

Digital interventions in mental health: evidence syntheses and economic modelling

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Scientific summary

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Scientific summary

Background

Digital interventions use software programs, accessed via computers, tablets, smartphones and virtual reality equipment, to deliver therapeutic activities that aim to prevent and improve the symptoms and disability associated with mental health and addiction problems. There is an assumption that using technology can save time and money because it enables self-care and allows clinicians to deliver therapy remotely. Economic evaluations can provide evidence on whether or not digital interventions offer good value for money, based on their costs and outcomes relative to the costs and outcomes of alternatives.

Objectives

Our aim was to review all published economic studies on digital interventions for mental health and addiction problems and then use an exemplar clinical condition to produce an economic model that demonstrates how we can bring together evidence from different sources to assess the cost-effectiveness of digital interventions compared with all possible alternatives. To do this, we aimed to develop classification criteria for categorising digital interventions and their alternatives, so that they could be reasonably pooled together in an evidence synthesis. To inform our economic model, we also aimed to conduct a quantitative synthesis of clinical outcomes from studies comparing digital interventions with alternatives for the exemplar clinical condition. We chose generalised anxiety disorder as our index condition for the clinical evidence synthesis and economic modelling because it has the highest weekly prevalence among all other mental health diagnoses and lends itself well to treatment with digital interventions, yet it is under-researched and under-reported. Finally, we aimed to explore how evidence on costs and outcomes, as well as other factors, can influence stakeholder decisions about the development, evaluation and adoption of digital interventions in mental health.

Methods

The project comprised four work packages completed in 18 months. The first was a systematic review, critical appraisal and summary of economic evaluations of digital interventions across all mental health conditions. The second was a systematic review and two network meta-analyses of randomised controlled trials on digital interventions for generalised anxiety disorder. The third was the economic modelling and value-of-information analysis of digital interventions for generalised anxiety disorder. The final work package was a series of seminars with service users, professionals and researchers.

To be able to draw comparisons and conclusions across different economic evaluations, we classified digital interventions and their comparators into different groups based on three criteria: (1) therapeutic intent (intervention vs. control), (2) software processing (digital vs. non-digital) and (3) interpersonal communication (supported vs. unsupported). We used 10 classification groups to pool and compare costs and outcomes of digital interventions and alternatives: medication, supported non-digital intervention, supported digital intervention, unsupported digital intervention, supported digital control, unsupported digital control, no intervention, unsupported non-digital intervention, unsupported non-digital control and supported non-digital control.

We conducted a first literature search in December 2018, which was updated in October 2020 for the economic studies in work package 1, and in June 2019 for the clinical studies in work package 2. We searched the following databases: MEDLINE, PsycInfo® (American Psychological Association,

Washington, DC, USA), Cochrane Central Register of Controlled Trials (CENTRAL), Cochrane Database of Systematic Reviews (CDSR), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Plus, Database of Abstracts of Reviews of Effects (DARE), EMBASE™ (Elsevier, Amsterdam, the Netherlands), Web of Science™ (Clarivate Analytics, Philadelphia, PA, USA) Core Collection, the Health Technology Assessment database and the National Institute for Health Research Journals Library, and the Database of Promoting Health Effectiveness Reviews (DoPHER). We also searched the NHS Economic Evaluation Database (NHS EED) for economic studies and two clinical trial registries for ongoing studies: ClinicalTrials.gov and the World Health Organization's International Clinical Trials Registry Platform (ICTRP) portal. We searched the National Institute for Health Research portfolio and conducted web searches using Google (Google Inc., Mountain View, CA, USA) and Google Scholar (Google Inc.) using simplified search terms. We searched the reference lists of previous systematic reviews and of our included studies. We conducted forward citation chasing on all identified protocols, conference abstracts and the included studies using Google Scholar for any relevant publications. We also contacted researchers in the field for unpublished studies.

For work package 1, eligible economic evaluations included participants with emerging or existing mental health conditions. Studies were excluded if the primary diagnosis of the participants was a physical condition (e.g. cancer or insomnia). Interventions based on software were included, but technologies simply used for telecommunication without any software processing (e.g. telephones or videoconferencing) were excluded. We included economic evaluations conducted alongside trials and modelling studies, as long as they compared two or more options and considered both costs and consequences (i.e. cost-minimisation, cost-effectiveness, cost-utility and cost-benefit analyses).

