Health technology assessment of chronic disease self-management support interventions

COPD *(extracted from main report)*

16 December 2015

Safer Better Care

Health Information and Quality Authority

An tÚdarás Um Fhaisnéis
agus Cáilíocht Sláinte

About the Health Information and Quality Authority

The Health Information and Quality Authority (HIQA) is an independent Authority established to drive high quality and safe care for people using our health and social care and support services in Ireland. HIQA's role is to develop standards, inspect and review health and social care and support services, and support informed decisions on how services are delivered. HIQA's ultimate aim is to safeguard people using services and improve the quality and safety of services across its full range of functions.

HIQA's mandate to date extends across a specified range of public, private and voluntary sector services. Reporting to the Minister for Health and the Minister for Children and Youth Affairs, the Health Information and Quality Authority has statutory responsibility for:

- **Setting Standards for Health and Social Services** – Developing person-centred standards, based on evidence and best international practice, for health and social care and support services in Ireland.

- **Regulation** – Registering and inspecting designated centres.

- **Monitoring Children's Services** – Monitoring and inspecting children's social services.

- **Monitoring Healthcare Quality and Safety** – Monitoring the quality and safety of health services and investigating as necessary serious concerns about the health and welfare of people who use these services.

- **Health Technology Assessment** – Providing advice that enables the best outcome for people who use our health service and the best use of resources by evaluating the clinical effectiveness and cost-effectiveness of drugs, equipment, diagnostic techniques and health promotion and protection activities.

- **Health Information** – Advising on the efficient and secure collection and sharing of health information, setting standards, evaluating information resources and publishing information about the delivery and performance of Ireland's health and social care and support services.

Advice to the Health Service Executive (HSE)

This health technology assessment (HTA) examined the clinical and cost-effectiveness of non disease specific (or generic) self-management support interventions for chronic diseases and disease-specific interventions for asthma, chronic obstructive pulmonary disease (COPD), diabetes (Type 1 and Type 2) and cardiovascular disease (stroke, hypertension, coronary artery disease and heart failure).

Broadly, self-management support interventions are any interventions that help patients to manage portions of their chronic disease, or diseases, through education, training and support.

The review of clinical effectiveness was restricted to self-management support interventions evaluated through randomised controlled trials in adult populations. Given the volume of literature available, the clinical effectiveness of self-management support interventions was evaluated using an 'overview of reviews' approach where systematic reviews were reviewed rather than the primary evidence. Systematic reviews were undertaken for each disease area. In the case of asthma, COPD, Type 1 and Type 2 diabetes, stroke and hypertension, these were undertaken as updates to a recent high quality review (PRISMS report) commissioned by the UK National Institute for Health Research that was published in 2014.

The cost-effectiveness of generic and disease-specific self-management support interventions was evaluated by undertaking systematic reviews of the available literature for each area.

General findings common across all the sections of this report are presented below. Specific advice in relation to the various generic and disease-specific interventions is outlined in the dedicated advice sections.

The general findings of this HTA, which precede and inform HIQA's advice, are as follows:

- A broad range of self-management and self-management support interventions exist which impacts on the clarity of what constitutes effective self-management support. The interventions described by the included studies were heterogeneous and frequently complex, comprising numerous components.

- This HTA considered evidence from over 2,000 randomised controlled trials as presented across 160 systematic reviews of clinical effectiveness. Evidence on

the likely cost implications and cost-effectiveness of self-management support interventions was considered from 181 costing and cost-effectiveness studies.

- Evidence of the clinical-effectiveness of chronic disease self-management support interventions provides a complex picture. An overview of reviews makes use of pooled clinical effectiveness data, sometimes across a large number of primary studies, and in many cases of heterogeneous data. While the pooled estimate may show limited effect, individual studies may show more or less effect. As with any intervention, there may be subgroups of patients that experienced greater treatment effect than others.

- Randomised controlled trials typically had small sample sizes and a short duration of follow-up, limiting the applicability and validity of the findings, and potentially failing to capture long-term benefits or to demonstrate if observed benefits could be sustained.

- Most economic analyses were conducted alongside these randomised controlled trials, limiting their ability to determine if observed savings could be sustained. The costing methodology and perspective adopted differed greatly between studies making it difficult to summarise and aggregate findings. Evidence of cost-effectiveness for a wide range of self-management support interventions in patients with chronic disease was generally of limited applicability to the Irish healthcare setting.

- International evidence suggests that most self-management support interventions are relatively inexpensive to implement. Reported costs vary according to the intensity of the intervention, but are typically low relative to the overall cost of care for the chronic disease in question. In some instances, the interventions resulted in modest cost savings through reduced healthcare utilisation. However, it is unclear if costs would be similar if programmes are rolled out to a larger population or if economies of scale might apply. Longer-term evidence is required to determine if benefits are sustained and if costs change over time. Although generally inexpensive on a per patient basis, the budget impact of these interventions could be substantial due to the large number of eligible patients.

- The individuals eligible for self-management support interventions are likely to experience high levels of multimorbidity whereby they have multiple chronic conditions, a number of which may be amenable to self-management. For people with multimorbidity, a coherent evidence-based approach that acknowledges their various conditions and how they interact is essential.

- Where chronic disease self-management support interventions are provided, it is critical that the implementation and delivery of the interventions are subject to

routine and ongoing evaluation. This would help to ensure that they are delivering benefits to patients, and allow the content and format of the interventions to be refined.

Based on these findings HIQA's advice to the Health Service Executive (HSE) is as follows:

Good evidence of effectiveness was found for certain chronic disease self-management support interventions, while limited or no evidence of effectiveness was found for others. The evidence for generic and the disease-specific interventions is presented in the following advice sections.

The HSE should prioritise investment in those interventions for which there is good evidence of clinical effectiveness. Where chronic disease self-management support interventions are provided, it is critical that an agreed definition of self-management support interventions is developed and the implementation and delivery of the interventions are standardised at a national level and subject to routine and ongoing evaluation.

Most interventions are relatively inexpensive to implement relative to the costs of treating chronic disease and, in some instances, can result in modest cost savings through reductions or shifts in healthcare utilisation. However, due to the numbers of eligible patients, the budget impact of these interventions may be substantial.

Advice – Chronic obstructive pulmonary disease

The key findings of this HTA in relation to self-management support interventions for patients with chronic obstructive pulmonary disease (COPD), which precede and inform HIQA's advice, are as follows:

- Based on 16 systematic reviews (185 randomised controlled trials), a range of self-management support interventions for patients with COPD were identified. These included patient education and use of written action plans, pulmonary rehabilitation, telemedicine, complex self-management support interventions and outreach nursing programmes. Standard pulmonary rehabilitation comprises many aspects of chronic disease self-management support and hence is included here; however, interventions such as education, exercise and behavioural changes are also core components of pulmonary rehabilitation, so the boundary between the intervention types is ill-defined.

- Very good evidence was found that education is associated with a reduction in COPD-related hospital admissions with limited evidence found that it is associated with improvements in health-related quality of life. There is no evidence that action plans when used alone and in absence of other self-management supports reduce healthcare utilisation or lead to improvements in quality of life.

- Very good evidence was found that pulmonary rehabilitation, which includes exercise training, is associated with moderately large, clinically significant improvements in health-related quality of life and functional exercise capacity in people with COPD. Large variation in the design of pulmonary rehabilitation programmes makes it difficult to identify their optimal format.

- Good evidence was found that complex self-management support interventions (involving multiple components and, or multiple professionals with the intervention delivered by a variety of means) are associated with improvements in health-related quality of life. No evidence was found of a statistically significant benefit regarding mortality while there was limited evidence of reductions in health care utilisation. Although it is not clear which components of self-management support relate to these improvements, education and exercise seem to be effective.

- Some evidence was found that:
    - telemedicine as part of a complex intervention decreases healthcare utilisation, with no evidence found of an impact on mortality.
    - outreach nursing programmes improve health-related quality of life.

- Based on 27 costing and cost-effectiveness studies, the economic literature was grouped into five main intervention types: self-management support programmes, pulmonary rehabilitation, telemedicine, case management, and 'other' self-management support interventions.

- Evidence was found that:

  o self-management support education programmes could result in potential cost savings due to reduced healthcare utilisation in patients with moderate to severe disease, depending on the efficiency with which the programmes are run.

  o case management may be cost saving for selected groups of patients with severe disease.

- Limited evidence was found that pulmonary rehabilitation is cost-effective in patients with moderate to severe COPD disease.

- Evidence for the cost-effectiveness of telemedicine interventions is mixed, with more applicable evidence suggesting that telehealth monitoring is not cost-effective.

- The reported per-patient cost of self-management interventions varied according to the intensity of the intervention, but was typically low relative to the overall cost of care of these patients. Ireland has a high prevalence of COPD so the budget impact of implementing self-management support interventions for these patients is likely to be sizeable.

Based on these findings HIQA's advice to the Health Service Executive (HSE) is as follows:

Education is associated with a reduction in COPD-related hospital admissions with limited evidence of improvements in health-related quality of life.

Pulmonary rehabilitation, which includes exercise training, is associated with moderately large, clinically significant improvements in health-related quality of life and functional exercise capacity in people with COPD. Large variation in the design of pulmonary rehabilitation programmes makes it difficult to identify their optimal format.

Complex self-management support interventions (involving multiple components and, or multiple professionals with the intervention delivered by a variety of means) are associated with improvements in health-related quality of life with limited evidence of reductions in health care utilisation. It is unclear which components lead to these improvements, but education and exercise seem to be effective.

There is some evidence that telemedicine may result in reductions in healthcare utilisation and that outreach nursing programmes can lead to improvements in health-related quality of life.

Economic studies suggest that education programmes and case management may be cost saving for selected patients, depending on the efficiency with which the programmes are run. There is limited evidence that pulmonary rehabilitation may be cost-effective in patients with moderate to severe COPD disease.

The reported per-patient cost of self-management interventions varied according to the intensity of the intervention, but was typically low relative to the overall cost of care of these patients. The overall budget impact of self-management support interventions may be considerable due to the high prevalence of COPD in Ireland.

Table of contents

List of abbreviations used in this report

BRUCIE	Better Regulation Using Carbohydrate and Insulin Education (Diabetes programme)
CBT	cognitive-behavioural therapy
CDSMP	chronic disease self-management programme – Stanford programme
CODE	Community Orientated Diabetes Education (Diabetes programme developed by Diabetes Ireland)
DAFNE	Dose Adjustment For Normal Eating
DESMOND	Diabetes Education and Self-Management for Ongoing and Newly Diagnosed (Diabetes Programme)
ES	effect size
EPP	Expert Patient Programme (UK programme based on Stanford model)
HC	health coaching
HTA	health technology assessment
I(C)T	information (and communication) technology
MI	motivational interviewing
NIHR	National Institute of Health Research
PICO	population - intervention - comparator – outcomes
PRISMS	Practical Systematic Review of Self-Management Support
QoL	quality of life
RCT	randomised controlled trial
R-AMSTAR	Revised Assessment of Multiple Systematic Reviews
SD	standard deviation
SMBP	self-monitoring of blood pressure
SMD	standard mean difference
SMS	self-management support

1 Introduction

1.1 Background to request

In December 2014, the Health Information and Quality Authority (HIQA) received a request from the Health Service Executive (HSE) to examine the clinical and cost-effectiveness of generic self-management support (SMS) interventions for chronic diseases and disease-specific interventions for chronic obstructive pulmonary disease (COPD), asthma, cardiovascular disease and diabetes.

1.2 Terms of Reference

Following an initial scoping of the technology, the terms of reference for this assessment were agreed between the Authority and the HSE:

> - **Phase I:** To review the clinical and cost-effectiveness of generic chronic disease self-management support interventions.
>
> - **Phase II:** To review the clinical and cost-effectiveness of disease-specific chronic disease self-management support interventions.
>
>   - **Phase IIa:** The diseases include chronic obstructive pulmonary disease (COPD), asthma, and diabetes.
>   - **Phase IIb:** The diseases include cardiovascular disease – stroke, hypertension, heart failure and ischaemic heart disease.
>
> - Based on this assessment, to advise on the optimal chronic disease self-management support interventions to be implemented by the HSE.

1.3 Overall approach

This health technology assessment (HTA) was conducted using the general principles of HTA and employing the processes and practices used by HIQA in such projects. In summary:

- The Terms of Reference of the HTA were agreed between HIQA and the Health Service Executive.

- An Expert Advisory Group was established. The role of the Expert Advisory Group was to inform and guide the process, provide expert advice and information and to provide access to data where appropriate. The terms of reference of the Expert Advisory Group are included below. A full list of the

membership of the Expert Advisory Group is available in the acknowledgements section of this report.

- An evaluation team was appointed comprising internal HIQA staff. Additionally, Dr Fiona Cianci, a Public Health Specialist Registrar in the Health Service Executive (HSE), Shaun Walsh and Dr Mark Gouldson assisted with the systematic review and data extraction.

- Following review by the Expert Advisory Group with amendments made, as appropriate, the final draft report was submitted to the Board of the Authority for approval. The completed report was submitted to the Minister for Health and the HSE as advice and published on the Authority's website.

The Terms of Reference of the Expert Advisory Group were to:

- Contribute to the provision of high quality and considered advice by HIQA to the HSE.

- Contribute fully to the work, debate and decision-making processes of the group by providing expert guidance, as appropriate.

- Be prepared to provide expert advice on relevant issues outside of group meetings, as requested.

- Provide advice to HIQA regarding the scope of the analysis.

- Support the Evaluation Team led by HIQA during the assessment process by providing expert opinion and access to pertinent data, as appropriate.

- Review the project plan outline and advise on priorities, as required.

- Review the draft report from the Evaluation Team and recommend amendments, as appropriate.

- Contribute to HIQA's development of its approach to HTA by participating in an evaluation of the process on the conclusion of the assessment.

2   Chronic disease self-management

This chapter describes the general purpose of self-management support (SMS) interventions. It provides a description of the different types of SMS interventions evaluated in the following chapters and the theories that underpin them.

