

Remote monitoring for long-term physical health conditions: an evidence and gap map

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Scientific summary

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Scientific summary

Background

Ageing populations and rising rates of non-communicable diseases are placing increasing pressure on health and social care services. New models of care are needed to meet these challenges. The use of technology offers opportunities for innovation, with the COVID-19 pandemic demonstrating its potential. Remote monitoring is one application of technology, involving the periodic or continuous measurement of an aspect of a patient's health, such as their blood pressure, at home. This information is passed to a healthcare professional to enable the patient's condition to be managed without the need for them to be seen face to face.

Remote monitoring could benefit individuals, helping people to manage their own health and identifying exacerbations at an earlier stage. By improving communication with healthcare providers, it can also facilitate the delivery of personalised care. Potential benefits for the healthcare system more widely include efficiencies in service use and resulting reductions in cost. However, current reviews of the evidence indicate that remote monitoring may be more effective for some health conditions and in improving certain health outcomes.

To commission and deliver effective remote monitoring interventions, policy-makers and practitioners need evidence on types of remote monitoring that improve health outcomes, as well as the acceptability of these interventions and how to implement them. The need for evidence synthesis on this topic was identified by a stakeholder group from NHS England's NHS @home (an initiative that is using technology to enable people to manage their health at home), which was consulted throughout the production of the map.

Objectives

Our aim was to identify and map the volume, diversity and nature of recent systematic reviews on the use of remote monitoring interventions for adults living with long-term physical health conditions. Our specific research objectives were to:

- map recent systematic reviews of the effectiveness of remote monitoring interventions for adults living with long-term physical health conditions
- map recent systematic reviews of the acceptability and/or implementation of remote monitoring interventions for adults living with long-term physical health conditions.

What is an evidence and gap map?

Evidence and gap maps provide an overview of the evidence on a given topic. They are produced using the same principles as a systematic review. However, instead of summarising effectiveness data or findings from included studies and synthesising this information to answer a specific question, data are extracted on key characteristics of the included studies and presented visually (further description of evidence and gap maps can be found in White H, Albers B, Gaarder M, Kornør H, Littell J, Marshall Z, *et al.* Guidance for producing a Campbell evidence and gap map. *Campbell Syst Rev* 2020;**16**(4):e1125). Evidence and gap maps are typically presented as a table, with rows listing the types and characteristics of the intervention and columns displaying outcomes. This allows the identification of areas of evidence concentration as well as gaps in the evidence. They can be used both to inform evidence-based policy, commissioning and provision of healthcare interventions, and to identify areas for future research.

Methods

A protocol for the evidence and gap map was registered on the OSF (Center for Open Science, Charlottesville, VA, USA) registry (<https://doi.org/10.17605/OSF.IO/6Q7P4>). We searched MEDLINE, the Cochrane Database of Systematic Reviews, the Cumulative Index to Nursing and Allied Health Literature Complete, EMBASE, Web of Science, Scopus, PEDro physiotherapy database, OTseeker, ProQuest Dissertations & Theses Global, Epistemonikos and Google Scholar for systematic reviews published between 2018 and March 2022 on the effectiveness, acceptability and implementation of remote monitoring interventions for adults with long-term physical health conditions. We also conducted searches of PROSPERO for continuing reviews and completed citation chasing on included studies.

Records identified by the searches were screened at title and abstract level by two independent reviewers, with disagreements resolved through discussion. Full texts were then screened using the same process. As prespecified in the protocol, our inclusion criteria were:

- systematic reviews which used a reproducible search strategy, prespecified inclusion/exclusion criteria and screening methods, conducted quality assessment and reported their method of data analysis
- at least 75% of participants were adults (≥ 18 years) with long-term physical condition(s)
- any type of remote monitoring (defined as the monitoring of a patient's health status without face-to-face contact), with this information being passed to a healthcare professional to guide care (we included reviews in which at least 75% of the primary studies evaluated remote monitoring interventions that met this definition)
- systematic reviews of effectiveness, containing quantitative comparative outcome evaluations (at least 75% of the included primary studies), and systematic reviews synthesising evidence on acceptability and/or implementation, containing primary studies of any design
- systematic reviews published in English
- conducted in high-income countries (at least 75% of the included studies).

Following the identification of a final sample of reviews for inclusion in the evidence and gap map, a standardised form was used to extract data from the reviews. Data were extracted by one reviewer and checked by a second, with disagreements resolved through discussion. Extracted data included study characteristics, patient population, characteristics of remote monitoring interventions and outcomes. Continuing reviews were classified according to their patient population of focus. AMSTAR 2 was used to assess the quality of included reviews.

EPPI-Reviewer 4 (EPPI Centre, Social Science Research Unit, UCL Institute of Education, University of London, London, UK) was then used to create an interactive EGM. Concentrations of systematic reviews and gaps in the secondary research were identified from the map and are summarised below.

We engaged with stakeholders and public and patient involvement (PPI) representatives throughout the production of the evidence and gap map. Our stakeholders were part of NHS England's NHS @home initiative, while the PPI group had five members with experience of a range of health conditions and types of remote monitoring. Input from both groups informed the focus of the project and the presentation of the interactive map.

