

reduction in F2F learning that has accompanied the COVID-19 pandemic.

### Algorithm based smartphone apps to assess risk of skin cancer in adults: systematic review of diagnostics accuracy studies

BMJ 368, 2020

Current algorithm based smartphone apps cannot be relied on to detect all cases of melanoma or other skin cancers. Test performance is likely to be poorer than reported here when used in clinically relevant populations and by the intended users of the apps. The current regulatory process for awarding the CE marking for algorithm based apps does not provide adequate protection to the public.

## Genetics and genomics

### (Gene): A Co-Designed Smartphone App for Genetics Education and Empowerment in the Pakistani Community

Studies in Health Technology and Informatics 315, 2024

In the Pakistani/British Pakistani community in England it is quite common for people to marry close cousin relatives, which can increase the chances of certain genetic problems in their children. Families in these situations often have little knowledge of genetics and encounter difficulties accessing genetic counselling services and culturally appropriate genetics information is needed to support these families. We describe the co-design of a prototype culturally sensitive smart phone app with the British Pakistani community, to improve understanding of genetics and genetic services.

### Patient-facing genetic and genomic mobile apps in the UK: a systematic review of content, functionality and quality

Journal of Community Genetics 13(2), April 2022

This systematic review of patient-facing genetic/genomic mobile apps explores content, function, and quality. It was evident that

there are few high-quality genomic/genetic patient-facing apps available in the UK. This demonstrates a need for an accessible, culturally sensitive, evidence-based app to improve genetic literacy within patient populations and specific communities.

### HIV

[Three cycles of mobile app design to improve HIV self-management: a development and evaluation study](#) Full text available with NHS OpenAthens account\*

Digital Health 10, 2024

**OBJECTIVE:** Employing three cycles of Design Science Research (DSR) to develop a mobile app 'ESSC (Excellent Self Supervised HIV Care)' to improve self-management among people living with HIV (PLWH). **METHODS:** This study is based on the DSR framework comprising three iterative cycles. In the Relevance cycle, PLWH participated in a survey of mobile health (mHealth) experiences and needs. In the Rigor cycle, the information-motivation-behavioural skills (IMB) model was applied to foundations of the app, and HIV specialists verified the contents.

### Maternity and perinatal care

[Effects of digital health interventions in women with high-risk pregnancies: a systematic review](#)

Women's Health Nursing (Seoul, Korea), 2025

**Purpose:** This systematic review evaluated the effectiveness of digital health interventions (DHIs) using technology-based strategies for women with pregnancy complications.

[Usage of digital, social and goal-setting functionalities to support health behavior change: A mixed methods study among disadvantaged women during or after pregnancy and their healthcare professionals](#)

International Journal of Medical Informatics 170, 2023

To conclude, digital, social and goal-setting functionalities were used to a limited extent by nurses and clients, and need optimization before implementation to support disadvantaged groups to change their health behavior.

[First-time Mothers' Understanding and Use of a Pregnancy and Parenting Mobile App \(The Baby Buddy App\): Qualitative Study Using Appreciative Inquiry](#)

JMIR mHealth and uHealth 10(11), 2022

Although this study included a small sample, it elicited rich data and insights into first-time mothers' app interactions. The findings suggest that easily accessible pregnancy information, which is perceived as reliable, can support first-time mothers in communicating with health care professionals. Face-to-face contact with professionals was preferred, particularly to discuss specific and personalized needs.

[Review of Mobile Apps for Women With Anxiety in Pregnancy: Maternity Care Professionals' Guide to Locating and Assessing Anxiety Apps](#)

Journal of Medical Internet Research 24(3), 2022

There is a lack of resources that provide coping strategies based on current evidence for the treatment of anxiety in pregnancy. Maternity care providers are limited in their ability to locate and recommend acceptable and trustworthy apps because of the lack of information on the evidence base, development, and testing of apps. Maternity care professionals and women need access to libraries of trusted apps that have been evaluated against relevant and established criteria.

### A qualitative study of the utilisation of digital resources in pregnant Chinese migrant women's maternity care in northern England

Midwifery 115, 2022

Digitised information provision has become routine practice of the two NHS maternity services where the study is based. Digital resources are widely used by pregnant Chinese migrant women in search for health information.

### Baby Buddy App for Breastfeeding and Behavior Change: Retrospective Study of the App Using the Behavior Change Wheel

JMIR mHealth and uHealth, 2021

Baby Buddy is a well-designed platform that could be used to change breastfeeding behaviors. Findings from stage one showed that Best Beginnings had defined breastfeeding as a key behavior requiring support and demonstrated a thorough understanding of the context in which breastfeeding occurs, the barriers and enablers of breastfeeding, and the target actions needed to support breastfeeding.

### Smartphone applications available to pregnant women in the United Kingdom: An assessment of nutritional information

Maternal & Child Nutrition 16(2), 2020

Overall, smartphone apps do not consistently provide accurate and useful nutritional information to pregnant women. This study highlights the need for the integration of evidence-based nutritional information during app development and for increased regulatory oversight. App developers should also make it clear that nutritional content is intended for a specific geographical region or population or modify for the intended audience.

### Mobile Health Applications for Prenatal Assessment and Monitoring

Current Pharmaceutical Design 25(5), 2019

Despite the potential advantages of these devices, some caution must be taken when implementing this technology into routine daily practice. To date, the majority of published research on mobile health in the prenatal setting consists of observational studies and there is a need for high-quality randomized controlled trials to confirm the reported clinical and economic benefits as well as the safety of this technology.

## **Medicines and medicine management**

### Addressing the Challenges of Penicillin Allergy Delabeling With Electronic Health Records and Mobile Applications

The Journal of Allergy and Clinical Immunology in Practice 11(3), 2023

Allergy labels are common, often incorrect, and potentially harmful. There are many opportunities for clinical decision support (CDS) tools integrated in the electronic health record (EHR) and mobile apps to address the challenges with drug allergy management, including penicillin allergy delabeling (PADL).

### What affected UK adults' adherence to medicines during the COVID-19 pandemic? Cross-sectional survey in a representative sample of people with long-term conditions

Journal of Public Health 32, 2023

Navigating changes in how medicines were accessed, and disruption of habits during the COVID-19 pandemic, was associated with suboptimal adherence. People were resourceful in overcoming barriers to access. Solutions to support medicines-taking need to take account of the multiple ways that medicines are prescribed and supplied remotely.

### Mobile apps for quick adverse drug reaction report: A scoping review

Pharmacoepidemiology 32(1), 2022

Apps are easier and faster ways of reporting. The integration of such a tool in an individual care plan would allow to maintain a complete electronic health record at both individual and global level and could be eventually seen as an added value by both health professionals and patients.

### Mobile Apps to Improve Medication Adherence in Cardiovascular Disease: Systematic Review and Meta-analysis

Journal of Medical Internet Research 23(5), 2021

Apps tended to increase medication adherence, but interventions varied widely in design, content, and delivery. Apps have an acceptable degree of usability; yet the app characteristics conferring usability and effectiveness are ill-defined. Future large-scale studies should focus on identifying the essential active components of successful apps.

### Do mobile device apps designed to support medication adherence demonstrate efficacy? A systematic review of randomised controlled trials, with meta-analysis

BMJ Open 10(1), 2020

App-based medication adherence interventions may have a positive effect on patient adherence. Larger scale studies are required to further evaluate this effect, including long-term sustainability, and intervention and participant characteristics that are associated with efficacy and app usage.

## **Patient outcomes and behaviours**

### The impact of mobile health interventions on service users' health outcomes and the role of health professions: a systematic review of systematic reviews

BMC Digital Health 3(3), February 2025

Mobile health (mHealth) tools have gained prominence in global healthcare in recent years, with demonstrated impacts on managing service users' health. While many systematic reviews have assessed the effectiveness of mHealth on health outcomes, the role of health professions in promoting mHealth adoption and leading to improved outcomes is less clear. This systematic review of systematic reviews (SR of SRs) critically appraises and synthesises evidence to examine both the impact of mHealth interventions on service users' outcomes and the role of health professions in facilitating their adoption.

## **Primary care and care homes**

### Digital health technology: factors affecting implementation in nursing homes

Nursing Older People, 2020

Three broad themes emerged from the interviews: improving communication; engaging with DHT and retaining humanised care; and introducing DHT and protecting data security. The co-creation workshop participants formulated the LAUNCH process model, a nurse-led, stepped approach supporting DHT implementation in nursing homes.

## **Rehabilitation and physical activity**

### Technology-enabled hybrid cardiac rehabilitation: Qualitative study of healthcare professional and patient perspectives at three cardiac rehabilitation centres in England

PloS One 20(3), 2025

This study used focus groups and semi-structured interviews to explore staff and patient experiences of using the Active+me REMOTE hybrid CR app, a cloud-based platform providing access to education modules, behaviour change support, live exercise classes, physical activity and health monitoring across

three sites in the East of England.

### Experiences of health tracking in mobile apps for multiple sclerosis: A qualitative content analysis of user reviews

Multiple Sclerosis and Related Disorders 69, 2023

Self-tracking options in MS apps are currently limited, though the apps that offer these functions are considered useful by individuals with MS. Additional qualitative research is required to understand how specific app features and opportunities for personalization should be incorporated into new self-management tools for this population.

### Inpatient trial of a tablet app for communicating brain injury rehabilitation goals

Disability and Rehabilitation: Assistive technology 19(4), 2023

The current findings do not provide wholesale support for this approach, yet we continue to feel that approaches that support clinician-client communication using asynchronous video may offer considerable future value and are worthy of further investigation.