2.1   Description of self-management

A broad range of self-management and self-management support (SMS) definitions exist which may reflect the lack of clarity on what constitutes effective SMS.

For the purpose of this review, the 2003 definitions of self-management and SMS agreed by the US Institute of Medicine are used. Self-management is defined as 'the tasks that individuals must undertake to live with one or more chronic diseases. These tasks include having the confidence to deal with the medical management, role management and emotional management of their conditions'. SMS is thus defined as 'the systematic provision of education and supportive interventions by health care staff to increase patients' skills and confidence in managing their health problems, including regular assessment of progress and problems, goal setting, and problem-solving support.'[1;2]

Figure 2.1 (on page 6) by Taylor et al. shows the process by which SMS enables individuals to improve their medical, emotional and risk management behaviours.[2;3] This illustrates that to effect change, individuals need to acquire or develop five core self-management skills: problem-solving; decision-making; appropriate resource utilisation; forming a partnership with a health-care provider; and taking necessary actions.[2;4;5] The final step is mediated by the patient's self-efficacy which is required to enact these skills and deliver behaviour change. Self-efficacy, one of the core concepts of social cognitive theory, focuses on increasing an individual's confidence in their ability to carry out a certain task or behaviour, thereby empowering the individual to self-manage.[2] SMS interventions to enhance these five core self-management skills and to improve self-efficacy can include different components (education, training, provision of information or equipment) delivered in a variety of formats such as, education programmes, telemedicine, health coaching and motivational interviewing. A range of delivery methods also exist such as group or individual, face-to-face or remote, professional or peer-led. These interventions can be generic, that is, they can be used across a range of chronic diseases or disease-specific, that is, designed for a specific disease type.

Generic SMS is currently provided in Ireland through programmes such as those run by Arthritis Ireland, Beaumont hospital and the HSE's ('Quality of Life') SMS programme. These programmes are all based on a model developed in Stanford University (Stanford model). Disease-specific programmes are also available. For

example, there are a range of diabetes-specific programmes for both Type 1 (DAFNE and Berger programmes) and Type 2 diabetes (DESMOND, X-PERT, and the CODE programme developed by Diabetes Ireland). A wide range of education programmes and peer-support groups are also available, including those provided by voluntary organisations, such as the Asthma Society, COPD Ireland, Croí, Diabetes Ireland, and the Irish Heart Foundation. However, the efficacy of many of these programmes has not been evaluated at a national level nor an assessment made as to the optimal programme or programmes that should be implemented and to whom they should be made available.

SMS interventions may be a worthwhile adjunct to best medical care to allow patients to take control of and manage portions of their own care. The cost of the intervention is predicted to be low relative to, for example, the potential resource savings associated with a reduction in the number of general practitioner (GP) visits, emergency department visits or hospitalisations. However, at present there is uncertainty regarding the benefits of SMS interventions in the short and long term. Also there is uncertainty about the optimal format that SMS should take. Should it be programme-based and if so, what type of programme is best? Should remote solutions be implemented? What is the evidence of cost-effectiveness? While some initiatives are already available in Ireland, their implementation is not consistent and may not be adequate to meet the growing burden of chronic diseases. With co-morbidity being common in the ageing population and the rise in the number of patients with multi-morbidity, is there a need for generic SMS interventions that can be applied across a range of chronic diseases? Are generic skills sufficient to manage chronic diseases? Evidence on the general care of patients with multiple morbidities is limited, but it has been reported that interventions that focus on particular risk factors may be more effective.[6] Alternatively, is there a need for disease-specific SMS interventions to manage certain aspects of selected chronic diseases? Or can a combination of generic tools combined with disease-specific components be used to optimise care?

The uncertainty regarding the format of optimal SMS presents an obstacle to informed decision making about the provision of this intervention in the Irish public healthcare system.

Summary statement

A broad range of self-management and self-management support definitions exist. For this review, the 2003 definitions agreed by the US Institute of Medicine are used:

Self-management is defined as 'the tasks that individuals must undertake to live with one or more chronic diseases. These tasks include having the confidence to deal with medical management, role management and emotional management of their conditions. '

Self-management support is defined as 'the systematic provision of education and supportive interventions by health care staff to increase patients' skills and confidence in managing their health problems, including regular assessment of progress and problems, goal setting, and problem-solving support.'

Self-management support interventions are any interventions that help patients to manage portions of their chronic disease or diseases through education, training and support.

Figure 2.1 **The process of adoption of self-management behaviours taken from Taylor et al. (adapted from Corbin and Strauss and Lorig and Holman).[2;3;5]**
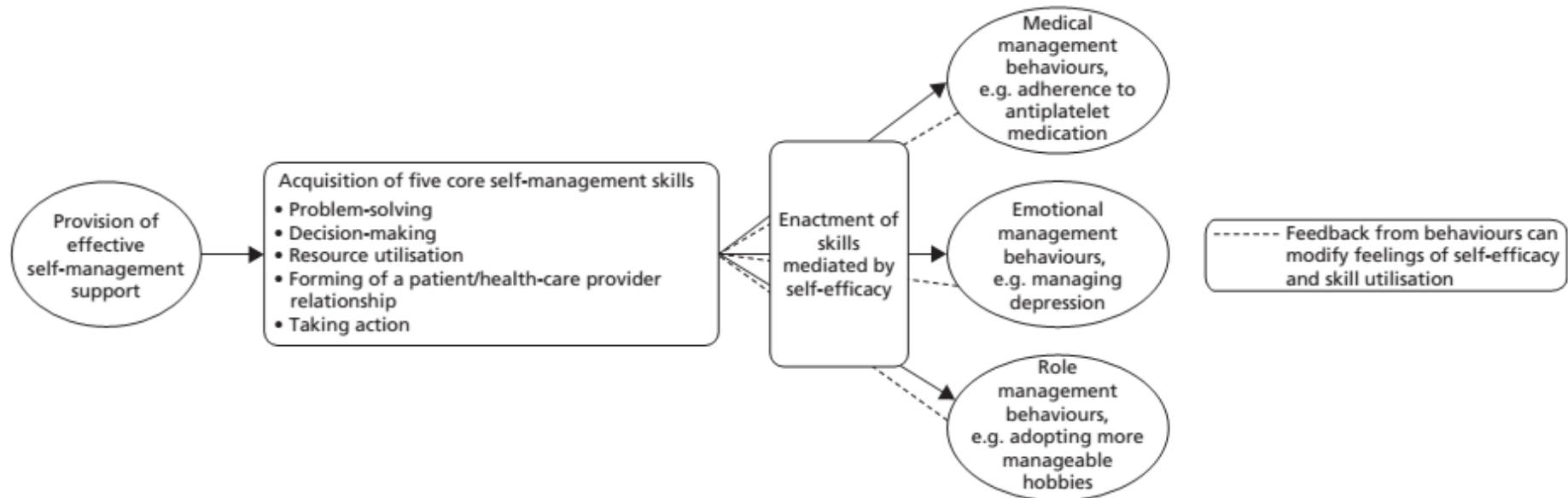
2.2 Description of the interventions

Phase I and Phase II of this assessment include appraisal of generic and disease-specific SMS interventions that help patients manage portions of their chronic disease through education, training and support, respectively. Included were:

- All formats and delivery methods (group or individual, face-to-face or remote, professional or peer-led).

- All studies that include a large component of SMS.

The following sections include some descriptions of well known SMS interventions. Further disease-specific interventions are discussed in the chapters on individual diseases.

2.2.1 Chronic disease self-management models/programmes

The following section includes a brief description of the most well-known and widely-used health behaviour change theories and health behaviour change interventions and programmes. A recent review by the New Zealand Guidelines Group included a detailed description of some of these interventions, and as such portions of these descriptions are summarised and referenced below.[7] Disease-specific programmes, where relevant, are discussed in the individual disease-specific sections of this report.

Health behaviour change theories

Trans-Theoretical Theory[7]

This model is based on the theory that behaviours can be modified. It is related to a person's readiness to change, the stages that they progress through to change and doing the right thing (processes) at the right time (stages). As such, tailoring interventions to match a person's readiness or stage of change is said to be essential. The model comprises emotions, cognitions and behaviours, and includes measures of self-efficacy and temptation. It has been used to modify target behaviour such as smoking cessation and stress management.

Social Learning/Social Cognitive Theory[7]

This theory proposes that behaviour change is affected by environmental influences, personal factors, and attributes of the behaviour itself. A central component of this theory is also self-efficacy. As well as belief in the behavioural change, the individual must value the outcomes they believe will occur as a result.

Theory of Reasoned Action and Theory of Planned Behaviour[7]

This social cognitive theory of reasoned action states that individual performance of a target behaviour is determined by the person's intention to perform that behaviour based on their attitude toward the behaviour and the influence of their social environment or subjective norm. The shared components are behavioural beliefs and attitudes, normative beliefs, subjective norms and behavioural intentions. The Theory of Planned Behaviour adds to the Theory of Reasoned Action, the concept of perceived control over the opportunities, resources, and skills necessary to perform a behaviour. These are considered to be critical in behavioural change. This is congruent with the concept of self-efficacy.

Cognitive Behavioural Theory and Cognitive Behavioural Therapy (CBT)[7]

This is a highly-structured psychotherapeutic method used to alter distorted attitudes and problem behaviours by identifying and replacing negative inaccurate thoughts and changing the rewards for behaviours. CBT attempts to help an individual make sense of overwhelming problems by breaking them down into smaller parts. CBT can take place on a one-to-one basis or with a group of people. It can be conducted from a self-help book or computer programme. The duration of the intervention can range from six weeks to six months depending on the problem and the individual; sessions usually last 30 to 60 minutes with a trained therapist.

Behaviour change programmes or models based on a single health behaviour change theory (including adaptations or modifications)

The Chronic Care Model

This model was developed by Wagner in the MacColl Institute in the 1990s in response to the increasing burden of chronic disease and the varying approaches of management and care (social learning/cognitive theory).[8;9] It is focused on changing a reactive system – responding mainly when a person is sick – to a more proactive system which focuses on supporting patients to self-manage. A principle part of the model is that the patient has a central role in managing their health and in particular self-efficacy. It is a high-level organisational or system level of health service provision and identifies the essential elements of a health care system that encourage high-quality care including the community, the health system, SMS, delivery system design, decision support and clinical information systems. As such, this is a higher level model than for example, the Stanford model and UK Expert Patient Programme which are discussed below, as SMS is only one component of the chronic care model.

Personalised care planning or 'building the house of care'

The management and care of long-term conditions tends to be seen as the clinician's responsibility rather than a collaborative endeavour with active patient involvement and effective SMS. In the UK, the King's Fund describe the 'house of care' in 2013, a metaphor which was devised to help those working in primary care adapt the chronic care model to their own situation. It encompasses all people with long-term conditions; and assumes an active role for patients, with collaborative personalised care planning at its heart.[10] Personalised care planning is described as a collaborative process in which patients and clinicians identify and discuss problems caused by, or related to the patient's condition, and develop a plan for tackling these. It has been described as a conversation, or series of conversations, in which they agree goals and actions for managing the patient's condition.[11]

Stanford Programme

This is based on the concept of self-efficacy within social learning theory. It was originally developed by Stanford University in the US. It uses peer educators to build self-efficacy in a group setting. The Stanford chronic disease self-management programme (CDSMP) is a generic programme, that is, it can be used for patients with a range of chronic diseases. It is based on the fact that people with chronic disease have similar concerns and, with specific skills and training, can effectively manage aspects of their own conditions.[12] The programme consists of two and a half hour workshops once a week for six weeks and while generally administered in community settings, is also available online.

UK Expert Patient Programme (EPP)

This is a modification of the Stanford model above and was introduced into the UK in 2002 and branded the EPP.[13] Similar to Stanford's CDSMP, it uses peer educators and consists of six weekly workshops conducted in community settings; it is also available as an on-line tool. The topics discussed during the workshops are also similar to those presented in the Stanford workshops. It covers topics such as: healthy eating, exercise, pain management, relaxation, action planning and problem solving.[13] It promotes patient knowledge by teaching the skills necessary for people to effectively manage their own chronic conditions, with support from physician team members.

Behaviour change programmes or models based on multiple health behaviour change theories

Flinders Programme™

The Flinders programme™ is a clinician-driven, behavioural change programme (based on multiple health behaviour change theories) that emphasises the role physicians have in building patient self-efficacy and the need to actively engage patients using the principles of cognitive behavioural therapy (CBT) during patient-physician interactions (one-on-one). The programme has seven principles of self-management which allow individuals to:[14]

1. Have knowledge of their condition.

2. Follow a treatment plan (care plan) agreed with their health professionals.

3. Actively share in decision making with health professionals.

4. Monitor and manage signs and symptoms of their condition.

5. Manage the impact of the condition on their physical, emotional and social life.

6. Adopt lifestyles that promote health.

7. Have confidence, access and the ability to use support services.

Other programmes or models

Other SMS interventions are based on behavioural theories such as the health belief model, the theory of reasoned action, the trans-theoretical model, the information-motivation-behavioural skills model and the theory of planned behaviour. They all specify determinants of behaviour that could potentially be changed to improve health and quality of life. The other SMS interventions that were identified as part of the systematic review of efficacy were motivational interviewing and health coaching which are similar, but distinct approaches.[15] The differences between these interventions are described briefly below.

- Motivational interviewing – based on the trans-theoretical model of behavioural change and 'readiness to change'. It uses a brief approach such as 60 minutes of counselling and education to increase motivation and commitment to change. Once that is achieved, other approaches are pursued.

- Health coaching – based on the trans-theoretical model of behavioural change and 'readiness to change'. It is a standalone, comprehensive intervention with a minimum of six sessions.

- Information-motivation-behavioural skills model – This is a behavioural theory which identifies constructs (including information, motivation and behaviour skills) that are needed for successful self-management or adherence.