For work package 1, we assessed the quality of the identified studies using standardised checklists that focused on the clarity of the research questions, the quality and completeness of data used, the methods used to characterise uncertainty in the evaluation model, and the interpretation of the results. We summarised cost-effectiveness conclusions, as reported by the reviewed studies, into three groups according to whether the studies found that (1) digital interventions dominated their alternatives (i.e. digital interventions had a lower cost and a better outcome), (2) digital interventions were dominated by their alternatives (i.e. digital interventions had a higher cost and a worse outcome) or (3) digital interventions achieved better outcomes with higher costs, so decisions about their cost-effectiveness depended on willingness-to-pay thresholds and the level of uncertainty associated with the results.

For work package 2, eligible clinical studies included participants with emerging or existing generalised anxiety disorder as determined by a standardised diagnostic interview or a score on a standardised measurement tool with an accepted cut-off value. Mixed populations of patients with generalised anxiety disorder and those with other conditions were included when clinical outcomes were reported separately for the subsample of participants with generalised anxiety disorder. We included digital interventions that were software based for patient-facing activity rather than systems that were only for administration, training or telecommunication. We included only randomised controlled trials.

For work package 2, we combined all trial-based effectiveness evidence in a single modelling framework allowing the estimation of relative treatment effects for all relevant comparisons between digital interventions and alternatives. Using an analysis of covariance framework for two outcome measures separately (i.e. the Generalised Anxiety Disorder 7-item questionnaire and the Penn State Worry Questionnaire), two network meta-analyses (one for each outcome) pooled post-treatment scores on each outcome, adjusted for baseline scores on the same outcome. We also carried out a risk-of-bias assessment for each study, checked for treatment effect modifiers, carried out several sensitivity analyses and evaluated network consistency. We presented the estimated results as relative treatment effect scores (and associated 95% credibility intervals) in the selected outcome measures. Finally, we estimated the probability of a treatment being the 'best', presented rankograms for all interventions and reported the surface under the cumulative ranking curve.

For work package 3, we used a Markov model, with 3-month cycles over the lifetime of an individual, to evaluate the cost-effectiveness of digital interventions for generalised anxiety disorder, across different types of technologies and therapeutic modalities, and for different comparators, from the perspective of the UK's health-care system. The model structure was based on anxiety severity, in which patients start in one of four health states: no, mild, moderate or severe anxiety. At each cycle of the model, patients can remain in a health state or transition to another, better or worse, health state. The intended effect of digital interventions was to reduce the severity of anxiety and move patients to less severe anxiety states. Model parameters included intervention effectiveness, state-specific utilities and costs, mortality and intervention costs. Patients' costs and health-related quality of life were tracked over the course of an individual's lifetime. The cumulative costs and quality-adjusted life-years gained or lost were then used to derive the net monetary benefit conditional on the marginal productivity of the health system. Probabilistic uncertainty analysis was conducted to characterise the uncertainty associated with input parameters to the model, and their impact on cost-effectiveness. One-way scenario analysis was performed to evaluate the sensitivity of the model results to our assumptions. The results from the probabilistic uncertainty analysis were used to estimate the value of information.

We held seven seminars with groups of stakeholders, which included commissioners who make funding decisions about services, practitioners and service managers who provide services, individual users who seek to improve or promote their mental health, and technologists and researchers who develop and evaluate digital interventions. Each seminar had two parts. The first part was the communication of our methods and findings through an interactive presentation. The second part was a question-answer and discussion session in which we asked the audience to identify the highlights of our findings that were important to them and any aspects of the presentation that were not clear, and to offer comments and feedback in general. We kept detailed notes and summarised and reflected on the key discussion points that arose from the seminars.