### Smartphone Apps Targeting Physical Activity in People With Rheumatoid Arthritis: Systematic Quality Appraisal and Content Analysis

JMIR mHealth and uHealth 8(7), 2020

This review identifies 4 PA apps of mixed quality and content for use by people with RA. Higher quality apps were more closely aligned to PA guidance and included a greater number of BCTs. One high-quality app (Rheumatoid Arthritis Information Support and Education) included 7 BCTs and was fully aligned with PA and exercise guidance.

### The Use of a Smartphone App and an Activity Tracker to Promote Physical Activity in the Management of Chronic Obstructive Pulmonary Disease: Randomized Controlled Feasibility Study

JMIR mHealth and uHealth 8(6), 2020

mHealth shows promise in helping people with COPD self-manage their physical activity levels. mHealth interventions for COPD self-management may be more acceptable to people with prior experience of using digital technology and may be more beneficial if used at an earlier stage of COPD.

### Smartphone-based systems for physical rehabilitation applications: A systematic review

Assistive Technology 33(4), 2019

The review identifies major research interests in stroke, cardiac disease, balance impairment and joint/limb rehabilitation; however, there is a lack of attention to other diseases. There are also few systems that have computerized existing clinical tests. On the basis of the review, design recommendations are formulated to encourage implementation of advanced functionalities, usability considerations, and system validation based on clinical evidence.

### Smartphone apps for total hip replacement and total knee replacement surgery patients: a systematic review

Disability and Rehabilitation 42(7), 2018

This study highlights that despite a wide range of apps currently available to total hip replacement and total knee replacement patients, there is significant variability in their quality. Future efforts should be made to develop apps in partnership with patients, to improve the content, interactivity and relevance of apps.



### Sexual and Reproductive Health

[Positive views, attitudes, and acceptability toward mHealth applications in addressing queer sexual and reproductive health: healthcare providers and the queer individuals](#)

Digital Health 10, 2024

OBJECTIVE: In the age of digital health, mankind has resources to write over the historical narrative of queer individuals' healthcare exclusions. The main purpose of this study was to explore the perspectives of both healthcare providers (HCPs) and queer individuals regarding the use of web-based tools and mobile health applications (mHealth apps) in the context of addressing queer individuals' sexual and reproductive health services and needs (SRHSN).

### Educating the workforce and role development

[Educating the healthcare workforce of the future: lessons learned from the development and implementation of a 'Wearables in Healthcare' course](#)

Npj Digital Medicine 6(214), 2023

Digital health technologies will play an ever-increasing role in the future of healthcare. It is crucial that the people who will help make that transformation possible have the evidence-based and hands-on training necessary to address the many challenges ahead. To better prepare the future health workforce with the knowledge necessary to support the re-engineering of healthcare in an equitable, person-centric manner, we developed an experiential learning course—Wearables in Healthcare—for advanced undergraduate and graduate university students.

[Assessing the digital literacy levels of the community pharmacy workforce using a survey tool](#) Abstract only\*

International Journal of Pharmacy Practice 31(1), 2023

Objectives: To investigate the digital literacy of staff in London,

UK, community pharmacies and to explore their perceptions about the use of eHealth tools. Methods: The study population was community pharmacy staff (N = 21,346) in Greater London

[Virtual reality and augmented reality smartphone applications for upskilling care home workers in hand hygiene: a realist multi-site feasibility, usability, acceptability, and efficacy study](#)

Journal of the American Medical Informatics Association: JAMIA 31(1), 2023

OBJECTIVES: To assess the feasibility and implementation, usability, acceptability and efficacy of virtual reality (VR), and augmented reality (AR) smartphone applications for upskilling care home workers in hand hygiene and to explore underlying learning mechanisms.

[Educating the healthcare workforce of the future: lessons learned from the development and implementation of a 'Wearables in Healthcare' course](#)

Digital Medicine 6(214), 2023

Digital health technologies will play an ever-increasing role in the future of healthcare. It is crucial that the people who will help make that transformation possible have the evidence-based and hands-on training necessary to address the many challenges ahead.

[Using live stream technology to conduct workplace observation assessment of trainee dental nurses: an evaluation of effectiveness and user experience](#)

BDJ open 9(4), 2023

This study provides evidence that workplace observation assessments can be performed in the future by using live stream technology. However, additional investigation and comparison will aid in determining the most effective way of using this approach and providing feedback to promote learning among dental trainees.



## Evidence Brief: Apps, sensors and wearable technologies

### New media platforms for teaching and networking: Emerging global opportunities for breast surgeons

Breast Care 18(3), 2023

Classrooms and operating theaters without walls that came with the internet boom brought substantial opportunities for breast surgeons. Platforms such as BreastGlobal, Breastics24h, Global Breast Hub, Oncoplastic Academy-Brazil, ibreastbook, Virtual Breast Oncoplastic Surgical Simulator and CluBreast helped surgeons who needed to get contemporary training and interaction for their professional continuous development.

### Digital health must be better integrated into medical education

BMJ 376, 2022

Digital health must be better integrated into our medical education and developed throughout the curriculum. As digital natives, medical students should be consulted on the design of digital health education, and we should push for better training within our medical schools. We must be equipped with the technological, legal, and ethical skills to prepare for a digital future and to ultimately provide the best care for our patients.

### Virtual Interactive Surgical Skills Classroom: A Parallel-group, Non-inferiority, Adjudicator-blinded, Randomised Controlled Trial (VIRTUAL)

Journal of Surgical Education 79(3), 2022

VCT provides greater accessibility and resource efficiency compared to FFT, with similar educational benefit. VCT has the potential to improve global availability and accessibility of surgical skills training.

### Mediating effects of academic self-efficacy and smartphone addiction on the relationship between professional attitude and academic burnout in nursing students: A cross-sectional study

Nurse Education Today 116, 2022

Of all the participants, 44.26 % had a certain degree of academic burnout. Professional attitude and academic self-efficacy were negatively related to academic burnout. Smartphone addiction was positively associated with academic burnout.

### Exploring the Shift in International Trends in Mobile Health Research From 2000 to 2020: Bibliometric Analysis

JMIR mHealth and uHealth 9(9), 2021

To the best of our knowledge, the most current bibliometric analysis dates back to 2016. However, the number of mHealth research published between 2017 and 2020 exceeds the previous total. The results of this study shed light on the latest hotspots and trends in mHealth research. These findings provide a useful overview of the development of the field; they may also serve as a valuable reference and provide guidance for researchers in the digital health field.

### Grass-roots junior doctor communication network in response to the COVID-19 pandemic: a service evaluation

BMJ Open Quality 10(2), 2021

This work demonstrates that a coordinated network using existing smartphone technologies and a novel communications structure can improve collaboration between senior leadership and junior doctors. Such a network could play an important role during times of pressure in a healthcare system.

### Integration of Technology in Medical Education on Primary Care During the COVID-19 Pandemic: Students' Viewpoint

JMIR Medical Education 6(2), 2020

Even in the absence of face-to-face teaching and clinical placements, students have been able to hone their medical

knowledge and soft skills through these virtual, simulated consultations. They have been exposed to a new consultation style while in a safe and collaborative learning space.

Perceptions of medical students towards online teaching during the COVID-19 pandemic: a national cross-sectional survey of 2721 UK medical students

BMJ Open 10(11), 2020

Online teaching has enabled the continuation of medical education during these unprecedented times. Moving forward from this pandemic, in order to maximise the benefits of both face-to-face and online teaching and to improve the efficacy of medical education in the future, we suggest medical schools resort to teaching formats such as team-based/problem-based learning. This uses online teaching platforms allowing students to digest information in their own time but also allows students to then constructively discuss this material with peers. It has also been shown to be effective in terms of achieving learning outcomes.

From smartphone to bed-side: exploring the use of social media to disseminate recommendations from the National Tracheostomy Safety Project to front-line clinical staff

Anaesthesia 75(2), 2020

This intelligence-led approach using social media is an effective and efficient method to disseminate knowledge on the principles of safe tracheostomy care to front-line clinical staff. Similar strategies may be effective for other patient safety topics, especially when targeting groups that do not use medical journals or other traditional means of dissemination.

Evaluation of Adaptive Feedback in a Smartphone-Based Game on Health Care Providers' Learning Gain: Randomized Controlled Trial

Journal of Medical Internet Research 7, 2020

There is a considerable learning gain between the first two rounds of learning with both forms of feedback and a small added benefit of adaptive feedback after controlling for learner differences. We suggest that linking the adaptive feedback provided to care providers to how they space their repeat learning session(s) may yield higher learning gains.

Effect of a game-based virtual reality phone application on tracheostomy care education for nursing students: A randomized controlled trial. Abstract only\*

Nurse Education Today 79, 2019

The game-based virtual reality phone application was effective in teaching the skill of suctioning a tracheostomy tube for nursing students in the short term, and it is recommended that this application be used in psychomotor skill training.

Use of Health Apps by Nurses for Professional Purposes: Web-Based Survey Study

JMIR mHealth and uHealth 7(11), 2019

Although the prescription of health apps in clinical environments is infrequent among nurses, they would be willing to prescribe apps if they were certified by a health organization. Finally, among nurses, there is a need for training in using and prescribing health apps for health care purposes.

### Diversity, inclusion and ethics

#### Mobile phone interventions to improve health outcomes among patients with chronic diseases: an umbrella review and evidence synthesis from 34 meta-analyses

The Lancet Digital Health 6(11), November 2024

This umbrella review of 34 meta-analyses, representing 235 randomised controlled trials done across 52 countries and 48 957 participants and ten chronic conditions, aimed to evaluate evidence on the efficacy of mobile phone interventions for populations with chronic diseases.