2.2.2 Chronic disease self-management – Telemedicine including internet support

Telemedicine, a term coined in the 1970s, literally means 'healing at a distance' and signifies the use of information and communication technology (ICT) to improve patient outcomes by increasing access to care and medical information.[16] However, there is no one universally accepted definition of telemedicine, so that the literature in this area describes a myriad of interventions delivered through different mechanisms for different purposes. A 2007 publication found 104 definitions of telemedicine in the peer-reviewed literature. Despite this, telemedicine was found to typically comprise four major elements: supply of medical care, use of technology, mitigation of issues of distance, and provision of benefits.[17] The World Health Organisation (WHO) has adopted the following broad description:

> 'The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities.'[16;18]

Telemedicine is constantly evolving to incorporate new advancements in technology and to respond and adapt to changing health needs. Telemedicine applications typically have two formats; synchronous which involves real-time interaction (that is, via the telephone or videoconferencing) or asynchronous communication (not real-time, for example via text messages, email or devices that permit store-and-forward transmission of data [for example, a home glucose metre]). Asynchronous methods that use store-and-forward transmission typically forward the data to a health professional who reviews the data and uses their clinical judgement to make recommendations to the individual. Telemedicine also includes internet- or web-based support (sometimes referred to as e-health). This can include internet versions of, for example, the online version of the Stanford CDSMP described above. Internet-based support offers an alternative to face-to-face interventions which could be beneficial if resources are limited.

2.3   Key messages

- Self-management is defined as the tasks that individuals must undertake to live with one or more chronic diseases.

- Self-management support interventions are any interventions that help patients to manage portions of their chronic disease or diseases through education, training and support.

- Self-efficacy, one of the core concepts of social cognitive theory, focuses on increasing an individual's confidence in their ability to carry out a certain task or behaviour, thereby empowering the individual to self-manage.

- Self-management support interventions can include a variety of formats such as, education programmes, telemedicine (text messages, email, internet-based support), health coaching and motivational interviewing. A range of delivery methods also exist such as group or individual, face-to-face or remote, professional or peer-led.

- There are several behaviour change programmes which focus mainly on improving self-efficacy. These include generic programmes such as the UK Expert Patients Programme (peer-led) and the Flinders model^{TM} (physician-led), and the generic and disease-specific Stanford programme (peer-led).

3   Methodology

3.1   Clinical-Effectiveness

This health technology assessment (HTA) of self-management support (SMS) interventions was undertaken as a series of rapid HTAs. As per the terms of reference, individual disease-specific assessments were prepared for asthma, chronic obstructive pulmonary disease, diabetes, cardiovasculuar disease (hypertension, stroke, ischaemic heart disease, and heart failure) as well as an assessment of generic SMS interventions not tailored to any one specific disease. The term 'rapid HTA' is analogous to that of a 'mini-HTA'; both terms are widely used in the international HTA setting to refer to a HTA with restricted research questions whose purpose is to inform decision making in a particular service setting or for a specific group of patients. Based on the approach used in a full HTA assessment, a rapid HTA uses a truncated research strategy with the review of published literature often restricted to a review of the secondary literature (including systematic reviews, meta-analysis, guidelines etc.) and does not include development of an independent economic model. This approach is useful when undertaking assessments that are proportionate to the needs of the decision maker.

A systematic review of chronic disease self-management support (SMS) interventions was undertaken for generic interventions and disease-specific interventions for each of the identified chronic diseases to identify, appraise and synthesise the best available evidence on their clinical effectiveness and safety.

This review included:

- development of a systematic review protocol

- appraisal and synthesis of all available evidence in line with international best practice in systematic reviews of interventions.

3.1.1   Literature review

A scoping review of the literature was carried out in preparation for this project and a large body of clinical effectiveness literature was identified. This included multiple systematic reviews of varying quality and scope that evaluated a range of SMS interventions. Based on the volume of literature available and the project timelines, an overview of reviews was considered to be the most efficient method to assess the clinical effectiveness of SMS interventions.

'Overviews of reviews' also known as, 'meta-reviews' or 'reviews of reviews' are an efficient way to gather a large body of the best available evidence in a single source to provide broad, cumulative statements that summarise the current evidence on the effectiveness of interventions. The term 'overview of reviews' is used by the

Cochrane Library and will be used in this report from this point on. An overview of reviews allows the findings of separate reviews to be compared and contrasted, thereby providing clinical decision makers with the evidence they need. The overview of reviews is limited to a summary of systematic reviews, that is reviews that are prepared using a systematic approach, and is itself done according to the principles of systematic reviewing. The disadvantage of this approach is the inability of an overview of reviews to reflect the most recent literature: following publication of a randomised controlled trial (RCT), it must first be captured in a systematic review, before subsequently being captured in an overview of reviews. This approach would therefore be less suitable for a fast-moving area where there are rapid advances in the technology. However, given their sample sizes, it is not appropriate to draw conclusions on the effect of an intervention based on a single, or a number of small RCTs. Therefore, it is unlikely that more recent RCTs not captured in an overview of reviews would be sufficient to substantially alter recommendations informing major policy decisions. As noted the scoping review identified a large body of clinical effectiveness literature. For efficiency, it was agreed that if a recent high quality review that met our inclusion criteria was retrieved, then it would be used as a starting point for this report.

Phase I:

A de novo search for systematic reviews evaluating generic chronic disease SMS interventions was conducted in PubMed, Embase and the Cochrane Library (Database of Abstracts of Reviews of Effects [DARE], Cochrane Database of Systematic Reviews [CDSR] and Health Technology Assessment Database [HTA]). No language restrictions were applied. The search was limited to reviews of randomised controlled trials (RCTs) and systematic reviews of RCTs. Initially a start date of 1993 (the year in which the Cochrane Collaboration was established) was used as it marked the widespread initiation of high-quality systematic reviews. However, this was subsequently amended to 2009 due to the volume of systematic reviews retrieved. This was deemed appropriate given that the retrieved high quality reviews published after 2009 included the earlier RCT data. All searches were carried out up to 10 February 2015. A search of reference lists of relevant studies and previous review articles was also performed. The criteria used for including studies are shown in Table 3.1. Full details of the search strings used and the retrieved results are provided in Appendix A3.1.

Phase II:

During scoping, the following recent high quality overview of reviews was retrieved: "A rapid synthesis of the evidence on interventions supporting self-management for people with long-term conditions: PRISMS – Practical systematic Review of Self-Management Support for long-term conditions",[2] hereafter referred to as the PRISMS report. This review was commissioned by the UK National Institute for

Health Research (NIHR) in 2012 and published in 2014. Based on a systematic search of the literature up to 1 June 2012, it summarised the best available evidence for SMS for a range of diseases including asthma, chronic obstructive pulmonary disease (COPD), Type 1 and Type 2 diabetes, stroke and hypertension.1 For these diseases, this assessment therefore was limited to an update to the PRISMS report and was completed by running additional searches in PubMed, Embase and the Cochrane Library from 2012 to 1 April 2015, see Appendix A3.1. The results of the updated search as well as the original PRISMS findings are reported in the relevant chapters of this assessment with any changes to the PRISMS findings clearly documented. PRISMS also included a qualitative meta-review and implementation systematic review which assessed SMS at an organisational and professional level.[2] These sections of the PRISMS review were not updated and the results are not included here as it was beyond the immediate scope of this HTA. PRISMS did not include telehealth reviews as they deemed them to be typically about mode of delivery rather than content of what was delivered. Telehealth interventions were included in the updated review. De novo systematic reviews were undertaken for the remaining diseases included in the Terms of Reference for this project (heart failure and ischaemic heart disease) as these were not assessed in the PRISMS report. Systematic searches were run in PubMed, Embase and the Cochrane Library from 2009 to 1 April 2015, see Appendix A3.1.

Table 3.1.   PICOS criteria for study eligibility

Population	**Phase I:** Adults ≥ 18 years old with at least one chronic disease. This includes common physical conditions such as asthma, COPD, arthritis, diabetes and cardiovascular diseases. **Phase II:** Adults ≥ 18 years old with the specified disease (Type I or Type II diabetes mellitus, asthma, COPD, ischaemic heart disease, heart failure, hypertension or stroke).
Intervention	**Phase I:** Any generic self-management support intervention which helps patients manage aspects of their chronic disease through education, training and support. All formats and delivery methods (group or individual, face-to-face or remote, professional or peer-led). All studies that include a large component of self-management support. The intervention is assessed in more than one chronic disease. **Phase II:** Any disease-specific self-management support intervention which helps patients manage aspects of their chronic disease through education, training and support.

---

1 The dates for the searches varied for the different diseases, however, June 2012 was the earliest review.

	All formats and delivery methods (group or individual, face-to-face or remote, professional or peer-led). All studies that include a large component of self-management support. The intervention is assessed in diabetes mellitus (Type I and Type II), asthma, COPD, ischaemic heart disease, heart failure, hypertension, or stroke.
Comparator	Studies where self-management support plus best medical care is compared with best medical care.
Outcomes	▪ Health care utilisation (including unscheduled use of healthcare services – for example, GP visits, emergency department visits, hospital (re)admissions, hospital length of stay) ▪ Patient-centered outcomes relating to patient quality of life, patient satisfaction, self-efficacy ▪ Health outcomes (including biological markers of disease)
Study design	Systematic reviews of randomised controlled trials or systematic reviews (overview of reviews).

Key: **COPD** – chronic obstructive pulmonary disease; **GP** – general practitioner.

As noted in Section 2.1, there is no universally accepted definition for self-management or SMS. This creates problems when attempting to identify, analyse and assess the available literature. Interventions may target different recipients (for example, patients, carers, health care professionals), include different components (for example, education, information, practical support, provision of equipment, social support, lifestyle advice, prompts, financial incentives), be delivered in different formats (for example, face-to-face, remote, web-based), be provided or facilitated by different individuals including healthcare personnel and trained or untrained lay persons, as well as differing in their intensity and duration. However, a consistent theme is that SMS interventions are typically complex interventions that include more than one component of SMS. For this reason, and consistent with the PRISMS report, with the exception of education interventions, this review did not assess single component SMS (for example, simple text message appointment reminders and drug reminder packaging). Other disease-specific inclusion or exclusion criteria are included in the individual disease chapters.

Given the wide range of SMS interventions identified, where possible the SMS interventions were classified by intervention type. Categorising the interventions into groups facilitated reporting and allowed study cross-over (overlap) to be assessed per intervention type.

3.1.3   Data extraction and quality assurance

Preliminary screening of all returned results was carried out by a single person to eliminate studies that were clearly not relevant. Assessment of eligibility of studies and identification of multiple reports from single studies was carried out independently by two people. Any disagreements were resolved by discussion.

Data extraction was performed independently by two people, with disagreements resolved by discussion. To adequately inform decisions in relation to the quantity and quality of evidence underpinning the findings of this assessment, quality assurance of the systematic reviews and meta-analyses was undertaken. The approach adopted and the tools used are discussed below. The quality of the primary studies underpinning the systematic reviews were not directly evaluated, instead information was extracted from the systematic reviews on the quality of the primary evidence, where reported.

Phase I and Phase II

Assessment of the quality of included systematic reviews was performed by two people independently using the Revised Assessment of Multiple Systematic Reviews (R-AMSTAR) quality appraisal tool.[19;20] This is an 11-item tool with item scores ranging from 1 to 4, providing therefore a possible range of up to 44 for the R-AMSTAR total scores. The methodology used by the PRISMS group was adopted given the validity of their approach and to facilitate interpretation and reporting of systematic reviews. The evidence was weighted by the quality of the systematic reviews retrieved (as indicted by the R-AMSTAR score) and the size of the studies they included (total number of participants included within the systematic review) to give an overall value (range * to ***) for each review (Table 3.2).

Table 3.2.   PRISMS quality ratings for systematic reviews[2]

Quality of studies		
Overall Value	**Quality of systematic review using R-AMSTAR**	**Systematic review sample size**
*	Lower quality (R-AMSTAR score <31)	Smaller sample size (<1,000 participants).
**	Lower quality (R-AMSTAR score <31)	Larger sample size (≥1,000 participants)
**	Higher quality (R-AMSTAR ≥31)	Smaller sample size (<1,000 participants).
***	Higher quality (R-AMSTAR ≥31)	Larger sample size (≥1,000 participants)

Note: This table is taken from the PRISMS study by Taylor et al..[2]

If an included systematic review performed a quality of evidence assessment, this information was also collected during the data extraction process. Tools used included the Grades of Recommendation, Assessment, Development and Evaluation (GRADE) system criteria[21] and the Jadad Scale.[22] GRADE identifies five key elements that can be used to rate confidence in the estimates of intervention effects. The criteria are: risk of bias; inconsistency of results; indirectness of evidence; imprecision; and publication bias. Assessing and combining these components determines the quality of evidence for each outcome of interest as 'high' (further research is very unlikely to change our confidence in this estimate of effect); 'moderate' (further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate); 'low (further research is likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate); and 'very low (any estimate of effect is very uncertain). The Jadad scale is a validated seven-item scale that assesses the quality of RCT methods relevant to random assignment, double blinding and the accountability of all patients including withdrawals; scores range from 0 (very poor) to 5 (rigorous). An 11-item scale with a range of 0 to 13 points has also been described; scores of nine or less are considered poor quality, while scores greater than nine are considered to be of good quality.

If a meta-analysis was undertaken, the quality and strength of evidence were evaluated in order to facilitate interpretation of the findings. Each meta-analysis was reviewed using a 43-item questionnaire that evaluated the data sources used, the analysis of individual studies by meta-analysts, the conduct of the meta-analysis, and its reporting and interpretation.[23] Based on this, each meta-analysis was graded as being of low, moderate or high quality. A grading of 'low quality' referred to studies where the conclusions were at high risk of bias due to poor data collection or methods of data synthesis. The conclusions in studies identified as 'moderate quality' were at risk of bias, but were likely to be broadly accurate, while studies graded as 'high quality' were very likely to have conclusions that accurately reflected the available evidence.