Results

We included 72 systematic reviews in the map. Of these, 61 focus on the effectiveness of remote monitoring and 24 on its acceptability or implementation, with some reviews including both types of outcome. We also identified 86 continuing reviews judged to be relevant to the review question. Most

of the reviews included studies conducted in North America and Europe; of the latter, 38 reviews included studies based in the UK. Reviews tended to investigate the use of remote monitoring in patients with cardiovascular disease (CVD; 45 reviews), diabetes (25 reviews) and respiratory conditions (23 reviews). Similarly, among the continuing reviews, the majority focus on patients with CVD (36 reviews), although a greater proportion (8 reviews) are investigating remote monitoring for neurological conditions. There was a lack of consistent reporting on further patient characteristics such as age, gender and digital literacy. A wide range of health indicators were monitored, the most common being blood pressure (47 reviews), heart-related (35 reviews) and lung-related indicators (30 reviews), symptoms (27 reviews), treatment adherence (25 reviews) and blood glucose (22 reviews).

The methods used to collect data included common devices, such as blood pressure and blood glucose monitors (48 reviews); symptom tracking [e.g. patients recording their symptoms in a computer application (app) or website, 29 reviews]; wearable devices (e.g. activity trackers, 20 reviews); and implantable devices (e.g. cardioverter defibrillators, 17 reviews). The most common ways of passing data to the healthcare provider were through apps, websites and e-mails (58 reviews); automatically (i.e. without the patient's involvement, 46 reviews) and by telephone calls (33 reviews). Nurses were the healthcare professionals most often reported as involved in the remote monitoring intervention (41 reviews). In most studies, feedback was provided to the patient via telephone (42 reviews) and contained motivational/educational elements (33 reviews). In some interventions, if critical values were registered, the healthcare provider responded by making changes to treatment (28 reviews); fewer included studies where the patient was referred for further medical care (12 reviews).

The outcomes assessed by the included reviews were categorised into six broad-outcome categories, with further subcategories. For physical health outcomes (55 reviews), mortality (23 reviews), blood glucose (16 reviews) and blood pressure (9 reviews) were the largest subcategories; for mental health and well-being outcomes, reviews reported on anxiety and depression (13 reviews) and quality of life (24 reviews); for health service use, hospitalisation (29 reviews) and emergency room visits (16 reviews). For health behaviours and self-regulation, there was most evidence for self-management (14 reviews) as a subcategory; for acceptability and implementation-related outcomes, most reviews reported on acceptability and satisfaction (24 reviews). Eleven reviews reported on both subcategories within the broad category of adherence and compliance. To obtain more precise estimates of specific outcomes, 48 reviews combined the results from individual studies using statistical methods (meta-analysis).

Only 5 of the included reviews were judged to be of high quality and 22 of moderate quality; the rest of the reviews were of low or critically low quality, which means that they had one or more major methodological shortcomings that make their results less reliable. In addition, many of the reviews provided limited information about the evaluated interventions, making the judgement of their relevance and the interpretation of results difficult.

Conclusions

The map shows a number of reviews looking at the effectiveness of remote monitoring and, to a lesser degree, its acceptability and/or successful implementation. These could support the commissioning and delivery of remote monitoring interventions, while 'gaps' in the map could inform the further research and the development of monitoring technologies. Most of the reviews focused on CVD, diabetes and chronic respiratory conditions. While the evidence for less common conditions is limited, there are a number of continuing reviews for some populations, such as patients with neurological conditions. Reviews on acceptability and implementation focused almost entirely on the patients' perspective, with only a small number on the perceptions and experiences of carers and healthcare professionals.

The evidence and gap map and the evidence contained within it have some limitations. More than half of the included reviews have serious methodological issues and many provided very scant descriptions

of the included interventions. Additionally, a lack of consistent reporting on factors, such as age, gender and digital literacy, means that it is difficult to assess the impact of remote monitoring on equity of access to services. As the map includes systematic reviews, not primary research, we were only able to include evidence for remote monitoring interventions that have been subject to a systematic review. Remote monitoring and related terms are not used consistently in the literature, which created difficulties in identifying all relevant reviews. Finally, the volume of literature found meant that we had to apply strict inclusion and exclusion criteria, so some relevant evidence may have been excluded. For example, while we limited the map to reviews published from 2018, older reviews may contain relevant information, particularly regarding the implementation of interventions.

The COVID-19 pandemic led to the rapid implementation of remote monitoring technology. While there has been a return to face-to-face provision for many services, the pandemic demonstrated the capabilities of technology. Demand for remote monitoring is likely to increase in the future, particularly given the role that it could play in meeting sustainability goals and reducing the environmental impact of health services. Evidence will be needed to support the design and delivery of further remote monitoring interventions. Future reviews should try to adhere more closely to the recommended systematic review methods; report their methods and findings as fully as possible; provide detailed description of the included interventions; report the effectiveness, acceptability and implementation of remote monitoring in all relevant patient groups; investigate the application of remote monitoring in further chronic conditions; and explore acceptability and implementation from a wider range of perspectives.

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