#### Consideration of inequalities in effectiveness trials of mHealth applications – a systematic assessment of studies from an umbrella review

International Journal for Equity in Health 23(181), 2024

The growing use of mobile health applications (apps) for managing diabetes and hypertension entails an increased need to understand their effectiveness among different population groups. It is unclear if efficacy and effectiveness trials currently provide evidence of differential effectiveness, and if they do, a summary of such evidence is missing. Our study identified to what extent sociocultural and socioeconomic inequalities were considered in effectiveness trials of mobile health apps in diabetic and hypertensive patients and if these inequalities moderated app effectiveness.

#### Recovery at your fingertips: pilot study of an mHealth intervention for work-related stress among nursing students

BMC Digital Health 2(64), 2024

Background: Work-related stress is detrimental to individual health and incurs substantial social costs. Interventions to tackle this problem are urgently needed, with mHealth solutions being a promising way of delivering accessible and standardized interventions on a wide scale. This study pilot tests a low-

intensive mHealth intervention designed to mitigate the negative consequences of stress through promoting recovery strategies.

#### From Digital Inclusion to Digital Transformation in the Prevention of Drug-Related Deaths in Scotland: Qualitative Study

Journal of Medical Internet Research 26, 2024

Background: Globally, drug-related deaths (DRDs) are increasing, posing a significant challenge. Scotland has the highest DRD rate in Europe and one of the highest globally. The Scottish Government launched the Digital Lifelines Scotland (DLS) program to increase the provision of digital technology in harm reduction services and other support services. Digital technology responses to DRDs can include education through digital platforms, improved access to treatment and support via telehealth and mobile apps, analysis of data to identify risk factors, and the use of digital tools for naloxone distribution.

#### Influencing Factors on the Success of Mobile Learning: A Systematic Review and Meta-Analysis

Investigacion & Educacion En Enfermeria 42(3), 2024

Objective. To study the geographical regions, success factors, and types of mobile device features that could result in educational success and early take-up. Methods. This systematic review and meta-analysis searched PubMed, CINAHL, EMBASE, PsycINFO and ProQuest databases between 2010 and November 2022. The keywords were m-learning features, practical experiences, and influencing. Comprehensive Meta-Analysis software was used to analyze and combine data. Results. 48 articles were reviewed in this study. Compatibility and user-friendliness of mobile phones were mentioned as key factors influencing the use of mobile devices in learning. Also, the key role of users' perspectives, attitudes, and skills as determinant factors of applying mobile technology in the learning process was revealed, which confirms its significant role in the success of m-Learning.

## Evidence Brief: Apps, sensors and wearable technologies

### Assessment of App Store Description and Privacy Policy to Explore Ethical and Safety Concerns Associated with the Use of Mental Health Apps for Depression

Indian Journal of Psychological medicine 45(2), 2023

There is an urgent need to improve the accessibility and usability of privacy policies by app developers, with the active involvement of other stakeholders.

### Older adults' user engagement with mobile health: A systematic review of qualitative and mixed methods studies

Innovation in Aging 7(2), 2023

Successful development and implementation of future mobile health intervention for older adults will be challenging given the physical and psychological limitations and motivational barriers that older adults experience. Design adaptations and well-thought-out blended alternatives (i.e. combining mobile health with face-to-face support) might be potential solutions to improve older adults' user engagement with mobile health interventions.

### Read and accepted? Scoping the cognitive accessibility of privacy policies of health apps and websites in three European countries

Digital Health, 2023

For this cross-sectional study, quantitative data collected in the Netherlands, Sweden, and the United Kingdom included: whether privacy information was in a country's official language (availability); number of distracting visual elements (ease of navigation); word count and Common European Framework of Reference (CEFR) reading level (readability). Health app privacy policies were compared to policies from a purposively selected sample of websites, and to benchmarks, including CEFR reading level B1.

### Locked out: Digitally excluded people's experiences of remote GP appointments

Healthwatch, 2021

The move to more digitally-led healthcare has worked well for some but excluded others over the past year. Our report explores how people have been excluded and what needs to happen to get the care they need.

### The need for feminist intersectionality in digital health

The Lancet Digital Health 3(8), 2021

In this Viewpoint, we show that because of lower access and exclusion from app design, gender imbalance in digital health leadership, and harmful gender stereotypes, digital health is disadvantaging women—especially women with racial or ethnic minority backgrounds. Tackling digital health's gender inequities is more crucial than ever.

### The ethics and value of contact tracing apps: International insights and implications for Scotland's COVID-19 response

Journal of Global Health 10(2), 2020

Drawing on UK and international experiences, it examines issues such as public trust, data privacy and technology design; how changing disease threats and contextual factors can affect the balance between public benefits and risks; and the importance of transparency, accountability and stakeholder participation for the trustworthiness and good-governance of digital systems and strategies.

### British South Asian Patients' Perspectives on the Relevance and Acceptability of Mobile Health Text Messaging to Support Medication Adherence for Type 2 Diabetes: Qualitative Study

JMIR mHealth and uHealth 8(4), 2020

There is increasing recognition that health interventions that are culturally adapted to the needs of specific groups are more likely to be relevant and acceptable, but evidence to support the

effectiveness of adapted interventions is limited and inconclusive.

### Is digital health care more equitable? The framing of health inequalities within England's digital health policy 2010–2017

Sociology of Health & Illness 41(S1), 2019

Revealing that while inclusion remains a priority area for policymakers, equity is being constituted in ways that reflect broader discourses of neoliberalism, empowerment and the turn to the market for technological solutionism, which may potentially exacerbate health inequalities.

### Moving beyond 'safety' versus 'autonomy': a qualitative exploration of the ethics of using monitoring technologies in long-term dementia care

BMC Geriatrics 19(145), 2019

There is an urgent need for greater consideration of the ethical and legal implications that remote technological monitoring might have upon workforce morale, recruitment and retention. Ensuring variety of technological design to facilitate equitable access for residents is financially extremely challenging. It is possible that considerations of equitable access are not deemed a priority due to the current generation of residents' low levels of technological familiarity and expectation.

## Leadership and strategy

### NHS needs better data from digital apps to tackle health inequalities, says report

BMJ, 2023

A lack of coordination and poor data collection is limiting efforts to understand how digital apps can tackle ethnic health inequalities, an analysis of NHS data has suggested.

### Charting a Course for Smartphones and Wearables to Transform Population Health Research

Journal of Medical Internet Research 25, 2023

The use of data from smartphones and wearable devices has huge potential for population health research, given the high level of device ownership; the range of novel health-relevant data types available from consumer devices; and the frequency and duration with which data are, or could be, collected. Yet, the uptake and success of large-scale mobile health research in the last decade have not met this intensely promoted opportunity.

### A scoping review of virtual care in the health system: infrastructures, barriers, and facilitators

Health Care Services Quarterly 42(2), 2023

For virtual care models to be able to improve the safety and quality of care, it is essential to identify the strengths and weaknesses of virtual care. In this Scoping review, literature published on virtual care was identified using international databases.

### Digital health education: the need for a digitally ready workforce

ADC Education & Practice 108(3), 2022

With widely available digital access comes improved equality in healthcare, especially for families finding it difficult to travel to attend appointments, access health information, self-manage conditions and reach HCPs. Those that struggle to access digital health must not be left behind.

### Leadership in the context of digital health services: A concept analysis

Journal of Nursing Management 30(7), 2022

Leadership attributes concerned leaders' behaviour, roles and qualities. Antecedents concerned informatics skills and competence, information and tools, understanding care systems



and their complexity and education. Consequences related to organization, professionals and patient and care.

### Strategic Guidance and Technological Solutions for Human Resources Management to Sustain an Aging Workforce: Review of International Standards, Research, and Use Cases

JMIR Human Factors 9(3), 2022

The synergy of international standardization and ethical framework tools with research can advance information and communication technology solutions in improving aging workforces. There appears to be a momentum that technological solutions to achieve an age-inclusive workforce will undoubtedly find a stronger place within the global context and is most likely to have increased acceptance of technological applications among aging workers as well as organizations and governments.

### Deploying a novel custom mobile application for STEMI activation and transfer in a large healthcare system to improve cross-team workflow. STEMIcathAID implementation project

Full text available with NHS OpenAthens account\*

The American Heart Journal 253, 2022

In conclusion, we developed a uniform approach for deployment of a mobile application for STEMI care in a large urban healthcare system in preparation for a pilot project employing the app for inter-hospital transfer of STEMI patients. We demonstrate that a STEMI care app can be deployed into clinical workflow in a safe way without interrupting the ongoing clinical process.

### Unmet informatics needs of nurses regarding the use of personal smartphones in the workplace

International Nursing Review, 2022

The unintended perception gaps between nurses and managers regarding work-related smartphone use can be closed by nursing leadership. Unmet nursing informatics, particularly for

information-seeking purposes, can be addressed in the context of quality assurance. Nurse leaders can advocate secure and proper use of smartphones in clinical practice.

### Health information technology and digital innovation for national learning health and care systems

The Lancet Digital Health 3(6), 2021

Current and future opportunities include integrating electronic health records across health and care providers, investing in health data science research, generating real-world data, developing artificial intelligence and robotics, and facilitating public–private partnerships. Many ethical challenges and unintended consequences of implementation of health information technology exist.

### Prospective Intention-Based Lifestyle Contracts: mHealth Technology and Responsibility in Healthcare

Health Care Analysis 29, 2021

This paper has two components. Firstly, it details empirical findings from a survey of 81 members of the United Kingdom general public on public attitudes towards individual responsibility and rationing healthcare, prospective and retrospective responsibility, and the acceptability of lifestyle contracts in the context of mobile health technology. Secondly, we draw on the empirical findings and propose a model of prospective intention-based lifestyle contracts, which is both more aligned with public intuitions and less ethically objectionable than more traditional, retrospective models of responsibility in healthcare.