Where available, data on the validity of the RCTs included in each meta-analysis were extracted to determine their risk of bias, that is, the risk that they overestimated or underestimated the true intervention effect. Biases are broadly categorised as selection bias, performance bias, detection bias, attrition bias, reporting bias and other potential sources of bias. Bias is typically assessed using a specific tool, such as the Cochrane Risk of Bias Tool. For each element the risk of bias is assessed as low, high or unclear. For each meta-analysis, the number of primary studies that were rated as being at low risk of bias (or rated as high quality) was reported relative to the total number of primary studies.

Finally, as done by the PRISMS group, a value ranging from 0 (no evidence of effect) to *** / --- very strong evidence of effect in favour of the intervention/control was assigned to each finding based on the probability of the event (Table 3.3). Effect sizes reported in the individual reviews are not just based on probabilities but include ranges of effects and confidence intervals.

Table 3.3   PRISMS evidence of effect[2]

Evidence of effect		
Value	**Probability**	**Evidence of effect**
0	p>0.05	No evidence of effect.
+/−	0.05≥p>0.01	Some evidence of effect in favour of intervention/control.
++/− −	0.01≥p>0.001	Strong evidence of effect in favour of intervention/control.
+++/− − −	p≤0.001	Very strong evidence of effect in favour of intervention/control.

Note: This table is taken from the PRISMS study by Taylor et al..[2]

3.2   Costs and Cost-Effectiveness

3.2.1   Literature review

A review of cost-effectiveness studies was undertaken to assess the available evidence for self-management support (SMS) interventions. Studies were included if they compared the costs and consequences of a SMS intervention to routine care.

A search was carried out to identify economic analyses of SMS interventions. In tandem with the systematic review of clinical effectiveness, the search for economic evaluations was carried out in PubMed, EMBASE and the Cochrane Library. The same search terms were used with the exception of terms for systematic review and meta-analysis. In place of these, search terms and filters for economic evaluations were applied. In addition, systematic reviews of SMS interventions identified through the clinical effectiveness search that included cost or economic outcomes were used to identify additional studies. The search was carried out up until 4 March 2015.

The PICOS (Population, Intervention, Comparator, Outcomes, Study design) analysis used to formulate the search is presented in Table 3.4 below.

Table 3.4.   PICOS analysis for identification of relevant studies

Population	**Phase I:** Adults ≥ 18 years old with at least one chronic condition. **Phase II:** Adults ≥ 18 years old with the specified disease (Diabetes Type I or Type II, asthma, COPD, ischaemic heart disease, heart failure, hypertension or stroke).
Intervention	**Phase I:** Any generic self-management support intervention that helps patients to manage aspects of their chronic disease care through education, training or support. **Phase II:** Any disease-specific self-management support intervention that helps patients to manage aspects of their chronic disease care through education, training or support.
Comparator	Routine care.
Outcomes	Cost or cost-effectiveness of intervention.
Study design	Randomised controlled trials, case-control studies, observational studies, economic modelling studies.

Key: **COPD** – chronic obstructive pulmonary disease.

Studies were excluded if:

- application of the SMS was limited to a population with a single specified chronic disease (Phase I only),
- a nursing home or non-community dwelling population was included,
- they included a paediatric population,
- cost data were not clearly reported,
- published prior to 2000 (limited relevance).

3.2.2 Data extraction and quality assurance

Preliminary screening of all returned results was carried out by a single person to eliminate studies that were clearly not relevant. Assessment of eligibility of studies and identification of multiple reports from single studies was carried out independently by two people. Any disagreements were resolved by discussion.

Studies were classified into intervention types, where applicable, corresponding to the categories used for the assessment of clinical effectiveness.

In accordance with national HTA guidelines, assessment of the quality of the studies identified was performed independently by two people with the studies subsequently assessed for their transferability to the Irish healthcare setting. Any disagreements were resolved by discussion. The Consensus on Health Economic Criteria (CHEC)-list was used to assess the quality of the studies.[24] This tool is useful to evaluate economic evaluations that are being considered for inclusion in a systematic review with a view to increasing the transparency and comparability of the reviews. For studies that included an assessment of cost-utility or an economic modelling approach, assessment of the relevance of the studies to the Irish healthcare setting and their credibility was considered using a questionnaire from the International Society of Pharmacoeconomic Outcomes Research (ISPOR).[25] This tool is used and tailored towards appraising conventional economic evaluations which typically assess a set number of interventions in a specific population.

Costs reported in each of the studies were inflated to 2014 using the local consumer price index and expressed in Irish Euro using the purchasing power parity exchange rate.[26]

6 Chronic obstructive pulmonary disease (COPD)

This health technology assessment (HTA) of chronic obstructive pulmonary disease (COPD) self-management support (SMS) is one of a series of rapid HTAs assessing SMS interventions for chronic diseases. Section 6.1 provides a brief description of COPD followed by separate reviews of the clinical- (Section 6.2) and cost-effectiveness (Section 6.3) literature of SMS interventions for COPD. Brief descriptions of the background and methods used are included with full details provided in a separate document (Chapter 3). Section 6.4 includes a discussion of both the clinical- and cost-effectiveness findings. The report concludes with a list of key points in relation to COPD SMS support (Section 6.5).

6.1 Description of the disease

Chronic obstructive pulmonary disease (COPD) is defined as 'a common preventable and treatable disease, which is characterised by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases'.[119] The clinical course of COPD is one of gradual impairment with episodes of acute exacerbations that contribute to the deterioration of a person's health status. In the later stages of disease, use of health services often increases with frequent hospitalisations. Currently there is no cure for COPD.[120] COPD is a major cause of morbidity and mortality and it is predicted that by 2020 it will be the third leading cause of death globally.[120] Ireland has one of the highest standardised death rates for COPD in the European Union.[120;121] Ireland also has one of the highest rates of hospital admissions for exacerbations of COPD in the Organisation for Economic Co-operation and Development (OECD). This is associated with a high smoking prevalence, a major risk factor for COPD.[120;122]

To provide some context to this section, it is noted that in 2008 a draft National Respiratory (COPD) Framework was published by the Irish Thoracic Society in conjunction with the Health Service Executive (HSE) and the Irish College of General Practitioners (ICGP). It stated that pulmonary rehabilitation is acknowledged by all international guidelines as a key component of the management of COPD; helping patients to optimise their function and better manage their disease.[123] This is based on the fact that best practice guidelines recommend that patients are referred to pulmonary rehabilitation programmes at the time of diagnosis. However, it is acknowledged that in Ireland early and accurate diagnosis of COPD in primary care is difficult due to limited access to diagnostic spirometry.[124] In 2008 many areas in Ireland had no pulmonary rehabilitation programmes, others had long waiting lists, others did not accept referrals from primary care, while the location of some posed access problems for those without transport.[123] Stated aims of the HSE's National

Clinical Programme for COPD are to improve access to diagnostic spirometry and to 'implement COPD pulmonary rehabilitation programmes to improve exercise tolerance, quality of life and reduce breathlessness in patients'.[125] In addition, it has a stated aim to provide access to patient information and self-management tools.[125] However, no decision has been made by the HSE as to the optimal format of such support interventions.

6.2   Review of clinical effectiveness

6.2.1   Background and Methods

Details of the background and methods for this assessment are included in Chapters 1 to 3 of this report. Briefly, an aim of this HTA is to review the clinical effectiveness of self-management support (SMS) interventions for a number of chronic conditions including chronic obstructive pulmonary disease (COPD). Given the large volume of literature available, it was noted that an update of an existing high-quality systematic review of SMS interventions could be considered sufficient to inform decision making.

In December 2014 a high-quality overview of reviews was published by the National Institute for Health Research in the UK. The Practical systematic Review of Self-Management Support for long-term conditions (PRISMS) overview comprised an overview of systematic reviews of randomised controlled trials (RCTs) up to 1 June 2012, and was undertaken according to the principles of systematic reviewing. An update to the PRISMS report was completed by running additional searches in PubMed, Embase and the Cochrane library from 2012 to 1 April 2015, see Appendix A3.1. In accordance with the PICOS (Population, Intervention, Comparator, Outcomes, Study design) agreed with the key stakeholder, this assessment is limited to SMS interventions for adults aged 18 and over. As noted in Chapter 3.1.1, SMS interventions are typically complex interventions that include more than one component of SMS. For this reason, and consistent with the PRISMS report with the exception of education interventions, this review did not assess single component SMS (for example, simple text message appointment reminders and drug reminder packaging). Results of the updated search are reported in addition to a summary of the findings of the PRISMS report. PRISMS did not include telehealth reviews as they deemed these to be typically about mode of delivery rather than content of what was delivered. Relevant telehealth interventions that incorporated a significant component of self management support were however included in this updated review.

Data extraction and quality assurance of the systematic reviews, meta-analyses and the risk of bias associated with the primary literature was undertaken as described in Chapter 3.1.3. In summary, in order to determine the quantity, quality, strength and

credibility of evidence underpinning the various SMS interventions, quality assurance of both the systematic review methodology (R-AMSTAR score) and the meta-analyses (Higgins et al.'s quality assessment tool)[23] was undertaken. While the R-AMSTAR score was used to determine the quality of the systematic reviews, the scores were then weighted by patient or participant trial size, with the quality of evidence being downgraded if the review was based on fewer than 1,000 participants. The quality of primary evidence was not evaluated directly; where reported, information on the risk of bias of the primary studies was extracted from the systematic reviews.

6.2.2   Description of the interventions

A general description of self-management and typical SMS interventions is included in Chapter 2. COPD-specific interventions introduced in this Phase II report include pulmonary rehabilitation. This is a more comprehensive form of SMS and is defined by the joint American Thoracic Society and European Respiratory Society as a '…comprehensive intervention based on a thorough patient assessment followed by patient tailored therapies that include, but are not limited to, exercise training, education, and behaviour change, designed to improve the physical and psychological condition of people with chronic respiratory disease and to promote the long-term adherence to health-enhancing behaviours.'[126] The educational component of pulmonary rehabilitation focuses on collaborative self-management and behaviour change.[126] It encompasses providing information and knowledge regarding COPD; building skills such as goal setting, problem solving and decision making; and developing action plans that allow individuals to better recognise and manage the disease.[126]

6.2.3   Results – Clinical-effectiveness

The PRISMS review retrieved a total of five systematic reviews of COPD-specific SMS interventions and generic interventions used in adults with COPD.[2] Summary details of the reviews are included in Table 6.1. The publication dates of the systematic reviews ranged from 2005 to 2012 while that of the included RCTs ranged from 1987 to 2011. The reviews included 28 individual RCTs and were conducted in Canada, the Netherlands, Sweden, France, US, UK, Australia and Hong Kong.

The PRISMS review was updated to April 2015 using the search string in Appendix A3.1. A further 11 systematic reviews were retrieved (Figure 6.1) that assessed a diverse range of SMS interventions for COPD including action plans,[127] integrated disease management (chronic care management that requires a community wide, systematic and structured multidisciplinary approach potentially employing multiple treatment modalities) ,[128] combinations of SMS interventions,[129-132] telemedicine[133-136] and pulmonary rehabilitation.[137] See Table 6.1 for details.

Study overlap is reported in Table 6.2. The results from one review by Harrison et al. (2015) are not discussed further due to large study overlap with another high-quality review by Jordan et al. (2015). The number of included RCTs per systematic review ranged from four to 65 with the number of participants ranging from 529[138] to 3,941.[129] The publication dates of the systematic reviews ranged from 2005 to 2015 while that of the included RCTs ranged from 1977 to 2013. RCT study locations were typically in Europe or North America. In total 185 unique RCTs were identified between the 16 RCTs included in this review.

The R-AMSTAR scores for the additional systematic reviews identified in the updated search ranged from 26 to 41, with scores of 31 or more indicating a high-quality systematic review. When weighted according to the number of participants in the original RCTs (less than 1,000 or greater than or equal to 1,000), nine of the systematic reviews were categorised as providing the highest quality evidence (*'three star'* *** review) while four reviews each were rated as *'two-star'* ** and two as *'one-star'* * in terms of their quality and size. Of the 15 systematic reviews discussed, 14 included a meta-analysis of which 11 were assessed as high-quality, two as moderate quality and one as low-quality. A grading of 'low-quality' refers to studies where the conclusions are at high-risk of bias due to poor data collection or methods of data synthesis. The conclusions in studies identified as 'moderate quality' are at risk of bias, but are likely to be broadly accurate, while studies graded as 'high-quality' are very likely to have conclusions that accurately reflect the available evidence (see also Chapter 3, Table 3.1). Table 6.3 below details the number of primary studies within the review, and the quality assessment of both the systematic reviews and meta-analyses and the evidence underpinning them, and provides a summary of findings for selected outcomes from the various meta-analyses assessing the impact of SMS interventions in COPD.