Results

In work package 1, we identified 76 economic evaluations (11 were economic models and 65 were within-trial evaluations). The studies did not capture all relevant comparators or the long-term impact of mental health problems. Given that digital interventions are complex and heterogeneous, there are specific challenges to their economic evaluation and the synthesis of economic evidence, including the estimation of all costs and outcomes, conditional on the analysis viewpoint, and identification of appropriate and clinically useful comparators. Although the results of the economic evaluations are not directly comparable because of their different methods, the overall picture suggests that digital interventions are likely to be cost-effective against no intervention and non-therapeutic controls, whereas the value of digital interventions compared with face-to-face therapy or printed manuals is unclear.

In work package 2, we carried out two network meta-analyses of 20 randomised controlled trials that included a total of 2350 participants with emerging or diagnosable generalised anxiety disorder. The majority of comparisons were between supported digital interventions and waiting lists or usual care; there were no trials using individual therapy (rather than group therapy) or manual-based self-help as comparators. Owing to very wide confidence intervals, the results of our network meta-analyses were inconclusive as to whether or not digital interventions are better than no intervention or than non-therapeutic active controls, or whether or not they confer any benefit over and above group therapy. One of the network meta-analyses included a study comparing a digital intervention with medication; based on this study, we found that medication was associated with lower anxiety scores at follow-up relative to all other interventions and controls. Medication also ranked first in terms of its likelihood of being most effective, which considered the uncertainty in relative effect estimates. Supported digital interventions were not necessarily 'better' than unsupported (pure self-help) digital interventions.

In work package 3, a decision-analytic model found that digital interventions for generalised anxiety disorder were associated with lower net monetary benefit than for medication and group therapy, but greater net monetary benefit than for non-therapeutic and no intervention controls. Supported digital interventions may offer better value than unsupported ones for higher investment; however, if investment is zero, unsupported digital interventions may be a better option. The net monetary benefit of digital interventions and their alternatives was driven by health-care resource use and health-related quality of life, which, in turn, were driven by anxiety severity, both directly and through morbidity. This means that value for money was driven by clinical outcomes rather than by intervention costs. A value-of-information analysis suggested that uncertainty in the treatment effect had the greatest value (£12.9B), whereas parameters defining the effect of generalised anxiety on costs and health-related quality of life (state-related costs and utilities, and excess mortality) had low or negligible value.

In work package 4, discussions with stakeholders identified several areas of importance for conducting and communicating research on costs and outcomes of digital interventions in mental health:

- What is the added value of digital interventions for children and young people, people living in rural areas and older adults?
- In what way do digital interventions make a difference to individual users rather than just populations?
- What is the role of the therapeutic relationship?
- What are the non-specific effects of technology beyond the therapeutic content?
- What are the safety risks and adverse effects?
- Are digital interventions sustainable?
- Can we use digital interventions for tracking and monitoring?
- How can digital interventions improve communication with clinicians?

To gauge the value of digital interventions, the stakeholders were interested in 10 key outcomes: relapse occurrence, risk increase, attendance and completion of sessions, waiting time, admission rates, remission and recovery rates, re-admission rates, treatment duration and discharge rates, transition experience and number of patients per clinician.

Conclusions

When it comes to value for money, digital interventions may be preferred to 'doing nothing' or 'doing something non-therapeutic' (e.g. monitoring or having a general discussion); however, there is uncertainty around their added value against medication, face-to-face therapy and printed manuals. With digital interventions for generalised anxiety disorder as a case in point, value for money is driven by clinical outcomes rather than intervention costs, and treatment effects have a very high value of information in resolving uncertainty of economic outcomes. This points to future research focusing on developing digital interventions that are more effective, rather than just cheaper, than their alternatives. To enhance their clinical effectiveness, we can improve the design and technology of digital interventions to enable them to achieve better outcomes as pure self-help tools and/or we can optimise the interpersonal support offered to patients to achieve better outcomes in the context of clinician-led treatment or supported self-help. Stakeholder feedback suggested that the value of future research is in demonstrating that digital interventions can increase patient choice, reach underserved populations and enable continuous care. The decision-making of stakeholders is also influenced by the 'inevitability of going digital'. With this in mind, strengthening the clinical and economic body of evidence on digital interventions is important not only to inform decisions about whether or not we should adopt them, but also to inform how we can make the most of them once they become an established and ubiquitous part of mental health care.

Study registration

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This report

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