### Ten statements to support nurse leaders implement e-health tools for nursing work in hospitals: A modified Delphi study

Journal of Clinical Nursing 30, 2021

Implementation of e-health tools for nursing work is complex in health settings and requires careful examination of multiple



## Evidence Brief: Apps, sensors and wearable technologies

factors and interactions between clinicians, tools, service users and the health organisation. This research proposes ten statements to support nurse leaders with decisions about implementing e-health tools to support nursing work in hospitals.

### Digital Innovation: Transition to Practice Using Apple Clips to Teach Nursing Leadership

Full text available with NHS OpenAthens account\*

Journal of Nursing Education 59(5), 2020

A digital assignment offers an opportunity to imagine learning assignments in nursing education that capture student attention in a non-traditional method reflecting the impact of technology on nursing education.

### Implementation of a Web-Based Tool With Text Message Prompts to Improve End-of-Shift Assessments for Emergency Medicine Residents

Journal of Graduate Medical Education 12(6), 2020

We found mixed evidence in support of using a web-based tool with text message prompts for mESA for EM trainees.

### Use of instant messaging to enhance leadership and management training for rural nurse managers

Nursing Management 26(6), 2019

Themes from the messages were identified as social interaction, professional networking and educational interactions. The findings demonstrate that instant messaging can be a useful platform for learners and their facilitators in a blended type of learning and can enhance communication, promote social interaction and professional networking, and support the application of knowledge to practice.

### Who uses apps in health promotion? A target group analysis of leaders

Health Informatics Journal, 2017

The findings showed that neuroticism, physical health and health-promoting leadership were important predictors for using an app for monitoring personal health and getting in social contact about health issues. The stress/recovery state was significantly related to the feature of getting in social contact.

### Leadership in practice: an analysis of collaborative leadership in the conception of a virtual ward

Nursing Management 23(6), 2016

This article describes how collaborative leadership was used to successfully implement a virtual ward in the primary care setting in south-east Powys, Wales. The author describes the leadership style and addresses strategies used to manage the change process. The journey demonstrates how collaborative leadership and working collectively enabled a new service to be developed, and established a mutual respect for different professionals' roles.

## **Mental health apps and wearables for the workforce and other service users**

### Smartphone apps for mental health: systematic review of the literature and five recommendations for clinical translation

BMJ Open 15(2), 2025

Objectives: Providing adequate access to mental health services is a global challenge. Smartphone apps offer a potentially cost-effective, available and accessible solution for monitoring, supporting and treating mental health conditions. This systematic review describes and evaluates the usage of smartphone apps across a wide range of mental health disorders in terms of clinical effectiveness, feasibility and acceptability.

## Evidence Brief: Apps, sensors and wearable technologies

### Recovery at your fingertips: pilot study of an mHealth intervention for work-related stress among nursing students

BMC Digital Health 2(64), 2024

Background: Work-related stress is detrimental to individual health and incurs substantial social costs. Interventions to tackle this problem are urgently needed, with mHealth solutions being a promising way of delivering accessible and standardized interventions on a wide scale. This study pilot tests a low-intensive mHealth intervention designed to mitigate the negative consequences of stress through promoting recovery strategies.

### Wearable devices for anxiety & depression: A scoping review

Computer Methods and Programs in Biomedicine Update 3, 2023

The emergence of affordable, consumer-grade biosensors offers the potential for new approaches to support mental health therapies for illnesses such as anxiety and depression. We believe that purposefully-designed wearable devices that combine the expertise of technologists and clinical experts can play a key role in self-care monitoring and diagnosis.

### Smartphone apps for mental health and wellbeing: A usage survey and machine learning analysis of psychological and behavioral predictors

Digital Health, 2023

Findings from the present study confirm that the use of SAMHW is growing, particularly among younger adult and female individuals who are negatively impacted by problematic smartphone use, COVID-19, and mental health problems. These individuals tend to bypass traditional care via psychotherapy or psychopharmacology, relying instead on smartphones to address mental health conditions or improve wellbeing.

### Health Care Workers' Need for Headspace: Findings From a Multisite Definitive Randomized Controlled Trial of an Unguided Digital Mindfulness-Based Self-help App to Reduce Healthcare Worker Stress

JMIR mHealth and uHealth 10(8), 2022

An unguided digital MBSH intervention (Headspace) can reduce health care workers' stress. Effect sizes were small but could have population-level benefits. Unguided digital MBSH interventions can be part of the solution to reducing health care worker stress alongside potentially costlier but potentially more effective in-person mindfulness-based interventions, nonmindfulness courses, and organizational-level interventions.

### Multicentre, England-wide randomised controlled trial of the 'Foundations' smartphone application in improving mental health and well-being in a healthcare worker population

British Journal of Psychiatry 222(2), 2022

The app had an effect in reducing psychiatric morbidity symptoms in a sample of HCWs. Given it is scalable with no adverse effects, the app may be used as part of an organisation's tiered staff support package. Further evidence is needed on long-term effectiveness and cost-effectiveness.

### The use of mobile phone applications to enhance personal safety from interpersonal violence - an overview of available smartphone applications in the United Kingdom.

BMC Public Health 22(1158), 2022

Reviews suggest that users find apps for personal safety and violence prevention useful. However, individuals also report them being unreliable, not working as described and having features that others may exploit. Findings have implications for the development of policy on apps to improve personal safety, especially given recent national policy (e.g. UK) discussions about their utility.

### The Apple Watch for Monitoring Mental Health–Related Physiological Symptoms: Literature Review

JMIR Mental Health 9(9), 2022

The results are encouraging regarding the application of the Apple Watch in mental health, particularly as heart rate variability is a key indicator of changes in both physical and emotional states. Particular benefits may be derived through avoidance of recall bias and collection of supporting ecological context data. However, a lack of methodologically robust and replicated evidence of user benefit, a supportive health economic analysis, and concerns about personal health information remain key factors that must be addressed to enable broader uptake.

### Stressors and Destressors in Working From Home Based on Context and Physiology From Self-Reports and Smartwatch Measurements: International Observational Study Trial

JMIR Formative Research 6(11), 2022

The results show that there are stressors and destressors when working from home that should be considered when managing stress in employees. Some of these stressors and destressors are (in)directly measurable with unobtrusive sensors, and prediction models based on these data show promising results for the future of automatic stress detection and management.

### Apprentices' Attitudes Toward Using a Mental Health Mobile App to Support Healthy Coping: Mixed Methods Study

JMIR Human Factors 9(3), 2022

Four major types of coping behaviors were identified: (1) social connection for disclosure, advice, and socializing; (2) pleasurable activities, such as engaging in hobbies, time-outs, and developing work-life separation; (3) cognitive approaches, including defusing from thoughts and cognitive reframing; and (4) self-care approaches, including exercise, a healthy diet, and getting adequate sleep.

### The Efficacy of “Foundations,” a Digital Mental Health App to Improve Mental Well-being During COVID-19: Proof-of-Principle Randomized Controlled Trial

JMIR mHealth and uHealth 10(7), 2022

This study provides a proof of principle that the digital mental health app Foundations can improve measures of mental well-being, anxiety, resilience, and sleep within 2 weeks of use, with greater effects after 4 weeks. Foundations therefore offers potential as a scalable, cost-effective, and accessible solution to enhance mental well-being, even during times of crisis such as the COVID-19 pandemic.

### Co-Design, Delivery, and Evaluation of Wellbeing Initiatives for NHS Staff: The HOW (Healthier Outcomes at Work) NHS Project

International Journal of Environmental Research and Public Health 19(8), 2022

Pre-post-intervention analysis demonstrated improvements in work engagement and working conditions, although significant improvements were only found in mean scoring on demands, control, managerial support, and peer support working condition measures. The project therefore demonstrates that co-produced initiatives which focus on improving either the organisation or resilience of the workforce may be useful in supporting employee health and wellbeing

### Evaluating the effectiveness and quality of mobile applications for perinatal depression and anxiety: A systematic review and meta-analysis

Journal of Affective Disorders 296, 2022

Despite their widespread availability, mHealth apps do not appear to effectively reduce perinatal depression or anxiety, and few were subjectively rated to be of high quality. There is a need to develop higher quality mHealth apps and assess their potential to improve perinatal maternal mental health.

### Improving Access to Behavioral Strategies to Improve Mental Well-being With an Entertaining Breakfast Show App: Feasibility Evaluation Study

JMIR Formative Research 6(3), 2022

This study shows that the app Wakey! could potentially be engaging across different socioeconomic groups, and there is an indication that it could positively impact the mental well-being of those engaged with the app. However, this study was a pragmatic trial with a limited sample, and the selection bias was present in the qualitative and quantitative study.

### Review of Mobile Apps for Women With Anxiety in Pregnancy: Maternity Care Professionals' Guide to Locating and Assessing Anxiety Apps

Journal of Medical Internet Research 24(3), 2022

App developers, publishers, and maternity care professionals should seek advice from women with lived experience of anxiety symptoms in pregnancy to locate, promote, and optimize the visibility of apps for pregnant women. There is a lack of resources that provide coping strategies based on current evidence for the treatment of anxiety in pregnancy. Maternity care providers are limited in their ability to locate and recommend acceptable and trustworthy apps because of the lack of information on the evidence base, development, and testing of apps.

### Design and Development of a Mobile Health (mHealth) Platform for Dementia Prevention in the Prevention of Dementia by Mobile Phone Applications (PRODEMOS) Project.

Frontiers in Neurology 16;12, 2021

Early involvement of end-users in the development process and during evaluation phases improved acceptability of the mHealth intervention. The actual use and usability of the PRODEMOS intervention will be assessed during the ongoing PRODEMOS

randomized controlled trial, taking a dual focus on effectiveness and implementation outcomes.