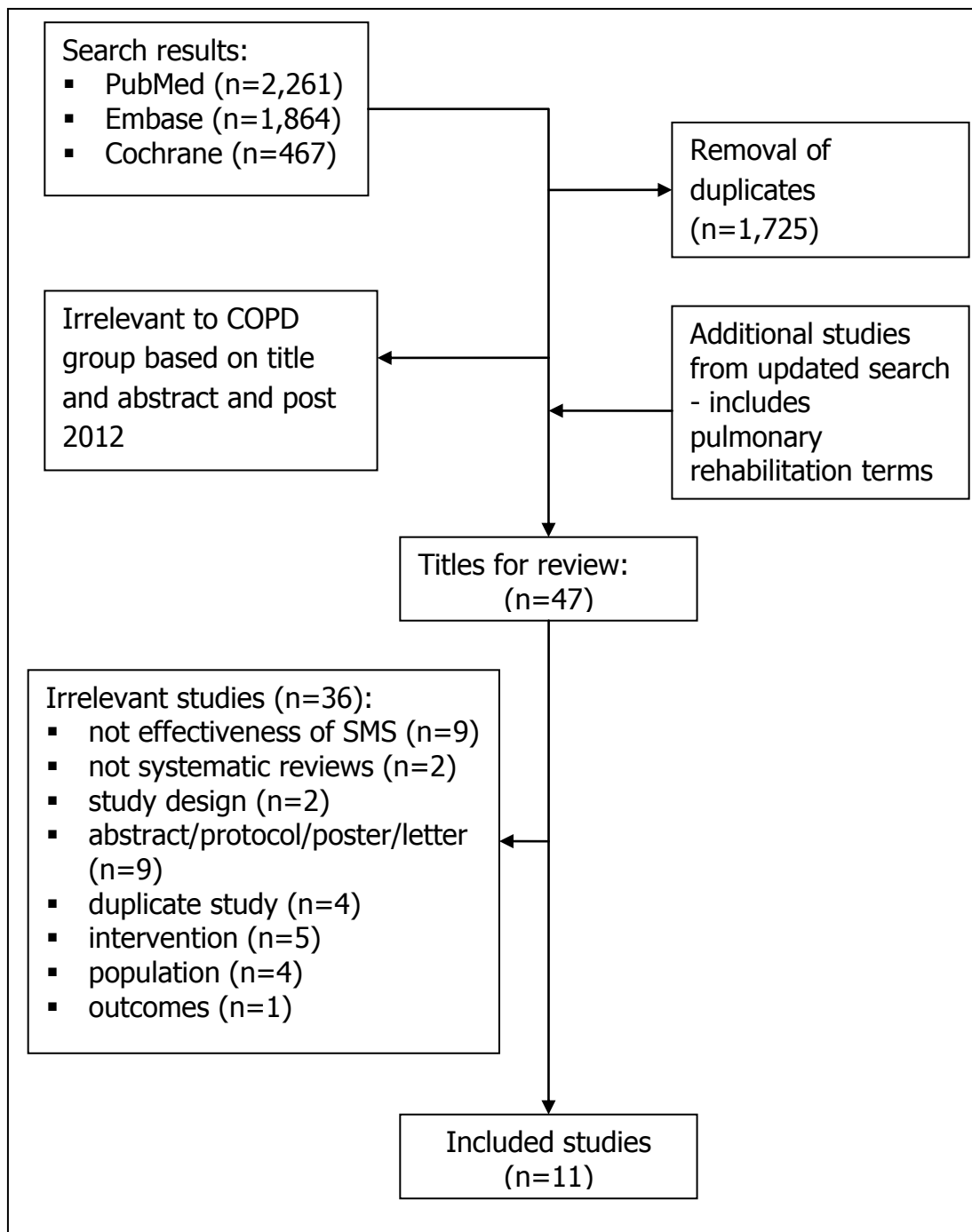**Figure 6.1 Flowchart of included studies from updated search**

```
┌─────────────────────────┐
│ Search results:         │
│  ▪ PubMed (n=2,261)     │──────────────┐        ┌────────────────────┐
│  ▪ Embase (n=1,864)     │              │        │ Removal of         │
│  ▪ Cochrane (n=467)     │              └───────▶│ duplicates         │
└─────────────────────────┘                       │ (n=1,725)          │
                                                   └────────────────────┘

┌─────────────────────────┐              ┌────────────────────┐
│ Irrelevant to COPD      │              │ Additional studies │
│ group based on title    │◀─────────────│ from updated search│
│ and abstract and post   │◀─────────────│ - includes         │
│ 2012                    │              │ pulmonary          │
└─────────────────────────┘              │ rehabilitation     │
                                         │ terms              │
                                         └────────────────────┘

                          ┌─────────────────────┐
                          │ Titles for review:  │
                          │       (n=47)        │
                          └─────────────────────┘

┌──────────────────────────────────────┐
│ Irrelevant studies (n=36):           │
│  ▪ not effectiveness of SMS (n=9)    │
│  ▪ not systematic reviews (n=2)      │
│  ▪ study design (n=2)                │◀──────────┐
│  ▪ abstract/protocol/poster/letter   │
│    (n=9)                             │
│  ▪ duplicate study (n=4)             │
│  ▪ intervention (n=5)                │
│  ▪ population (n=4)                   │
│  ▪ outcomes (n=1)                    │
└──────────────────────────────────────┘

                          ┌─────────────────────┐
                          │ Included studies    │
                          │      (n=11)         │
                          └─────────────────────┘
```

Table 6.1   Summary of systematic reviews retrieved

Author (year)	Intervention
Reviews retrieved in PRISMS search	
Education / Action Plans	
Effing (2007)[139]‡	Self-management education
Tan (2012)[140]	Self-management education – disease-specific
Turnock (2005)[141]¥	Action plans
Complex SMS interventions	
Bentsen (2012)[138]	Range of SMS interventions
Home care by outreach nursing programmes	
Wong (2012)[142]	Home care by outreach nursing
Reviews retrieved in updated search	
Education / Action Plans	
Walters (2010)[127] ¥	Action plans - COPD exacerbations
Pulmonary rehabilitation	
McCarthy (2015)[137]	Pulmonary rehabilitation
Telemedicine	
Cruz (2014)[133]	Home telemonitoring
Kamei (2012)[134]	Telehome monitoring-based telenursing
Lundell (2014)[135]	Telehealthcare – making pulmonary rehabilitation accessible
McLean (2011)[136]	Telehealthcare
Complex SMS interventions	
Dickens (2013)[129]	Range of complex interventions (multiple components and/or multiple professionals, with interventions (e.g., education, rehabilitation, psychological therapy, social or organisational interventions, or drug trials targeting a psychological problem) delivered by a variety of means (individual, group, telephone or computer-based)
Harrison (2015)[132]	Range of SMS – Following COPD exacerbation
Kruis (2013)[128]	Range of integrated disease management interventions (chronic care management that requires a community wide, systematic and structured multidisciplinary approach potentially employing multiple treatment modalities)
Zwerink (2014)[131]‡	Range of SMS interventions
Jordan (2015)[130]	Range of SMS – Following COPD exacerbation. Moderate to severe COPD.

Key: **COPD** = chronic obstructive pulmonary disease; **SMS** = self-management support.
¥Walter's Cochrane review (CR) (2010) is an update of Turnock's CR (2005).
‡Zwerink's CR (2014) is an update of Effing's CR (2007). Note: In Zwerink's update they chose to exclude studies with education as the only active intervention.

Table 6.2   Study overlap between the included systematic reviews (PRISMS report plus the systematic reviews from the updated search).[**] Adapted from PRISMS review[2]

	Review (year)	1	2	3	4	5		6	7	8	9	10	11	12	13	14	15	16
PRISMS reviews																		
1	Bentsen (2012)	**4**																
2	Effing (2007)	2	**13**															
3	Tan (2012)	2	4	**12**														
4	Turnock (2005)	0	1	1	**3**													
5	Wong (2012)	1	4	2	0	**9**												
Reviews retrieved in updated search																		
6	Cruz (2014)	0	0	0	0	0		**9**										
7	Dickens (2013)	1	5	4	1	4		1	**32**									
8	Harrison (2015)	0	0	2	0	1		0	4	**7**								
9	Kamei (2012)	0	0	0	0	0		1	0	0	**7**							
10	Kruis (2013)	1	4	2	0	4		1	1	1	0	**26**						
11	Lundell (2014)	1	1	2	0	1		0	1	1	0	1	**9**					
12	Zwerink (2014)	3	6	5	0	2		1	7	1	0	6	2	**29**				
13	McLean (2011)	1	1	2	0	1		0	3	3	2	1	3	3	**10**			
14	Walters (2010)	0	2	1	3	0		0	3	1	0	1	0	0	0	**5**		
15	Jordan (2015)	0	0	2	0	2		0	4	5	0	1	1	1	2	0	**10**	
16	McCarthy (2015)	0	3	0	0	1		0	3	0	0	12	0	2	0	0	1	**65**

*Walter's Cochrane review (CR) (2010) is an update of Turnock's CR (2005). Note: Zwerink's CR (2014) is an update of Effing's CR (2007).

**** PRISMS review is based on a search from 1993 to June 2012. This search was updated to April 2015.

Table 6.3   Study details, quality assurance and summary of findings from meta-analysis of impact of self-management support interventions on health-related quality of life, resource utilisation and mortality

Study	Quality of Systematic Review			Primary Studies		Quality of Meta-analysis	QoL	Hospitalisation
	R-AMSTAR score	Partici-pants	Quality	n	low-risk^			
Education / action plans								
Effing 2007[139]	34	2,239	***	13	3	High	WMD −2.58 (−5.14 to 0.02)	OR 0.64 (0.47 to 0.89)
Tan 2012[140]	33	2,103	***	12	2	High	WMD −3.78 (−6.82 to −0.73)	OR 0.55 (0.43 to 0.71)
Turnock 2005[141]	39	367	**	3	0	High	WMD −0.32 (−3.34 to 2.70)	‡
Walters 2010[127]	34	574	**	5	1	High	WMD −0.54 (−3.05 to 1.98)	‡)
Pulmonary rehabilitation								
McCarthy 2015[137]	41	3,822	***	65	17	High	WMD −6.89 (−9.26 to −4.52)	-
Telemedicine								
Cruz 2014[133]	33	587	**	9	2	High	SMD −0.53 (-0.97 to -0.09)	RR 0.72 (0.53 to 0.98)
Kamei 2012[134]	30	550	*	9	6	Moderate	-	RR 0.80 (0.68–0.94)
Lundell 2014[135]	36	982	**	9	2	Low	-	-
McLean 2011[136]	39	1,004	***	10	0	High	WMD −6.57(−13.62 to −0.48)	OR 0.46 (0.33 to 0.65)
Complex SMS interventions								
Bentsen 2012[138]	26	529	*	4	NR	NA	-	-
Dickens 2013[129]	35	3,941	***	32	8	Moderate	-	
Kruis 2013[128]	37	2,997	***	26	5	High	WMD −0.22 (−7.43 to 6.99)¥	
Zwerink 2014[131]	39	3,688	***	29	9	High	WMD −3.51 (−5.37 to −1.65)	
Jordan 2015[130]	40	1,502	***	10	1	High	WMD−3.84 (−6.40 to −1.29)	
Home care by outreach nursing								
Wong 2012[143]	37	1,498	***	9	4	High	WMD −2.60 (−4.81 to−0.39)	OR 1.01 (0.71 to 1.44)

Key: **WMD** = Weighted mean difference; **NR** = not reported; **NA** = not applicable; **Qol**, quality of life; **RR** = relative risk; **OR** = Odds Ratio;.
^ Number of the total primary studies identified as being at low risk of bias.
‡Turnock 2005 and Walters 2010 both included pooled estimates for hospitalisations, but these were not presented as relative risks. Neither found a statistically significant impact. Walters also reported a pooled estimate for ED visits (no significant impact), but no estimate of relative risk.
¥ St. George's Respiratory Questionnaire (SGRQ) for QoL at >12 months.

Table 6.3   (continued). Study details, quality assurance and summary of findings from meta-analysis of impact of SMS interventions on health-related quality of life, resource utilisation and mortality.

Study	Quality of Systematic Review			Primary Studies		Quality of Meta-analysis	ED	Unscheduled/ urgent healthcare use#	Mortality
	R-AMSTAR score	Partici-pants	Quality	n	low-risk^				
Education / action plans									
Effing 2007[139]	34	2,239	***	13	3	High			
Tan 2012[140]	33	2103	***	12	2	High			
Turnock 2005[141]	39	367	**	3	0	High			
Walters 2010[127]	34	574	**	5	1	High			
Pulmonary rehabilitation									
McCarthy 2015[137]	41	3,822	***	65	17	High			
Telemedicine									
Cruz 2014[133]	33	587	**	9	2	High	RR 0.68 (0.38 to 1.18)		RR 1.43 (0.40 to 5.03)
Kamei 2012[134]	30	550	*	9	6	Moderate	RR 0.52 (0.41 to 0.65)		RR 1.36 (0.77 to 2.41)
Lundell 2014[135]	36	982	**	9	2	Low			
McLean 2011[136]	39	1,004	***	10	0	High	OR 0.27 (0.11 to 0.66)		
Complex SMS interventions									
Bentsen 2012[138]	26	529	*	4	NR	NA			
Dickens 2013[129]	35	3,941	***	32	8	Moderate		OR 0.68 (0.57 to 0.80)	
Kruis 2013[128]	37	2,997	***	26	5	High	OR 0.64 (0.33 to 1.25)		OR 0.45 (0.16 to 1.28)
Zwerink 2014[131]	39	3,688	***	29	9	High			OR 0.79 (0.58 to 1.07)
Jordan 2015[130]	40	1,502	***	10	1	High	not combined, low quality		HR 1.07 (0.74 to 1.54)
Home care by outreach nursing									
Wong 2012[143]	37	1,498	***	9	4	High			

Key: **ED** = emergency department; **NR** = not reported; **NA** = not applicable; **RR** = relative risk; **OR** = Odds Ratio; **HR** = Hazard ratio.
^ Number of the total primary studies identified as being at low risk of bias. # It is assumed that the definitions are similar.
‡Turnock 2005 and Walters 2010 both included pooled estimates for hospitalisations, but these were not presented as relative risks. Neither found a statistically significant impact. Walters also reported a pooled estimate for ED visits (no significant impact), but no estimate of relative risk.

6.2.3   Summary of findings

Detailed summaries of the systematic reviews including the intervention and comparator, outcomes assessed, duration of follow-up, sample size (number of RCTs and total number of participants), and the evidence of effect are included in Appendix A.6.1. The following are reported based on the findings from PRISMS and the additional systematic reviews retrieved in the updated search.

6.2.3.1   Education / Action plans

Three star (***) reviews

Based on two three-star reviews, PRISMS reported that self-management education support or disease-specific education interventions were associated with a reduction in COPD-related hospital admissions.[139;140] Results from the high-quality meta-analysis showed a significant reduction in the probability of at least one hospital admission among patients receiving self-management support education compared with those receiving usual care. They also reported that the effect of education interventions on health-related quality of life is less established as a consistent and clinically significant positive effect on quality of life was not observed.

