Health Education England

Evidence Brief: Apps, sensors, and wearable technologies

Contents

Produced by the HEE Knowledge Management team Evidence Briefs offer a quick overview of the published reports, research, and evidence on a workforce-related topic.

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- Complete Evidence Brief list – link for HEE staff
- Complete Evidence Brief list – link for External staff

Key publications – the big picture

Building our future digital workforce
Source: 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
Source: NHS Long Term Plan
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
Source: UK Government
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
Source: The King's Fund
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
Source: Health Education England
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.

Case Studies

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.

- Track the impact of antipsychotic drugs on patient's cardiac health in their own home – North East and Yorkshire
- Recognize the deterioration of residents' health and improve the care available – London
- Remote monitoring technologies for heart failure, COPD and Covid-19 – Midlands
- Remote monitoring of symptom using the digitally enabled service – North West
- Remote patient monitoring to identify deterioration of patients with silent hypoxia – South East
- Remote monitoring and digital tools to improve health and wellbeing for people with learning disabilities – 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 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
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
The technology allows NHS clinicians to monitor patients at home, give advice on how to prepare for surgery and spot those 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
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.

Trust pilots remote monitoring for heart failure patients
The remote monitoring platform, provided by healthcare technology company Luscii, allows patients to take charge of their healthcare and input important health data such as their weight, blood pressure and heart rate on a daily basis, providing their clinical team with instant access to this information. Doctors and heart failure nurses can monitor for any concerning changes, with the platform also flagging up early signs of patient deterioration using an AI-powered ‘clinical engine’.

Croydon introduces remote monitoring for Covid-19 patients
The NHS in Croydon has launched a home oxygen monitoring service for patients with suspected or confirmed Covid-19. Patients who join the service will be provided with a pulse oximeter (a finger pulse device that can measure heart rate and oxygen levels in the blood) to use at home to monitor their oxygen saturation levels. They will also be recruited into a virtual ward where a clinical team will remotely monitor symptoms for a period of 14 days.

Wearable sensor trialled for remote Covid-19 monitoring
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.

HEE Star

More resources and tools are available by searching for 'technology' in the HEE Star

HEE National Data Programme

HEE staff can look at the National Data Warehouse (NDL) SharePoint site to find out more about datasets and Tableau products.

Published Peer Reviewed Research

Leadership and strategy

NHS needs better data from digital apps to tackle health inequalities, says report
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 2021
Implementation of e-health tools for nursing work is complex in health settings and requires careful examination of multiple 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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.

Apps: implementation and effectiveness

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

Rehabilitation and physical activity

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

Medicines and medicine management

Addressing the Challenges of Penicillin Allergy Delabeling With Electronic Health Records and Mobile Applications
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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.

Dermatology and wound care

Improving Teledermatology Referral with Edge-AI: Mobile App to Foster Skin Lesion Imaging Standardization
Publication date: 2023

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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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.

Cardiology and respiratory care (including smoking cessation)

Effectiveness of cardiac rehabilitation with mHealth through smartphone functionalities: a systematic review protocol.
Publication date: 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
Publication date: 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?
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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?
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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.

Maternity and perinatal care

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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication Date: 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
Publication date: 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.

Clinical support and decision tools

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

The use of smartphone-application based medical photography for open fractures: A national survey of orthoplastic affiliated Major Trauma Centres in England. Abstract only*
Publication Date: Jun ,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.
Publication Date: May ,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
Publication date: 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
Publication date: 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
Publication date: 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.
Publication Date: 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
Publication date: 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
Publication date: 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
Publication date: 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.
Publication Date: 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.
Publication Date: 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
Publication date: 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.

Primary care and care homes

Evaluation of the Near Me consulting service in Scotland during Covid-19
Publication date: 2021
As part of Scotland's response to the COVID-19 pandemic, the use of the Near Me video system to access appointments for health and social care was rapidly scaled up at the outbreak of the pandemic. Now, a report by experts from Oxford University has concluded that using the technology has helped to reduce

the risk of infection and allowed for continued service provision.

Digital health technology: factors affecting implementation in nursing homes
Publication date: 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.

Genetics and genomics

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

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

Wearable devices for anxiety & depression: A scoping review
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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.
Publication Date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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.
Publication Date: 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)
Publication date: 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

Publication date: 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
Publication date: 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.

Co-Creating and Evaluating an App-Based Well-Being Intervention: The HOW (Healthier Outcomes at Work) Social Work Project
Publication date: 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. Abstract only*
Publication Date: 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
Publication date: 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.
Publication Date: 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
Publication date: 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.

Sensors and wearables: implementation and effectiveness

Wearable full-body motion tracking of activities of daily living predicts disease trajectory in Duchenne muscular dystrophy
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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.

Implementation of a mHealth solution to remotely monitor patients on a cardiac surgical waiting list: service evaluation
Publication date: 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.
Publication Date: 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.
Publication Date: Nov 04 ,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*
Publication Date: Oct ,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
Publication Date: 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.
Publication Date: 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
Publication date: 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*
Publication Date: 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
Publication Date: 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.

Design of the pilot, proof of concept REMOTE-COVID trial: remote monitoring use in suspected cases of COVID-19 (SARS-CoV-2).
Publication Date: 2021
This trial should prove the feasibility of a rapidly implemented model of healthcare delivery through remote monitoring during

a global pandemic at a hotel, acting as an extension to a healthcare trust. Potential benefits would include reducing infection risk of COVID-19 to healthcare staff, with earlier recognition of clinical deterioration through ambulatory, continuous, remote monitoring using a discrete wearable sensor.

The early warning research on nursing care of stroke patients with intelligent wearable devices under COVID-19.
Publication Date: 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.

Mobile App-Based Remote Patient Monitoring in Acute Medical Conditions: Prospective Feasibility Study Exploring Digital Health Solutions on Clinical Workload During the COVID Crisis.
Publication Date: Jan 15 ,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.
Publication Date: 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.
Publication Date: 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
Publication date: 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.
Publication Date: 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.
Publication Date: 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
Publication date: 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

Virtual wards: a rapid evidence synthesis and implications for the care of older people
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 17th 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
Publication date: 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.

Educating the workforce and role development

Using live stream technology to conduct workplace observation assessment of trainee dental nurses: an evaluation of effectiveness and user experience
Publication date: 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.

New media platforms for teaching and networking: Emerging global opportunities for breast surgeons
Publication date: 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
Publication date: 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)
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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
Publication date: 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*
Publication Date: 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
Publication date: 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.

Workforce and service user perspective

Readiness for five digital technologies in general practice: perceptions of staff in one part of southern England
Publication date: 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.
Publication Date: 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.
Publication Date: 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
Publication date: 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
Publication date: 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
Publication date: 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.
Publication Date: 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
Publication Date: 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
Publication date: 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.
Publication Date: 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.

Diversity, inclusion and ethics

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

*Help accessing articles or papers

Where a report/ journal article or resource is freely available the link has been provided. If an NHS OpenAthens account is required this has been indicated. It has also been highlighted if only the abstract is available. If you do not have an OpenAthens account you can self-register here.

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