### Care co-ordinator in my pocket': a feasibility study of mobile assessment and therapy for psychosis (TechCare)

BMJ Open 11(11), 2021

Innovative digital clinical technologies, such as the TechCare App, have the potential to increase access to psychological interventions, reduce health inequality and promote self-management with a real-time intervention, through enabling access to mental health resources in a stigma-free, evidence-based and time-independent manner.

### Just-in-Time Adaptive Mechanisms of Popular Mobile Apps for Individuals With Depression: Systematic App Search and Literature Review

Journal of Medical Internet Research 23(9), 2021

Owing to this lack of tailoring to individual, state, or situation, we argue that the apps cannot be considered JITAIs. The lack of publications investigating whether JITAI mechanisms lead to an increase in the effectiveness or efficacy of the apps highlights the need for further research, especially in real-world apps.

### Influences on the uptake of health and wellbeing apps and curated app portals: think-aloud and interview study

JMIR mHealth and uHealth 9(4), April 2021

The uptake of health and well-being apps appears to be primarily affected by social influences and the perceived utility of an app. App uptake via curated health app portals perceived as credible may mitigate concerns related to data protection and accuracy, but their implementation must better meet user needs and expectations.

## Evidence Brief: Apps, sensors and wearable technologies

### Co-Creating and Evaluating an App-Based Well-Being Intervention: The HOW (Healthier Outcomes at Work) Social Work Project

International Journal of Environmental Research and Public Health 17(23), 2020

Six months following dissemination, surveys demonstrated significant improvements in communication, and mean score improvements in four other working conditions. This project, therefore, demonstrates that co-developed initiatives can be positively impactful, despite post-intervention data collection being impacted by COVID-19.

### Experiences and implications of smartphone apps for depression and anxiety.

Sociology of Health & Illness 42(4), 2020

People engage with apps in a straightforward and uncomplicated manner, leading to immediate symptomatic alleviation, but to limited longer term benefit. The contradiction between the apps' promise as tools of individual empowerment, with their ability to promote responsibilising frameworks that restrain users' reflexivity, is central to their implications. Apps can thus contribute to isolation from interpersonal support and promote reductionist biomedical conceptualisations of mental ill health.

### Exploring Suicidal Ideation Using an Innovative Mobile App- Strength Within Me: The Usability and Acceptability of Setting up a Trial Involving Mobile Technology and Mental Health Service Users

JMIR Mental Health 7(9), 2020

This study reports on the engagement with the SWiM app, the technical difficulties the research team faced, the importance of building key relationships, and the implications of using Facebook as a source to detect suicidality.

### Smartphone-Enhanced Symptom Management In Psychosis: Open, Randomized Controlled Trial.

Journal of Medical Internet Research 22(8), 2020

The active smartphone monitoring system is feasible and was accepted by users in a 3-month study of people with severe mental illness, with surprisingly high levels of adherence. App use was associated with psychotic symptom improvement in recent-onset participants, but not those with longstanding illness, supporting the notion of improved self-management. When built into clinical management workflows to enable personalized alerts of symptom deterioration, the app has demonstrated utility in promoting earlier intervention for relapse.

### Using technology to support the emotional and social well-being of nurses: A scoping review

Journal of Advanced Nursing 76(1), 2020

Nurse retention is an international issue linked to quality of patient care. There are financial implications for healthcare providers who compensate for the workforce deficit by employing costly agency staff. This scoping review aims to map and evaluate the available literature on technology-mediated support for the emotional and social well-being of nurses.

## Remote monitoring

### A scoping review of digital technologies in antenatal care: recent progress and applications of digital technologies

BMC Pregnancy and Childbirth 25(1), 2025

INTRODUCTION: Digital health technologies have vastly improved monitoring, diagnosis, and care during pregnancy. As expectant mothers increasingly engage with social media, online platforms, and mobile applications, these innovations present valuable opportunities to enhance the quality of maternal healthcare services., OBJECTIVE: This review aims to assess



the applicability, outcomes, and recent advancement of digital health modalities in antenatal care.

### Devices for remote continuous monitoring of people with Parkinson's disease: a systematic review and cost-effectiveness analysis

Health Technology Assessment (Winchester, England) 28(30), 2024

Background: Parkinson's disease is a brain condition causing a progressive loss of coordination and movement problems. Around 145,500 people have Parkinson's disease in the United Kingdom. Levodopa is the most prescribed treatment for managing motor symptoms in the early stages. Patients should be monitored by a specialist every 6-12 months for disease progression and treatment of adverse effects. Wearable devices may provide a novel approach to management by directly monitoring patients for bradykinesia, dyskinesia, tremor and other symptoms. They are intended to be used alongside clinical judgement. Objectives: To determine the clinical and cost-effectiveness of five devices for monitoring Parkinson's disease: Personal KinetiGraph, Kinesia 360, KinesiaU, PDMonitor and STAT-ON.

### Patient Characteristics Associated With Disparities in Engagement With and Experience of COVID-19 Remote Home Monitoring Services: A Mixed-Methods Evaluation

Health Expectations 27(4), 2024

Introduction: The adoption of remote healthcare methods has been accelerated by the COVID-19 pandemic, but evidence suggests that some patients need additional support to engage remotely, potentially increasing health disparities if needs are not met. This study of COVID-19 remote home monitoring services across England explores experiences of and engagement with the service across different patient groups. Method(s): This was a mixed-methods study with survey and interview data collected

from 28 services across England between February and June 2021.

### Investigating barriers & facilitators for the successful implementation of the BP@home initiative in London: primary care perspectives

Plos One 19(2), 2024

BACKGROUND: The Covid-19 pandemic led to the implementation of a national policy of shielding to safeguard clinically vulnerable patients. To ensure consistent care for high-risk patients with hypertension, NHS England introduced the BP@home initiative to enable patients to self-monitor their blood pressure by providing them with blood pressure monitors. This study aimed to identify barriers and facilitators to the implementation of the initiative based on the experience and perspectives of programme managers and health care professionals (HCPs) involved in its implementation in London.

### Cost-Effectiveness of Remote Cardiac Monitoring With the CardioMEMS Heart Failure System: A Systematic Review

Medical Journal of the Islamic Republic of Iran 37, 2023

Background: Heart Failure (HF) imposes a relevant burden and a considerable health concern, with high prevalence and mortality rates. This study was conducted to assess the cost-effectiveness of remote cardiac monitoring with the CardioMEMS Heart Failure System. Methods: In the present systematic review, several scholarly databases were searched and updated from inception up to September 20, 2022. The objective of the present review was formulated according to the patient/population, intervention, comparison and outcomes format.

### Towards a framework for implementing remote patient monitoring from an integrated care perspective: a scoping review

International Journal of Health Policy and Management 12(1), pp. 1–13, 2023



BACKGROUND: Remote patient monitoring (RPM) has been increasingly adopted over the last decade, with the Covid-19 pandemic fostering its rapid development. As RPM implementation is recognised as complex and highly demanding in terms of resources and processes, there are multiple challenges in providing RPM in an integrated logic.

### Continuous Glucose Monitoring

[Removing barriers to management of adults with type 2 diabetes on insulin using continuous glucose monitoring in UK primary care practice: An expert consensus](#)

Diabetic Medicine : A Journal of the British Diabetic Association 42(3), 2025

AIMS: This expert consensus reviews the reality of primary care clinical management of people with type 2 diabetes (T2D) on non-intensive insulin therapy, with an emphasis on the use of continuous glucose monitoring (CGM) technology for effective care in this participant group. Here, we identify key unmet needs for skills and systems development within this frontline healthcare setting, along with major challenges and opportunities associated with managing these changes effectively.

[Budget impact analysis of continuous glucose monitoring in individuals with type 2 diabetes on insulin treatment in England](#)

Health Economics Review 14(1), 2024

Introduction: In 2022, updated guidance from NICE expanded the options for self-monitoring of blood glucose for patients with type 2 diabetes (T2DM), to include continuous glucose monitoring (CGM). In this budget impact analysis, the cost impact of CGM was compared with traditional self-monitoring of blood glucose (SMBG) in adults with T2DM over 1 year from the commissioner perspective in England.

[Evaluation of Glycemic Control in Patients With Diabetes by a Continuous Glucose Monitoring System During the Month of Ramadan](#)

Cureus 16(10), 2024

INTRODUCTION: Ramadan presents challenges for patients with type 2 diabetes mellitus (T2DM) who choose to fast. Maintaining good glycemic control through regular monitoring during fasting is crucial. This study aims to evaluate and compare glycemic fluctuations in fasting and non-fasting T2DM patients during Ramadan.

### Covid-19

[A rapid mixed-methods evaluation of remote home monitoring models during the COVID-19 pandemic in England](#)

Background: Remote home monitoring services were developed and implemented for patients with COVID-19 during the pandemic. Patients monitored blood oxygen saturation and other readings (e.g. temperature) at home and were escalated as necessary., Objective: To evaluate effectiveness, costs, implementation, and staff and patient experiences (including disparities and mode) of COVID-19 remote home monitoring services in England during the COVID-19 pandemic (waves 1 and 2).

[Patient and staff experiences of using technology-enabled and analogue models of remote home monitoring for COVID-19 in England: A mixed-method evaluation](#)

International Journal of Medical Informatics 179, 2023

Objective: To evaluate patient and staff experiences of using technology-enabled ('tech-enabled') and analogue remote home monitoring models for COVID-19, implemented in England during the pandemic. Method(s): Twenty-eight sites were selected for diversity in a range of criteria (e.g. pre-hospital or early discharge service, mode of patient data submission).

Between February and May 2021, we conducted quantitative surveys with patients, carers and staff delivering the service, and interviewed patients, carers, and staff from 17 of the 28 services.