Two star (**) reviews

Based on the 2005 Cochrane review, PRISMS reported that action plans for COPD patients are recommended to be used only in combination with other self-management components.[141] While evidence was found that action plans improved self-management knowledge (increased recognition and appropriate reaction to an exacerbation of symptoms via the self-initiation of antibiotics or steroids), there was no evidence of significant effects on mortality, healthcare utilisation, health-related quality of life, lung function, functional capacity, symptom scores, anxiety or depression.

A 2010 update[127] to the above 2005 Cochrane review concurred with this finding. Consistent with the 2005 review, the intervention arm in this review was limited to individual action plans with limited or no self-management education (less than one hour), and excluded other broader education and exercise self-management interventions, irrespective of whether they included an action plan. No evidence was found that action plans reduce healthcare utilisation (hospital admissions, emergency department admissions or GP consultations), but evidence was found that action plan use is associated with increased initiation of corticosteroid or antibiotic treatment for acute exacerbations.

> **Summary statement for education**
>
> There is very good evidence that education in patients with COPD is associated with a reduction in COPD-related hospital admissions with limited evidence that it is associated with improvements in health-related quality of life. There is no evidence that action plans when used alone and in the absence of other self-management supports reduce healthcare utilisation or lead to improvements in quality of life.

6.2.3.2   Pulmonary rehabilitation

Three star (***) reviews

A 2015 Cochrane review and meta-analysis by McCarthy et al.[137] of 65 RCTs compared pulmonary rehabilitation (defined as exercise training for at least four weeks with or without education and, or psychological support) with usual care on HRQoL and functional and maximal exercise capacity in persons with COPD. They reported that pulmonary rehabilitation improves functional exercise capacity and HRQoL, with improvements noted in domains related to dyspnoea and fatigue, emotional function and a sense of control over the condition. These improvements are reported as moderately large and clinically significant. The authors reported that the results strongly support inclusion of pulmonary rehabilitation as part of the management and treatment of patients with COPD. However, they also noted that large variation in the design of the pulmonary rehabilitation programmes included in the meta-analysis resulted in substantial heterogeneity. The programmes assessed ranged in duration from four to 52 weeks with the majority being eight (n=18) or 12 weeks (n=18) long. As such, they recommended that further studies should focus on identifying the components of pulmonary rehabilitation that are essential, its ideal length and location, the degree of supervision and intensity of training required, and how long treatment effects persist.

> **Summary statement for pulmonary rehabilitation**
>
> There is very good evidence that pulmonary rehabilitation which includes exercise training improves health-related quality of life and functional exercise capacity in people with COPD. Large variation in the design of pulmonary rehabilitation programmes makes it difficult to identify their optimal format.

6.2.3.3   Telemedicine

Three star (***) reviews

A 2011 Cochrane review and meta-analysis by McLean et al.[136] reported that telehealthcare as part of a complex health intervention in COPD patients appears to decrease the number of times patients attend the emergency department and hospital. No impact on mortality rates was observed at 12 months follow up.

Two star (**) reviews

A 2014 meta-analysis by Cruz et al.[133] assessed telehealth in COPD and found limited evidence of effectiveness, with only small positive effects for home telemonitoring to reduce healthcare utilisation and improve health-related outcomes in patients with COPD.

A 2014 meta-analysis by Lundell et al.[135] assessed a range of telehealthcare interventions for COPD (mainly focused on making pulmonary rehabilitation more accessible) and found evidence that it may lead to improvements in physical activity. However, by excluding studies that were outliers until a relatively homogeneous result was retrieved (I^2<60%) the authors are likely to have underestimated the degree of heterogeneity associated with this outcome and undermined the validity of the pooled estimate.

One star (*) reviews

The 2012 meta-analysis by Kamei et al.[134] on telehome monitoring-based telenursing for patients with COPD reported statistically significant decreases in healthcare service use for patients with severe COPD. Statistically significant reductions in emergency department visits and disease exacerbations were also reported, but the intervention had no effect on mortality.

Summary statement for telemedicine

There is some evidence that telemedicine as part of a complex intervention decreases healthcare utilisation, with no evidence found of an impact on mortality.

6.2.3.4 Complex SMS interventions

Three star (***) reviews

A 2014 Cochrane review and meta-analysis by Zwerink et al.[131] reported that SMS interventions in patients with COPD are associated with improved HRQoL health-related quality of life (St George's Respiratory Questionnaire [SGRQ]), a reduction in respiratory-related and all-cause hospital admissions, and improvement in self-reported activity-related dyspnoea (Medical Research Council [MRC] scale). However, they assessed a diverse range of interventions (for example varying educational programmes delivered through a variety of methods (for example, group, individual, face-to-face, telephone follow-up) and were unable to determine their most effective parts.

A 2015 National Institute for Health Research (in the UK) review by Jordan et al.[130] included a review of the provision of SMS for patients shortly after being discharged from hospital with an acute exacerbation of their COPD. It concluded that there was

little evidence of benefit to providing SMS to patients shortly after discharge from hospital, although effects observed were consistent with possible improvement in HRQoL and reduction in hospital admissions. They noted that it was not easy to tease out the most effective components of SMS packages, although interventions containing exercise seemed the most effective.

A 2013 meta-analysis by Dickens et al.[129] reported that the use of urgent healthcare in patients with COPD was significantly reduced by using a range of 'complex interventions'. Such complex interventions involved multiple components and, or multiple professionals, with interventions (for example, education, rehabilitation, psychological therapy, social or organisational interventions, or drug trials targeting a psychological problem) delivered by a variety of means (individual, group, telephone or computer-based). They noted that the key components of these interventions that were associated with a reduction in urgent healthcare utilisation were education, exercise and relaxation.

A meta-analysis by Kruis et al.[128] reported that integrated disease management interventions improved disease-specific quality of life and exercise capacity. A significant improvement in self-reported activity-related dypsnoea was also reported using the MRC Dyspnoea Scale, but another study found no improvement using the Borg scale (a validated instrument assessing exercise-induced dyspnoea and used as an outcome measure in pulmonary rehabilitation programmes). The authors defined integrated disease management as interventions that contained a programme provided by caregivers from at least two different disciplines, with two different components (for example, exercise, education, self management), and concluded that there was insufficient evidence to refute or confirm the long term effectiveness of integrated disease management.

One star (*) reviews

PRISMS did not report any conclusions based on the single one-star review they identified.

> **Summary statement for complex SMS interventions**
>
> Based on the quantity and quality of the systematic reviews and the underpinning primary randomised controlled trials (RCTs), there is good evidence that complex self-management support (SMS) interventions (involving multiple components and, or multiple professionals delivered by a variety of means) in patients with COPD are associated with improvements in health related quality of life (HRQoL). No evidence was found of a statistically significant benefit regarding mortality while there was limited evidence of reductions in health care utilisation. Although it is not clear which

components of SMS support relate to these improvements, education and exercise seem to be effective.

6.2.3.5 Outreach nursing programmes

Three star (***) reviews

Based on a single three-star review by Wong et al.,[143] PRISMS reported that outreach nursing programmes improved health-related quality of life (although the improvement may not have been clinically significant), but their effect on hospitalisations was variable.

Summary statement for outreach nursing programmes

There is some evidence that outreach nursing programmes improve health-related quality of life in patients with COPD.

6.3 Review of cost effectiveness of self-management support interventions

A review of cost-effectiveness studies was undertaken to assess the available evidence for self-management support (SMS) interventions for people with COPD. Studies were included if they compared the costs and consequences of a SMS intervention to routine care.

6.3.1 Search strategy

A search was carried out to identify economic analyses of SMS interventions. In conjunction with the systematic review of clinical effectiveness, the search for economic evaluations was carried out in MEDLINE, EMBASE and the Cochrane Library. The same search terms were used with the exception of terms for systematic review and meta-analysis. In place of these, search terms and filters for economic evaluations were applied. In addition, systematic reviews of SMS interventions identified through the results of the clinical effectiveness search which included cost or economic outcomes were used to identify additional studies. The search was carried out up until 4th March 2015.

The PICOS (Population, Intervention, Comparator, Outcomes, Study design) analysis used to formulate the search is presented in Table 6.4 below.

Table 6.4. PICOS analysis for identification of relevant studies

Population	Adults ≥ 18 years old with COPD.
Intervention	Any self-management support intervention that helps people with COPD through education, training or support.
Comparator	Routine care.
Outcomes	Cost or cost-effectiveness of intervention.
Study design	Randomised controlled trials, case-control studies, observational studies, economic modelling studies.

Studies were excluded if:

- a nursing home or non-community dwelling population was included,
- it included a paediatric population,
- cost data were not clearly reported,
- published prior to 2000 due to limited relevance.

As outlined in Chapter 3.2.2 and in accordance with national HTA guidelines, assessment of the quality of the studies using the Consensus on Health Economic Criteria (CHEC)-list was performed independently by two people. For studies that included an assessment of cost-utility or an economic modelling approach, assessment of the relevance to the Irish healthcare setting and their credibility was considered using a questionnaire from the International Society of Pharmacoeconomics and Outcomes Research (ISPOR).

6.3.2 Results – Cost-effectiveness

The initial screening retrieved 63 papers relating to COPD. Of these, 38 studies were identified for full text review, with the remaining 25 excluded as irrelevant or unsuitable based on screening of abstract or full text. A further 13 were excluded according to the various exclusion criteria. Two additional studies were identified following hand searching of systematic reviews of clinical effectiveness included in Section 6.2, leaving 27 articles included in this review.

Five studies were conducted in Canada, six studies in the UK, four in the US and three from Spain. In addition, there were two studies from Australia and the Netherlands and one each from Belgium, Denmark, Italy, Ireland and Norway. The included studies were all published between 2001 and 2015. The characteristics of the included studies are given in Table 6.5. Costs reported in each of the studies were inflated to 2014 prices using the consumer price index for health and expressed in Irish Euro using the purchasing power parity exchange rate.[122]

Table 6.5   Characteristics of the studies included

Study	Country	Intervention
Bakerly (2009)[144]	UK	Integrated care
Bourbeau (2006)[145]	Canada	SMS education
Cecins (2008)[146]	Australia	Pulmonary rehabilitation
Chandra (2012)[147]	Canada	Smoking cessation*
Chandra (2012)[147]	Canada	Pulmonary rehabilitation*
Chuang (2011)[148]	US	Case management
De San Miguel (2013)[149]	Australia	Telemedicine
Dewan (2011)[150]	US	Disease management
Farrero (2001)[151]	Spain	Case management
Gallefoss (2004)[152]	Norway	SMS education
Gillespie (2013)[153]	Ireland	Pulmonary rehabilitation
Golmohammadi (2004)[154]	Canada	Pulmonary rehabilitation
Griffiths (2001)[155]	UK	Pulmonary rehabilitation
Haesum (2012)[156]	Denmark	Telemedicine
Hernandez (2003)[157]	Spain	Case management
Hoogendoorn (2010)[158]	Netherlands	Pulmonary rehabilitation
Jodar-Sanchez (2014)[159]	Spain	Telemedicine
Jordan (2015)[130]	UK	Post-discharge SMS intervention
Khdour (2011)[160]	UK	SMS education
Liu (2013)[161]	US	Case management
Monninkhof (2004)[162]	Netherlands	SMS education
Pare (2013)[163]	Canada	Telemedicine
Stoddart (2015)[164]	UK	Telemedicine
Taylor (2012)[165]	UK	SMS education
Tinkelman (2003)[166]	US	Case management
Van Boven (2014)[167]	Belgium	Pharmacy led medication adherence
Vitacca (2009)[168]	Italy	Telemedicine

*The 2012 HTA by Chandra et al., separately modelled the costs and benefits of smoking cessation and pulmonary rehabilitation versus usual care and so are reported as two individual reports here.
Key: **SMS** = self-management support.

The studies were classified according to the type of intervention assessed: SMS education programmes, pulmonary rehabilitation, telemedicine, case management, and other SMS interventions. Of note, many interventions included more than one element such as case management plus telephonic support or education plus physical activity.

This review captures all SMS interventions assessed for COPD and retrieved few conventional economic evaluations (n=5). Seventeen of the retrieved studies gathered cost data as part of a randomised controlled trial (RCT) while data for five other studies were based on a non-randomised prospective study (n=1) or observational cohort studies (n=4). The quality of the included studies varied with eight identified as being of high-quality (see Appendix Table A6.3).

6.3.2.1 Self-management support education programmes

Five studies were identified that investigated a variety of SMS education programmes, including two from the UK and one each from Canada, Norway and the Netherlands (see Table A6.4). Interventions typically involved an education programme which was delivered by a healthcare specialist at home or in a primary care setting; two studies from the UK examined a pharmacy-led SMS education programme while another was delivered by a lay person (tutor). In four of the studies the education programme was used in combination with another intervention such as an exercise programme, exercise classes, access to telephone follow up by a nurse or individual follow-up sessions.

All of the studies were based on patient data gathered from an RCT with a follow-up ranging from six months to one year. Study sizes ranged from 62 to 191 patients. Where reported, the patients' ages ranged from over 35 years to below 70 years. Four studies included those with moderate to severe disease.

Three studies reported cost savings as a result of an SMS education programme.[145;160;165] The 2006 Canadian study by Bourbeau et al.[145] described a six to eight week education programme with use of an action plan and ongoing supervision from a case manager for people with moderate to severe disease. It reported results for different caseloads of patients per case manager. Using 14 patients as its base case, it found the total cost of the intervention per patient was €2,953. Of note, this also included a pool of 20 stationary bikes which were distributed to each patient for the first two months of follow-up to increase physical activity motivation. An incremental cost-effectiveness ratio (ICER) of €3,293 per hospitalisation prevented was reported from the third-party payer perspective. For a more realistic caseload of 50 patients per case manager, they estimated a total intervention cost of €929 per patient and an ICER of €1,036 per hospitalisation prevented. The authors postulated the intervention would be less cost-effective in those with milder disease.

A mean cost of intervention of €177 per patient was reported in the 2002 Norwegian study by Gallefos et al. describing an education programme comprising both group and one-to-one education visits, and an individualised action plan. Improvements in

health-related quality of life (HRQoL) were reported and a cost-benefit ratio of 1: 4.8 was found from a societal perspective.

The 2011 study from Northern Ireland described a pharmacist-led education programme and found a non-significant mean cost saving of €1,005 in the intervention group, driven mainly by the decrease in hospitalisations and associated with a mean differential quality-adjusted life year (QALY) gain of 0.065.[160] Therefore, the education intervention was dominant (that is less costly and more effective than usual care) and an ICER was not calculated.

Two studies reported an increase in costs arising from a SMS education programme. A 2004 study from the Netherlands by Monnikhof et al. of the COPE SMS programme reported no measurable changes in HRQoL or QALYs and a slight decrease in healthcare consumption for participants enrolled in a five-week group education session, coupled with a weekly fitness programme.[162] The cost per patient of the self-management intervention was €713. The incremental cost difference from a societal perspective was €931 per patient per year in favour of usual care; the additional costs were mostly due to the high intervention costs. Participants in this study had mild disease. The 2012 UK study by Taylor et al. described a lay-led structured education programme and found that, when the total cost of providing seven courses and staff training was divided amongst all patients in the intervention group, this resulted in a cost per patient of €541.[165] However, when the 27 patients who failed to attend were excluded, the intervention cost per patient was €827. A small gain was reported in HRQoL. An ICER from a provider perspective of €16,465 per QALY gained over 6 months was calculated, however, interpretation of the ICER is complicated given the absence of a significant clinical effect size. Although the cost of the intervention was not offset by a decrease in healthcare utilisation, the authors suggested that the intervention was still cost-effective using NICE guideline threshold values.

All but one study reported potential cost savings or cost-effectiveness for patients with moderate to severe disease; however, the potential for savings depended on the efficiency with which the programme could be delivered. Potential cost savings were driven by a decrease in healthcare utilisation. However, only three studies examined HRQoL utility scores and of these, two reported small differences in favour of the intervention group in the short term.

6.3.2.2 Pulmonary rehabilitation for COPD

Six studies were identified that examined the cost-effectiveness of pulmonary rehabilitation: two from Canada and one each from Australia, Ireland the Netherlands and the UK (Table A6.5). The interventions varied from four weeks to four months in duration, but in general comprised similar education and

physiotherapy exercise components. The number of weekly sessions also varied from daily to once a week. Some programmes specified input from dieticians and smoking cessation counselling, while others described inputs from physiotherapists only. Three of the studies were conducted alongside RCTs, two were pre- and post-intervention studies and one used published data to populate an economic model with a 30 year horizon. Follow-up ranged from 22 weeks to one year and the number of participants ranged from 199 to 350.

The cost of the intervention ranged from €273 per patient for twice weekly exercise classes reported by Cecins et al.[146]to €1,758 for an intensive four month programme with an additional 20 month maintenance follow-up in the study from the Netherlands.[158] The study published in Ireland, described an eight-week community-based programme provided by a nurse and physiotherapist for patients with mild to moderate disease and found a mean cost of €948 per patient.[153] This comprised €650 healthcare costs and €297 in patient costs.

Four studies conducted a cost-utility analysis. Chandra et al. modelled the cost-effectiveness of a four-week multi-disciplinary programme from a provider perspective and using a 5% discount rate, found an ICER of €12,885 per QALY and €10,502 per life year gained. Based on a two-year follow-up period, the Netherlands' study estimated an ICER of €34,548 per QALY and €26,966 per QALY from a societal and healthcare payer perspective, respectively; although the difference in QALYs between the intervention and the control groups was not significant. Excluding the additional resources for the intervention, overall healthcare utilisation was similar in the two groups at the study end point. The Irish study reported that pulmonary rehabilitation was only cost-effective when disease-specific health status scores were used (€980 per unit increase in the Chronic Respiratory Disease Questionnaire [CRQ] total score). It is important to note that though statistically significant improvements in the CRQ scores occurred at 22 week follow-up, the authors raised concerns that the confidence intervals included differences that were not clinically significant. The study did not report significant QALY gains and this is reflected in an ICER of €544,099 per QALY gained. The short follow-up of 22 weeks may also have affected this estimate by not capturing potential future cost savings. Finally, the authors of an exploratory UK study examined the potential cost-effectiveness of outpatient pulmonary rehabilitation delivered in a post-exacerbation period.[155] The main drivers of the model were the effect on hospital readmission, the duration of effect, and the cost of the self-management support programme. To be cost-effective, the authors concluded that the self-management programme post admission for an acute exacerbation would need to cost no more than GBP£2,200 (€2,749) if the relative reduction in admissions was consistent with a hazard ratio of 0.82.

As has been shown, the intensity, duration and composition of the rehabilitation programmes varied although all of them exhibited the greatest focus on exercise classes. All the included studies reported some degree of improvement in clinical outcome or utility, irrespective of disease severity. Based on the better quality studies, there is limited evidence that pulmonary rehabilitation is cost-effective in moderate to severe disease. The evidence from the one Irish study indicated that it is not cost-effective in those with mild to moderate disease. However, these findings were influenced by the choice of quality of life instrument, with speculation that the generic EQ5D instrument was not sufficiently sensitive to detect clinically meaningful differences in COPD health status. The follow-up period was limited to 22 weeks, so long-term costs and effects are uncertain.

6.3.2.3   Telemedicine interventions for COPD.

Six studies were identified that assessed telemedicine SMS interventions for patients with COPD (Table A6.6). These examined telemedicine interventions requiring daily patient-self monitoring and remote transmission of repeated clinical measurements to a nurse, case manager or respiratory physician who would trigger contact with the patient as required to provide clinical advice. The studies were from Australia, Denmark, Spain, Italy, UK and Canada. All of these studies were based on RCTs with follow-up ranging from four to 21.5 months; the number of participants ranged from 45 to 256.

Of the telehealth monitoring studies, all but one required daily monitoring of vital signs and symptoms which were then transferred securely. In contrast, the Danish study described a customised monitoring frequency protocol for each patient.[156]

There were three cost-utility analyses. The Danish study, customised monitoring frequency for each patient and included monthly online telerehabilitation team case discussion. They found the intervention to be more effective and less costly than usual care when all healthcare costs from a provider perspective were considered. Using a 3% discount rate for capital costs, the cost of their intervention equipment was estimated at €597.[156] The authors cautioned that their project was small sized and conducted by a highly motivated researcher, doctors and patients thus questioning its reproducibility on a large scale. Jodar-Sanchez et al. estimated an ICER of €278,379 per QALY gained for their intervention in patients with severe COPD who took daily measurements and sent them a clinical call centre for review by a case manager.[159] The ICER, which indicated the intervention was not cost-effective, was based on the difference in all health-related hospital costs and health outcomes between trial arms over four months. Stoddart et al. examined telemedicine in a cohort of patients with mixed disease severity and reported an ICER of €182,673 per QALY. Their cost analysis was over one year and included all

healthcare costs from a provider perspective.[164] The largest proportion of costs in their study was due to equipment costs.

The three remaining studies reported cost savings associated with telemedicine. Pare et al. described daily remote telemonitoring by a case manger and focused their cost analysis on COPD-related emergency department attendances, hospitalisations and home visits. They estimated a net saving of €1,103 per patient year in the tele-homecare group mainly driven by reduction in hospitalisation and length of stay.[163] They also found that the cost of technology and nursing staff required for the intervention accounted for 20% of total healthcare costs. Of note, during the study period the control group also experienced a 38% reduction in number of hospitalisations. De San Miguel found net costs saving of €2,425 per person per year in their trial based on total healthcare cost from a provider perspective collected over six months and annualised.[149] Their participants had severe disease and the authors found that daily monitoring prompted more communication from patients with their physicians. Lastly, the Italian study looked at telemedicine in a cohort of patients with chronic respiratory failure on home ventilation or long-term oxygen therapy.[168] Only a proportion of these had COPD and were analysed separately. They found the cost of the intervention ranged from €903 to €1,008 per patient. The mean direct healthcare costs per patient excluding the intervention were €8,907 in the intervention group and €14,728 in the control over a one year period. The reduction in cost was mainly due to fewer hospitalisations, emergency department and GP visits.

The costs included in the studies vary widely with some limiting their analysis to hospital costs only, while others also include primary care costs. Some studies only examined COPD-related costs while others included all healthcare costs. This methodological variance limits the conclusions that can be gleaned from these studies.

In summary, evidence for the cost-effectiveness of telemedicine is mixed, with more applicable evidence suggesting that telemedicine interventions are not cost-effective. Interpretation of the evidence is complicated by the small study sizes, short-term follow-up (four to 12 months) and differences in disease severity between studies.

6.3.2.4   Case-management interventions

Five studies were identified that assessed case management-type interventions: two from Spain[151;157] and three from the US (see Table A6.7). The interventions varied with one of the Spanish studies outlining a schedule of home visits and telephone review by a nurse for a cohort of stable COPD patients on long-term oxygen therapy, while the other described early discharge of patients with exacerbations facilitated by a limited number of nurse home visits and unlimited telephone contact in the eight-week period following discharge. One of the US studies modelled the effect of a

hypothetical home-based case management intervention aimed at early detection and treatment of exacerbations, while the second US study examined a disease management programme comprising a dedicated case manager to liaise with patients and physicians, unlimited access to a nurse-led helpline, an action plan and home visits. Finally, Chuang et al. described an intervention where nurses performed a number of regular and scheduled telephone call for educational and clinical advice purposes, as well as written educational materials, action plan and progress reports to primary care.[148]

The three better quality studies were based on RCT data and provide the basis for the remainder of this discussion. Follow-up duration in the intervention studies varied from eight weeks to one year. The number of participants ranged from 122 to 222 and all cost analysis were undertaken from the provider or third party payer perspective.

All three studies found cost savings mainly due to reduced hospitalisations and emergency department visits. Farrero et al. found the cost of their hospital-based home care programme to be 6.7 million pesetas for the one year study period. As outcomes, they examined diagnosis-related group costs of hospital resources used only and found net cost savings of 8.1 million pesetas during that time. Hernandez et al. found that the average direct healthcare costs for the intervention group at eight week follow up were 62% of the average costs estimated for the control group (€1,827 and €2,960 respectively, p=0.003).[157] These costs included the intervention costs, transport costs and both primary and secondary care costs from a public insurer perspective. Readmission rates were quite high in both groups at approximately 25%, but the cost savings achieved were driven by significantly lower lengths of inpatient stay (1.7 versus 4.2 days p<0.001) and a reduction in emergency department presentations (11 patients versus 21 patients, respectively). Chuang et al. examined costs from a third party payer perspective and found a reduction in all paid claims for the 141 participants of $328,766 at one year follow-up. The total programme costs were $225,012, resulting in an estimated return-on-investment of 46% from the payer perspective.

All the intervention studies examined some clinical outcomes alongside service utilisation. Farrero et al. found no significant differences between groups in quality of life scores and arterial blood gases, but reported similar and significant deterioration in lung function measured at follow-up for both groups. In contrast, Hernandez et al. found significant improvements for the intervention group in both HRQoL scores and patient satisfaction at eight week follow-up, as well as an increased proportion of patients in the intervention group with improvements in disease-related knowledge.

Evidence for case management examined heterogeneous interventions in different cohorts of patients with limited applicability to the Irish healthcare setting. All three studies that reported cost data collected alongside an RCT, found potential cost savings, but conflicting evidence regarding clinical effect. Of note, the study that reported a positive clinical effect was limited to eight week follow-up and the validity of the results is dependent on whether the effect can be sustained in the long-term.

6.3.2.5 Other self-management support interventions

Five papers were identified that described a variety of other SMS interventions for COPD (Table A6.8). Two of these were from the UK,[130;144] with one each from Canada[147], Belgium[167] and the US. One study was a non-randomised prospective study with a matched retrospective control group, while the remaining four were economic models. Two studies were conducted alongside RCTs, while the other two used published estimates from various sources to populate their economic models.

Bakerely et al. described an integrated care approach to early discharge with a self-management plan for 130 patients with COPD.[144] They compared the one year costs of all hospital and community care in the integrated care group to hospital care costs in a retrospective matched group (n=95) and reported a cost saving of £600 per patient from a provider perspective.

Chandra et al. performed an economic evaluation of intensive counselling for smoking cessation compared with usual care which was described as a GP visit and leaflet.[147] They used a lifetime horizon and provider perspective with a 5% discount rate and found a lifetime cost savings of €1,674 and an increase in life years and QALYs; that is, that intensive counselling dominated (that is less costly and more effective) usual care. The report also assessed the impact of nicotine replacement therapy versus usual care, and a combination of intensive counselling plus nicotine replacement therapy versus placebo therapy, but did not directly compare the various interventions.

Dewan et al. used data from an RCT with one year follow-up to inform a post-hoc economic evaluation of a disease management programme. The intervention resulted in a significant reduction in hospitalisations and emergency department visits (p<0.003) and improvement in quality of life (p<0.001). The average cost saving per patient was US$593 after paying for the cost of disease management intervention.[150]

Van Boven et al. used the data from a three-month RCT of community pharmacy intervention to increase medication adherence to extrapolate costs and benefits for a one year period. They reported a cost saving of €227 per patient associated with a small QALY gain.[167] They then modelled the effects with a 12.5 year time horizon

for the same cohort and found the intervention remained cost saving, assuming that adherence returned to baseline levels after one year.

The second UK study used published data to populate an economic model to examine the effect of a SMS intervention delivered up to six weeks following discharge from hospital.[130] The intervention used in the base case was described as moderate to high intensity and consisted of two one-on-one education sessions, an action plan, and telephone follow up with a specialist nurse with home visits or specialist telephone review as appropriate. Using a 30-year provider perspective the ICER was found to be €10,270 per QALY gained. Of note, the authors did not specify any discount rate used. The ICER for the low-intensity intervention which comprised two telephone calls with a nurse was estimated as €1,291 per QALY gained. In contrast, the ICER for the high intensity intervention, described as four initial home education visits with an additional seven visits in the first year, was €11,569.