### Remote patient monitoring for COVID-19 patients: comparisons and framework for reporting

BMC Health Services Research 23(1), 2023

BACKGROUND: COVID-19 has challenged health services throughout the world in terms of hospital capacity and put staff and vulnerable populations at risk of infection. In the face of these challenges, many health providers have implemented remote patient monitoring (RPM) of COVID-19 patients in their own homes. However systematic reviews of the literature on these implementations have revealed wide variations in how RPM is implemented; along with variations in particulars of RPM reported on, making comparison and evaluation difficult.

### Exploring the patient experience of remote hypertension management in Scotland during COVID-19: a qualitative study

BMJ Open 13(12), 2023

Objectives The aim of this study was to understand how patients experienced hypertension management, with or without blood pressure (BP) telemonitoring, during the COVID-19 pandemic. Design, methods, participants and setting This qualitative study conducted between April and November 2022 consisted of 43 semistructured telephone interviews (23 men and 20 women) from 6 primary care practices in one area of Scotland.

### Staff experiences of training and delivery of remote home monitoring services for patients diagnosed with COVID-19 in England: A mixed-methods study

Journal of Health Services Research and Policy 28(3), 2023

Objectives: Remote home monitoring services for patients at risk of rapid deterioration introduced during the COVID-19 pandemic had important implications for the health workforce. This study

explored the nature of 'work' that health care staff in England undertook to manage patients with COVID-19 remotely, how they were supported to deliver these new services, and the factors that influenced delivery of COVID-19 remote home monitoring services for staff.

### Patient and Clinician Perceptions of the Pulse Oximeter in a Remote Monitoring Setting for COVID-19: Qualitative Study

Journal of Medical Internet Research 25(1), 2023

Background: As a response to the COVID-19 pandemic, the Sydney Local Health District in New South Wales, Australia, launched the rpavirtual program, the first full-scale virtual hospital in Australia, to remotely monitor and follow up stable patients with COVID-19. As part of the intervention, a pulse oximeter wearable device was delivered to patients to monitor their oxygen saturation levels, a critical indicator of COVID-19 patient deterioration. Understanding users' perceptions toward the device is fundamental to assessing its usability and acceptability and contributing to the effectiveness of the intervention, but no research to date has explored the user experience of the pulse oximeter for remote monitoring in this setting.

## **Sensors and Wearables: implementation and effectiveness**

### New and emerging technology for adult social care - the example of home sensors with artificial intelligence (AI) technology

Health and Social Care Delivery Research 11(9), June 2023

This study evaluates how one example of a technology using home-based sensors with artificial intelligence capabilities (pseudonymised as 'IndependencePlus') was implemented in three case study sites across England. The focus of this study was on decision-making processes and implementation.

### A comparison of perceived image quality between computer display monitors and augmented reality smart glasses

Radiography 29(3), 2023

Introduction: Augmented-reality (AR) smart glasses provide an alternative to standard computer display monitors (CDM). AR smart glasses may provide an opportunity to improve visualisation during fluoroscopy and interventional radiology (IR) procedures when there can be difficulty in viewing intra-procedural images on a CDM. The aim of this study was to evaluate radiographer perception of image quality (IQ) when comparing CDM and AR smart glasses.

### New and emerging technology for adult social care - the example of home sensors with artificial intelligence (AI) technology

Health and Social Care Delivery Research 11(9), 2023

Background: Digital technology is a focus within the NHS and social care as a way to improve care and address pressures. Sensor-based technology with artificial intelligence capabilities is one type of technology that may be useful, although there are gaps in evidence that need to be addressed.,

### Are wearable electronic vision enhancement systems (wEVES) beneficial for people with age-related macular degeneration? A scoping review

Ophthalmic & Physiological Optics: The Journal of the British College of Ophthalmic Opticians (Optometrists) 43(4), 2023  
INTRODUCTION: Age-related macular degeneration (AMD) is the most common cause of irreversible visual impairment in the United Kingdom. It has a wide-ranging detrimental impact on daily living, including impairment of functional ability and quality of life. Assistive technology designed to overcome this impairment includes wearable electronic vision enhancement systems (wEVES). This scoping review assesses the usefulness of these systems for people with AMD.

### What impacts the acceptability of wearable devices that detect opioid overdose in people who use opioids? A qualitative study

Drug and Alcohol Review 43(1), 2023

Introduction: Drug-related deaths involving an opioid are at all-time highs across the United Kingdom. Current overdose antidotes (naloxone) require events to be witnessed and recognised for reversal. Wearable technologies have potential for remote overdose detection or response but their acceptability among people who use opioids (PWUO) is not well understood. This study explored facilitators and barriers to wearable technology acceptability to PWUO.

### Wearable full-body motion tracking of activities of daily living predicts disease trajectory in Duchenne muscular dystrophy

Nature Medicine 29, 2023

The biomarker developed in this study, derived from digital readouts of daily-life movement behavior, can predict disease progression in patients with muscular dystrophy and can potentially track the response to therapy.

### The applications of wearable devices in the rehabilitation of ankle injuries: A systematic review and meta-analysis

Medicine in Novel Technology and Devices 17, 2023

Wearable devices are a promising approach that has positive effects on ankle injuries in terms of functional performance and reducing the extent of swelling. There is insufficient evidence from randomized controlled trials (RCTs) to support this for ankle injury patients using wearable devices.

### Acceptability of wearable devices for measuring mobility remotely: Observations from the Mobilise-D technical validation study

Digital Health, 2023

Digital tools may bridge existing communication gaps between patients and clinicians and participants are open to this. This

work indicates that waist-worn devices are supported, but further work with patient advisors should be undertaken to understand some of the key issues highlighted.

### Premature atrial and ventricular contractions detected on wearable-format electrocardiograms and prediction of cardiovascular events

European Heart Journal: Digital Health 4(2), 2023

In middle-aged individuals without CVD, premature contractions identified in 15 s single-lead ECGs are strongly associated with an increased risk of AF and HF. These data warrant further investigation to assess the role of wearable ECGs for early cardiovascular risk stratification.

### Self-Management of Subclinical Common Mental Health Disorders (Anxiety, Depression and Sleep Disorders) Using Wearable Devices

International Journal of Environmental Research and Public Health 20(3), 2023

We screened 445 papers and analysed the reports from 12 wearable devices concerning their device type, year, biometrics used, and machine learning algorithm deployed. Electrodermal activity (EDA/GSR/SC/Skin Temperature), physical activity, and heart rate (HR) are the most common biometrics with nine, six and six reference counts, respectively. Additionally, while smartwatches have greater penetration and integration within the marketplace, fitness trackers have the most significant public value benefit of £513.9 M, likely due to greater retention.

### Mobility recorded by wearable devices and gold standards: the Mobilise-D procedure for data standardization

Scientific Data 10(38), 2023

These guidelines highlight the encountered challenges and the adopted solutions with the final aim of supporting standardization and integration of data in other studies and, in turn, to increase

and facilitate comparison of data recorded in the scientific community. We also provide samples of standardized data, so that both the structure of the data and the procedure can be easily understood and reproduced.

### Evaluation of Huawei smart wearables for detection of atrial fibrillation in patients following ischemic stroke: The Liverpool-Huawei stroke study

American Heart Journal 257, 2023

Atrial fibrillation (AF) often remains undetected following stroke. Documenting AF is critical to initiate oral anticoagulation, which has proven benefit in reducing recurrent stroke and mortality in patients with AF. The accuracy and acceptability of using smart wearables to detect AF in patients following stroke is unknown.

### Wearing the Future—Wearables to Empower Users to Take Greater Responsibility for Their Health and Care: Scoping Review

JMIR mHealth and uHealth 10(7), 2022

Considerable literature findings suggest that wearables can empower individuals by assisting with diagnosis, behavior change, and self-monitoring. However, greater adoption of wearables and engagement with wearable devices depend on various factors, including promotion and support from providers to encourage uptake; increased short-term investment to upskill staff, especially in the area of data analysis; and overcoming the barriers to use, particularly by improving device accuracy.

### Monitoring and Managing Lifestyle Behaviors Using Wearable Activity Trackers: Mixed Methods Study of Views From the Huntington Disease Community

JMIR Formative Research 6(6), 2022

Although wearable activity trackers were broadly recognized as acceptable for both monitoring and management, various

aspects of device design and functionality must be considered to promote acceptance in this clinical cohort.

### Continuous Monitoring of Respiratory Rate with Wearable Sensor in Patients Admitted to Hospital with Pneumonia Compared with Intermittent Nurse-Led Monitoring in the United Kingdom: A Cost-Utility Analysis

PharmacoEconomics 6, 2022

Our results indicate that ARRM using RespiraSense, in addition to intermittent nurse-led monitoring of RR, in patients admitted to the hospital with pneumonia could be a cost-saving and cost-effective intervention if the minimum clinical thresholds are met.

### The feasibility and acceptability of digital technology for health and wellbeing in social housing residents in Cornwall: A qualitative scoping study

Digital Health, 2022

Five categories of factors influencing technology use were identified: functional, physical / health, psychological and attitudinal, technology-associated barriers, and privacy, safety and security. Preferred types of digital technology were wearable activity monitors (e.g. Fitbit®), virtual assistants (e.g. Amazon Alexa) and social messaging (e.g. WhatsApp).

### Exploring the feasibility and acceptability of a sleep wearable headband among a community sample of chronic pain individuals: An at-home observational study

Digital health, 2022

The Dreem 2 headband appears to be a feasible and acceptable means of collecting sleep measurements among individuals with chronic pain, despite common sleep disturbances. These devices may have utility for screening, assessment and monitoring in research and practice. Further research is needed to provide guidelines and training for integration.

### Rapid design and implementation of a virtual pain management programme due to COVID-19: a quality improvement initiative

British Journal of Pain 16(2), 2022

This report demonstrates how a remotely delivered PMP, fully in line with national guidance, was rapidly developed and implemented in a hospital setting for patients with chronic musculoskeletal pain. We also discuss the relevance of our findings to the issues of cost, patient experience, patient preferences and inequities of access in delivering telerehabilitation for chronic pain.

### Patients' and Clinicians' Visions of a Future Internet-of-Things System to Support Asthma Self-Management: Mixed Methods Study

Journal of Medical Internet Research 23(4), 2021

An automated internet-of-things system that requires minimal input from the user and provides timely advice in line with an asthma action plan agreed by the patient with their clinician was preferred by most respondents. Links to asthma information and the ability to connect with clinicians by text or email were perceived by patients as features that would provide a sense of safety.

### A Real-Time Wearable System for Monitoring Vital Signs of COVID-19 Patients in a Hospital Setting

Frontiers in Digital Health 3, 2021

Patients were monitored for a median of 31.5 [8.8, 75.4] hours, representing 88.1 [62.5, 94.5]% of the median time they were registered in the system. This indicates the system was being used in the isolation ward during this period. An updated version of the system has now also been used throughout the second and third waves of the pandemic in the UK.



## Evidence Brief: Apps, sensors and wearable technologies

### [Implementation of a mHealth solution to remotely monitor patients on a cardiac surgical waiting list: service evaluation](#)

JAMIA Open 4(3), 2021

The emergence of COVID-19 resulted in postponement of nonemergent surgical procedures for cardiac patients in London. mHealth represented a potentially viable mechanism for highlighting deteriorating patients on the lengthened cardiac surgical waiting lists.

### [Effectiveness of wearable activity trackers to increase physical activity and improve health: a systematic review of systematic reviews and meta-analyses.](#)

The Lancet Digital health 4(8), 2022

Activity trackers appear to be effective at increasing physical activity in a variety of age groups and clinical and non-clinical populations. The benefit is clinically important and is sustained over time. Based on the studies evaluated, there is sufficient evidence to recommend the use of activity trackers.

### [Evaluation of a Wearable in-Ear Sensor for Temperature and Heart Rate Monitoring: A Pilot Study.](#)

Journal of Medical Systems 46(91), 2022

In the context of the COVID-19 pandemic, wearable sensors are important for early detection of critical illness especially in COVID-19 outpatients. We sought to determine in this pilot study whether a wearable in-ear sensor for continuous body temperature and heart rate monitoring (Cosinuss company, Munich) is sufficiently accurate for body temperature and heart rate monitoring. Body temperature and heart rate were reliably measured by the wearable in-ear sensor.

### [Utilizing Data from Wearable Technologies in the Era of Telemedicine to Assess Patient Function and Outcomes in Neurosurgery: Systematic Review and Time-Trend Analysis of the Literature.](#) Abstract only\*

World Neurosurgery, 2022

Wearables can provide clinicians with objective measurements to determine patient function and quality of life. The rise in articles related to wearables in neurosurgery demonstrates the increased adoption of wearable devices during the COVID-19 pandemic. Wearable devices appear to be a key component in this era of telemedicine and their positive utility and practicality are increasingly being realized in neurosurgery.

### [Wearable Technology for Monitoring Respiratory Rate and SpO2 of COVID-19 Patients: A Systematic Review](#)

Diagnostics (Basel) 12(10), 2022

Although wearable devices are effective in the continuous monitoring of COVID-19 patients, further research on actual patients is necessary to determine the efficiency and effectiveness of wearable technology before policymakers can mandate its use.

### [Population-level impact of a pulse oximetry remote monitoring programme on mortality and healthcare utilisation in the people with COVID-19 in England: a national analysis using a stepped wedge design.](#)

Emergency Medicine Journal 39(8), 2022

Overall enrolment onto the programme in eligible people was low (2.5%). At a population level in England, there was no association with a change in mortality after implementation of the programme, and small increases in ED attendances and emergency hospital admissions. Our findings suggest the CO@h programme is a safe pathway for patients with COVID-19, but due to low total enrolment at a population level, further research

is needed to identify whether the programme is effective at an individual level.

### [Wearable technology: covid-19 and the rise of remote clinical monitoring](#)

BMJ 372, 2021

In a scheme in north west London, “wearables” collected the vital signs of people quarantining before or after travelling abroad and healthcare staff who couldn’t isolate at home. Round-the-clock data were monitored by a trained team. If the team spotted signs of deterioration, people could be transferred to hospital when necessary. Reducing direct contact between people in quarantine and health workers could reduce transmission of SARS-CoV-2 and reduce the use of personal protective equipment.

### [Remote care technologies, older people and the social care crisis in the United Kingdom: a Multiple Streams Approach to understanding the ‘silver bullet’ of telecare policy.](#) Abstract only\*

Ageing and Society 41(8), 2021

The policy announcement in November 2018 by the Secretary of State for Health and Social Care that: ‘from today, let this be clear: tech transformation is coming’ indicates that confidence in care technologies, so apparent over the past decade in policy circles, remains unabated. This article suggests, based on evidence of significant limitations in technological solutions to care needs, that this confidence is misplaced.

### [Sensor, Wearable, and Remote Patient Monitoring Competencies for Clinical Care and Training: Scoping Review](#)

Journal of Technology in Behavioural Science 6, 2021

Sensor, wearable, and remote patient monitoring technologies are typically used in conjunction with video and/or in-person care for a variety of interventions and care outcomes. This scoping review identifies clinical skills (i.e., competencies) needed to

ensure quality care and approaches for organizations to implement and evaluate these technologies.

### [The pilot, proof of concept REMOTE-COVID trial: remote monitoring use in suspected cases of COVID-19 \(SARS-CoV 2\)](#)

BMC Public Health 21(1), 2021

A pilot, proof-of-concept, feasibility trial was conducted in engineered hotels near London airports (May-June 2020). Individuals arriving to London with mild suspected COVID-19 symptoms requiring quarantine, as recommended by Public Health England, or healthcare professionals with COVID-19 symptoms unable to isolate at home were eligible. The SensiumVitals™ patch, measuring temperature, heart & respiratory rates, was applied on arrival for the duration of their stay. Alerts were generated when pre-established thresholds were breached; trained nursing staff could consequently intervene.

### [The early warning research on nursing care of stroke patients with intelligent wearable devices under COVID-19.](#)

Personal and Ubiquitous Computing 27, 2021

Stroke patients under the background of the new crown epidemic need to be home-based care. However, traditional nursing methods cannot take care of the patients' lives in all aspects. Based on this, based on machine learning algorithms, our work combines regression models and SVM to build a smart wearable device system and builds a system prediction module to predict patient care needs. The node is used to collect human body motion and physiological parameter information and transmit data wirelessly. The software is used to quickly process and analyze the various motion and physiological parameters of the patient and save the analysis and processing structure in the database. By comparing the results of nursing intervention experiments, we can see that the smart wearable device designed in this paper has a certain effect in stroke care.

## Evidence Brief: Apps, sensors and wearable technologies

### Mobile App-Based Remote Patient Monitoring in Acute Medical Conditions: Prospective Feasibility Study Exploring Digital Health Solutions on Clinical Workload During the COVID Crisis.

JMIR Formative Research 5(1), 2021

In this small-scale pilot study, we demonstrated the economic and operational impact that digital remote patient monitoring technology can have in improving working efficiency and reducing operational costs. Although this particular RPM solution was deployed for the COVID-19 pandemic, it may set a precedent for wider utilization of digital, remote patient monitoring solutions in other clinical scenarios where increased care delivery efficiency is sought.

### Accurate Monitoring of Parkinson's Disease Symptoms With a Wearable Device During COVID-19 Pandemic.

In Vivo 35(4), 2021

Case report: We report two cases with PD, whose symptoms were monitored with a new wearable CE-marked system (PDMonitor®), enabling appropriate treatment modifications. Conclusion: Objective assessment of the patient's motor symptoms in his daily home environment is essential for an accurate monitoring in PD and enhances treatment decisions.

### Transformation of primary care during the Covid-19 pandemic: experiences of healthcare professionals in eight European countries.

British Journal of General Practice 71(709), 2021

PCPs rapidly transformed primary care delivery despite a number of challenges. Representation of primary care at policy level and engagement with local primary care champions are needed to facilitate easy and coordinated access to practical information on how to adapt services, ongoing training, and access to appropriate mental health support services for PCPs. Preservation of autonomy and responsiveness of primary care

are critical to preserve the ability for rapid transformation in any future crisis of care delivery.

### Mobile phones as fomites for potential pathogens in hospitals: microbiome analysis reveals hidden contaminants

Journal of Hospital Infection 104(2), 2020

Almost all (99.2%) of hospital staff smartphones were contaminated with potential pathogens, and bacterial colony forming units (CFUs) were significantly higher on hospital phones than in the control group.

### Wearables for the Next Pandemic.

IEEE 8, 2020

This paper reviews the current state of the art in wearable sensors, including current challenges, that can alleviate the loads on hospitals and medical centers.

### Using Smartphones and Wearable Devices to Monitor Behavioral Changes During COVID-19.

Journal of Medical Internet Research 22(9), 2020

RADAR-base, a freely deployable data collection platform leveraging data from wearables and mobile technologies, can be used to rapidly quantify and provide a holistic view of behavioral changes in response to public health interventions as a result of infectious outbreaks such as COVID-19. RADAR-base may be a viable approach to implementing an early warning system for passively assessing the local compliance to interventions in epidemics and pandemics, and could help countries ease out of lockdown.

### Smartphone-delivered self-management for first-episode psychosis: the ARIES feasibility randomised controlled trial

BMJ Open 10(8), 2020

83% and 75% of participants were retained in the trial at the 4-month and 12-month assessments. All treatment group

participants had access to My Journey 3 during the trial, but technical difficulties caused delays in ensuring timely access to the intervention. The median number of My Journey 3 uses was 16.5 (IQR 8.5 to 23) and median total minutes spent using My Journey 3 was 26.8 (IQR 18.3 to 57.3). No serious adverse events were reported.

### Virtual wards

See also the complementary [Evidence Brief on Virtual Wards](#)

#### Virtual wards: a rapid evidence synthesis and implications for the care of older people

Age and Ageing 52(1), 2023

There is substantial evidence for the clinical effectiveness of hospital at home but less evidence for virtual wards. Guidance for virtual wards is lacking on key aspects including team characteristics, outcome selection and data protection. We recommend that research and evaluation is integrated into development of virtual ward models. The issue of carer strain is particularly relevant.

#### Interprofessional collaboration in a community virtual ward: A focus group study

Scandinavia Journal of Caring Sciences 37(3), 2023

We found that interprofessional collaboration in community virtual wards may be a sustainable way of organising healthcare services for patients with multimorbidity living at home.

Interprofessional collaboration with a patient-centred and health promotion approach, seems to increase the quality of the follow-up for patients with multimorbidity living at home. Additionally, mutual interprofessional trust and respect seems to be essential for making use of the unique expertise of different professions in the follow-up for patients with multimorbidity.

#### Expansion of patient eligibility for virtual glaucoma clinics: a long-term strategy to increase the capacity of high-quality glaucoma care

British Journal of Ophthalmology 107(1), 2023

This study demonstrates that VGCs with expanded patient eligibility criteria can deliver high-quality glaucoma care that is safe, effective and with high levels of patient satisfaction. This approach provides a long-term solution to adapt delivery of glaucoma care to our expanding and ageing population.

#### Patient satisfaction with a virtual multidisciplinary team balance clinic: a pilot study

British Journal of Healthcare Management 29(1), 2023

Overall, respondents were satisfied with the virtual consultations. Respondents either agreed or strongly agreed with 13 of the 14 items; the only exception was 'I obtained better access to healthcare services by use of telemedicine'. Most respondents were happy with the quality of communication and valued the time saved on travel, although one pointed out that this may not be an appropriate mode of service delivery for patients who are deaf.

#### Using virtual wards and long-term conditions management network to improve practice and performance

BMJ Open Quality 11(4), 2022

An online platform created as an extension to the forum enabled members to continue networking and access resources. The forum provided space for relationships to get stronger. This enabled innovation that changed practice and performance around increased uptake of tech-enabled remote monitoring solutions by patients as well as indirect health outcomes.

### A Covid -19 Virtual Ward Model: A Preliminary Retrospective Clinical Evaluation From a UK District General Hospital

Journal of Primary Care & Community Health, 2022

The virtual ward model exemplifies the potential benefits of collaborative working between primary and secondary care services, relieving pressure on hospitals whilst providing ongoing treatments at home such as supplemental oxygen. It also facilitates an early supported discharge of clinically stable patients with an improving clinical trajectory by managing them in the community.

### The impact of post-hospital remote monitoring of COVID-19 patients using pulse oximetry: A national observational study using hospital activity data

eClinical Medicine 48, 2022

We found no evidence of early discharges or changes in readmissions associated with the roll out of COVID Virtual Wards across England. Our analysis made pragmatic use of national-scale hospital data, but it is possible that a lack of specific data (for example, on which patients were enrolled and on potentially important confounders) may have meant that true impacts, especially at a local level, were not ultimately discernible.

### The impact of remote home monitoring of people with COVID-19 using pulse oximetry: A national population and observational study

eClinical Medicine 45, 2022

For every 10% increase in coverage of the programme, mortality was reduced by 2% (95% confidence interval: 4% reduction to 1% increase), admissions increased by 3% (-1% to 7%), in-hospital mortality fell by 3% (-8% to 3%) and lengths of stay increased by 1.8% (-1.2% to 4.9%). None of these results are statistically significant, although the confidence interval indicates that any adverse effect on mortality would be small, but a

mortality reduction of up to 4% may have resulted from the programme.

### The clinical presentation of monkeypox: a retrospective case-control study of patients with possible or probable monkeypox in a West London cohort

International Journal of Infectious Diseases 126, 2022

Our aim was to characterize diagnostic features of patients with confirmed and possible monkeypox to guide future risk stratification and to describe a virtual care model. Health authorities can consider a virtual ward approach in the hMPHXV outbreak.

### Remote care and triage of obstetric patients with COVID-19 in the community: operational considerations

BMC Pregnancy and Childbirth 22(550), 2022

Norfolk and Norwich University Hospitals Trust deployed a flexible maternity virtual ward (MVW) service using the Current Health platform to care for pregnant women during the pandemic. Patients were monitored either intermittently with finger pulse oximetry or continuously with a wearable device.

### Bringing hospital care home: Virtual Wards and Hospital at Home for older people

British Geriatrics Society, 17 August 2022

This document summarises the current landscape of Virtual Wards from the perspective of healthcare for older people, and provides advice to BGS members looking to set up such services for older people living with frailty.

### Applying a COVID Virtual Ward model, assessing patient outcomes and staff workload

Acute Medicine 20(4), 2021

A COVID virtual ward (CVW) is recommended by NHS England, but 'usual care' outcomes have not been reported. In this



comparison, discharging patients without a CVW did not lead to more re-presentations, re-admissions, ITU escalations or deaths compared to published outcomes for hospitals with a CVW.

### Workforce and service user perspective

#### Readiness for five digital technologies in general practice: perceptions of staff in one part of southern England

BMJ Open Quality 11(2), 2022

Improving digital readiness in general practice is complex and multifactorial. Issues may be alleviated by using dedicated digital implementation teams and closer collaboration between stakeholders (GPs and their staff, patients, funders, technology companies and government).

#### The relationship between trust and attitudes towards the COVID-19 digital contact-tracing app in the UK.

PLoS, 2022

This paper examines the NHS COVID-19 smartphone app, the digital contact-tracing solution in the UK. There is lower trust amongst non-users of the app and trust correlates to many other aspects of the app, a lack of trust could hinder adoption and effectiveness of digital contact-tracing. The design of technology requiring wide uptake, e.g., for public health, should embed considerations of the complexities of trust and the context in which the technology will be used.

#### Virtual care and the impact of COVID-19 on nursing: A single centre evaluation.

Journal of Advanced Nursing 78(2), 2022

Virtual care and remote working were implemented to accommodate the restrictions imposed because of the pandemic. The benefits of these changes to nurses and patients support these being business as usual. However, clear policies are needed to ensure that nurses feel supported when working

remotely and there are robust assessments in place to ensure virtual care is provided to patients who have access to the necessary technology.

#### Patients' experiences of, and engagement with, remote home monitoring services for COVID-19 patients: A rapid mixed-methods study

Health Expectations 25(5), 2022

Remote home monitoring models place responsibility on patients to self-manage symptoms in partnership with staff; yet, many patients required support and preferred human contact (especially for identifying problems). Caring burden and experiences of those living alone and barriers to engagement should be considered when designing and implementing remote home monitoring services.

#### Meaningful patient and public involvement in digital health innovation, implementation and evaluation: A systematic review

Health Expectations 25(4), 2022

PPI is largely viewed as valuable and essential in digital health innovation, but rarely practised. Several barriers exist for both innovators and patients, which currently limits the quality, frequency and duration of PPI in digital health innovation, although improvements have been made in the past decade.

#### Digital Technologies and the Role of Health Care Professionals: Scoping Review Exploring Nurses' Skills in the Digital Era and in the Light of the COVID-19 Pandemic

JMIR Nursing 5(1), 2022

Further advancing nurses' readiness in adopting telemedicine requires an integrated approach, including combination of technical knowledge, management abilities, soft skills, and communication skills.

### Taming the chaos: NHS professionals' perspective of using video consulting during COVID-19 in Wales.

BMJ Open Quality 10(4), 2021

This study provides evidence of general positivity, acceptance and the success of the VC service in Wales. Future research studies will now be able to explore and evaluate the implementation methods used within this study, and investigate their effectiveness in being able to achieve better outcomes through VC.

### Nurses' Use of Personal Smartphone Technology in the Workplace: Scoping Review

JMIR mHealth and uHealth 8(11), 2020

Nurses view personal smartphones as an efficient method to gather patient care information and to communicate with the health care team. This scoping review facilitates critical reflection on patient care practices within the digital context. We infer that nurses' use of their personal devices to communicate among the health care team may demonstrate a technological "work-around" meant to reconcile health system demands for cost-efficiency with efforts to provide quality patient care.

### Day and night comfort and stability on the body of four wearable devices for seizure detection: A direct user-experience

Epilepsy & Behaviour, 2020

One hundred and fifteen participants were enrolled. The devices had a good stability on the body including during seizures. Overall, all the devices were considered comfortable to be worn, including during sleep. However, devices containing wires and patches demonstrated a lesser degree of stability on the body and were judged less positively.

### Patient experiences with technology enabled care across healthcare settings: a systematic review.

BMC Health Services Research 10(779), 2020

This review deepens the understanding of patients' experiences with technology enabled care solutions. Patients' experiences not only relate to the practical/technical element of the device or solution, but to how this impact on their everyday life. Patient participation in development and planned use of such solutions should be considered an integral part in healthcare quality initiatives.

## Competency Frameworks

### Profession and Service Specific Digital Capabilities Frameworks

NHS England Workforce, Training and Education

Development of the profession and service specific learning requires the use of established frameworks, tools and resources to revise and shape education and training, professional standards, accreditation and career development.