6.4   Discussion

This section discusses the main findings from the review of the clinical-effectiveness and cost-effectiveness literature.

6.4.1   Clinical-effectiveness

Sixteen systematic reviews comprising 185 unique RCTs are included in this overview of reviews. There was large heterogeneity across the interventions, however, to aid interpretation of the results the reviews were broadly categorised as 'a range of SMS interventions', 'education/action plans', 'pulmonary rehabilitation', 'telemedicine' and 'homecare by outreach nursing'.

The impact of SMS interventions on healthcare utilisation was assessed in several reports. Limited evidence was found that education and telemedicine-based SMS as well as self-management support comprising a range of SMS interventions (also referred to as complex SMS interventions, that is involving multi-components and, or multiple providers, with interventions delivered by a variety of means) are associated with statistically significant reductions in healthcare utilisation. The PRISMS review found that SMS via education is associated with a statistically significant reduction in COPD-related hospital admissions. The updated review found that a range of complex SMS interventions which specifically included education, exercise and relaxation therapy were also associated with a statistically significant reduction in urgent healthcare based on a Cochrane review. Another Cochrane review reported reductions in healthcare utilisation (patients treated with integrated disease management on average discharged earlier) and improvements in quality of life for a range of integrated disease management interventions. However, the interventions and patient populations varied widely making it difficult to make recommendations on the most effective content of self-management training. A third Cochrane review

of a range of SMS interventions found statistically significant reductions in respiratory-related hospitalisations and improvements in HRQoL. Again, the interventions and patient populations varied widely making clear recommendations on effective components of SMS difficult. There was little evidence of benefit in providing SMS to patients shortly after discharge from hospital, based on a large National Institute of Health Research (NIHR) review. They reported that it was difficult to tease out the most effective components of SMS packages, but that interventions containing exercise seemed most effective. Finally, some evidence was found that telehealthcare is associated with statistically significant reductions in hospitalisations.

Good evidence was found that pulmonary rehabilitation and SMS that comprises a range of SMS interventions are associated with significant improvements in health-related quality of life (HRQoL). The updated search found that pulmonary rehabilitation which includes at least four weeks exercise training is associated with clinically and statistically significant improvements in important domains of HRQoL, including dyspnoea, fatigue, emotional function and mastery (that is, the sense of control that individuals have over their condition). Clinically significant improvements were also reported for functional exercise capacity. However, it was noted that there is substantial variation in the design of pulmonary rehabilitation programmes making it difficult to identify their optimal format, duration and intensity. Some evidence was also found that nursing outreach programmes improve HRQoL in individuals with COPD. No evidence of a reduction in mortality was found for any of the SMS interventions that assessed this outcome.

Given the description of the COPD patient populations, it would appear that the evidence should be broadly applicable to the Irish healthcare setting. A potential caveat to this assumption is the extent to which the comparator (usual care) in these RCTs) is representative of usual care in Ireland. Given the increasing tendency for usual or standard of care to be determined by evidence-based clinical guidelines and the convergence of such guidelines in Western countries, this assumption is reasonable. However, differences may exist in how care is provided, impacting the adherence to recommended standard of care. For example, COPD care in the Irish primary care setting may differ to that in the UK's National Health Service system as the latter is incentivised by the quality of outcomes framework. Particular difficulties in Ireland have included delays in the diagnosis of COPD due to limited access to spirometry testing in primary care, although targets have been set by the HSE's Clinical Care Programme for COPD to address this issue.[125] Improved access to pulmonary rehabilitation has also been a focus of the programme: in 2013 there was access to structured pulmonary rehabilitation in 24 acute hospitals and 14 integrated service areas with a structured COPD outreach programme operational in 14 acute hospitals.[169]

Due to the volume of evidence available, and in the interest of efficiency, this assessment of SMS interventions in COPD was undertaken in the form of an overview of reviews. As discussed in Chapter 3.4.1, a disadvantage of this approach is the inability of an overview of reviews to reflect the most recent literature: following publication of an RCT, it must first be captured in a systematic review, before subsequently being captured in an overview of reviews. However, given their sample sizes, it is not appropriate to draw conclusions on the effect of an intervention based on a single, or a number of small, RCTs. Therefore it is unlikely that more recent RCTs not captured in this overview of reviews would be sufficient to substantially alter recommendations informing major policy decisions.

6.4.2   Cost effectiveness

Our review identified 27 unique studies examining a broad range of interventions. The majority of the studies reported cost data alongside an RCT and therefore used short time horizons ranging from four to 12 months for analysis. This has implications for the interpretation of the findings as firstly, a larger proportion of intervention costs are often accrued at the start of a programme while secondly, the duration may not be sufficient to capture all relevant benefits. Furthermore, for benefits that are observed, it is not certain if these are sustained in the long-term. The evidence of cost-effectiveness contrasts with that of the review of clinical-effectiveness which comprised 16 systematic reviews and 185 unique RCTs.

SMS interventions were typically compared with current standard of care. This was often poorly described and varied according to the location and date of the study. This represents an important caveat when comparing international data to the Irish healthcare setting. As noted in Section 6.4.1, while there is an increasing tendency for usual or standard of care to be determined by evidence-based clinical guidelines, differences may exist in how care is provided, impacting the adherence to recommended standard of care.

The SMS education programmes were heterogeneous including a range of elements in addition to the educational components. In contrast, the pulmonary rehabilitation programmes were more consistent: while they varied in duration, all adopted a multi-disciplinary approach. The telemedicine interventions that used remote monitoring were the most homogenous group, with regular clinical measurements remotely transmitted to a clinical case manager who would provide management feedback. The applicability of the international evidence to the Irish healthcare setting is limited, due to differences in the health system financing mechanisms and therefore the perspective adopted. The quality of the cost-effectiveness studies was variable, with only eight studies identified as higher quality studies.

In the modelling studies included, discount rates varied from 1.5% to 5% impacting the applicability of their findings to the Irish context where a discount rate of 5% for both costs and benefits is applied. The studies included a large variety of participants from those with mild disease to patients on home ventilation and long-term oxygen at home. Though examining these individually gives a good picture of cost-effectiveness across the spectrum of disease it does hinder comparison of findings between studies.

Overall, the findings for SMS interventions in COPD are encouraging, though the quality of the included economic evaluations was predominantly poor. The most consistent evidence was for SMS education programmes with the majority of studies reporting it to be cost saving for patients with moderate to severe disease, although the nature of the intervention provided was heterogeneous.

All of the included studies for pulmonary rehabilitation reported some degree of improvement in clinical outcome or utility, irrespective of disease severity. Based on the four better quality studies, there is limited evidence that pulmonary rehabilitation is cost-effective in moderate to severe disease. The evidence from the one Irish study indicated that it was not cost-effective in those with mild to moderate disease. However, these findings were influenced by the choice of quality of life instrument, with speculation that the generic EQ5D instrument was not sufficiently sensitive to detect clinically meaningful differences in COPD health status. Some of the interventions had effect sizes that were not statistically significant. Interpretation of the results of any subsequent cost-effectiveness ratios can be complicated, and should focus in these instances on the cost findings.

With regard to telemedicine, evidence for cost-effectiveness was mixed, with more applicable evidence from a UK study suggesting that telemedicine interventions are not cost-effective. There were four studies that focused on case management of COPD patients, but many of the other studies had elements of case management as adjunct to their main intervention. In general, these appeared to be cost saving for select groups of patients with severe disease.

Where reported, the per-patient cost of self-management support interventions was seen to vary according to the intensity of the intervention, with comprehensive pulmonary rehabilitation and complex SMS support packages being more costly to implement. Costs were typically low relative to the overall cost of care of patients with more severe disease. Ireland has a high prevalence of COPD, so the budget impact of implementing self-management support interventions for all eligible patients is likely to be substantial.

SMS support seems to decrease healthcare utilisation in patients with COPD, but the exact nature of that effective support is difficult to identify given the broad range of

interventions described in the included studies. The international evidence is of limited applicability to the Irish healthcare setting due to differences in the healthcare financing mechanisms and potential differences in the current standard of care.

6.5   Key points

- Sixteen systematic reviews of self-management support (SMS) interventions in adults with COPD were identified for inclusion in this overview of reviews.

- A diverse range of interventions were identified with the largest volume of evidence obtained for 'complex SMS interventions' (n=6), COPD educational programmes/action plans (n=4), telemedicine (n=4), pulmonary rehabilitation (n=1) and 'homecare by outreach nursing' (n=1).

- The quality of the systematic reviews varied, with nine rated as being higher quality reviews.

- The primary evidence underpinning the systematic reviews was found to be generally at moderate to high-risk of bias, meaning that studies may have over- or under-estimated the effect size. The randomised controlled trials (RCTs) were published between 1977 and 2013. These were mainly completed in Europe or North America.

- The interventions and patient populations varied widely making it difficult to make recommendations on the most effective content of self-management support.

- There is very good evidence that education in patients with COPD is associated with a reduction in COPD-related hospital admissions with limited evidence that it is associated with improvements in health-related quality of life. There is no evidence that action plans when used alone and in the absence of other self-management supports reduce healthcare utilisation or lead to improvements in quality of life.

- There is very good evidence that pulmonary rehabilitation which includes exercise training improves health-related quality of life (HRQoL) and functional exercise capacity in people with COPD. Large variation in the design of pulmonary rehabilitation programmes makes it difficult to identify their optimal format.

- There is some evidence that telemedicine as part of a complex intervention in COPD decreases healthcare utilisation, with no evidence was found of an impact on mortality.

- There is some evidence that outreach nursing programmes improve HRQoL in patients with COPD.

- Based on the quantity and quality of the systematic reviews and the underpinning primary RCTs, there is good evidence that complex SMS interventions (involving multiple components and, or multiple professionals with the intervention delivered by a variety of means) in patients with COPD are associated with improvements in

HRQoL. No evidence was found of a statistically significant benefit regarding mortality while there was limited evidence of reductions in health care utilisation. Although it is not clear which components of SMS support relate to these improvements, education and exercise seem to be effective.

- Most economic analyses were conducted alongside RCTs with small sample sizes and a short duration of follow-up, limiting the applicability and validity of the findings, and potentially failing to capture long-term benefits or to demonstrate if observed benefits and savings could be sustained.

- The interventions described by the included studies were heterogeneous and frequently comprised multiple components. Furthermore, the costing methodology and perspective adopted differed greatly between studies making it difficult to summarise and aggregate findings.

- Evidence for SMS education programmes suggest they could result in potential cost savings due to reduced healthcare utilisation in patients with moderate to severe disease, depending on the efficiency with which the programmes are run.

- There is limited evidence that pulmonary rehabilitation is cost-effective in patients with moderate to severe COPD disease.

- Evidence for the cost-effectiveness of telemedicine interventions is mixed, with more applicable evidence suggesting that telehealth monitoring is not cost-effective.

- Evidence suggests that case management may be cost saving for selected groups of patients with severe disease.

- The reported per-patient cost of self-management support interventions varied according to the intensity of the intervention, but was typically low relative to the overall cost of care of these patients. Ireland has a high prevalence of COPD, so the budget impact of implementing self-management support interventions for all eligible patients is likely to be substantial.

- The findings of the overview of clinical effectiveness are expected to be broadly applicable to the Irish healthcare setting, although recognising there may be differences in how and where care is delivered. The evidence of cost-effectiveness is of limited applicability to the Irish healthcare setting, with findings from the European studies being of greater relevance.

12   Discussion

A health technology assessment (HTA) is intended to support evidence-based decision-making in regard to the optimum use of resources in healthcare services. Measured investment and disinvestment decisions are essential to ensure that overall population health gain is maximised, particularly given finite healthcare budgets and increasing demands for services provided. The purpose of this HTA was to examine the clinical and cost-effectiveness of self-management support (SMS) interventions for chronic diseases. Self-management can be broadly defined as the tasks that individuals must undertake to live with one or more chronic diseases. These can broadly be defined as interventions that help patients to manage portions of their chronic disease or diseases through education, training and support.

12.1   Scope of the study

This HTA examined the clinical and cost-effectiveness of generic self-management support (SMS) interventions for chronic diseases and disease-specific interventions for diabetes (Type 1 and Type 2), chronic obstructive pulmonary disease (COPD), asthma, cardiovascular disease (stroke, hypertension, ischaemic heart disease [IHD] and heart failure).

For the purpose of this review, the 2003 definitions of self-management and SMS developed by the US Institute of Medicine were used. Self-management was thus defined as: 'the tasks that individuals must undertake to live with one or more chronic diseases. These tasks include having the confidence to deal with the medical management, role management and emotional management of their conditions.' SMS was defined as: 'the systematic provision of education and supportive interventions by health care staff to increase patients' skills and confidence in managing their health problems, including regular assessment of progress and problems, goal setting, and problem-solving support.'

SMS interventions may: target different recipients (for example, patients, carers, healthcare professionals); include different components (for example, education, information, practical support, providing equipment, social support, lifestyle advice, prompts, financial incentives); be delivered in different formats (for example, face-to-face, remote, web-based); be delivered by different individuals (including healthcare personnel and trained or untrained lay persons); differ in their intensity and duration.

A consistent theme is that SMS interventions are typically complex interventions that include more than one component of SMS. For this reason, with the exception of education interventions, this report did not assess single component SMS (for

example, simple text message appointment reminders and drug-reminder packaging).

The review of clinical effectiveness was restricted to SMS interventions evaluated through randomised controlled trials (RCTs) in adult populations. Given the volume of literature available, the clinical effectiveness of SMS interventions was evaluated using an 'overview of reviews' approach, where systematic reviews were reviewed rather than the primary evidence. Where existing high-quality overviews were identified, these were updated rather than undertaking a de novo overview of reviews. The cost-effectiveness of generic and disease-specific SMS interventions was evaluated by undertaking systematic reviews of the available literature for each of the disease categories.

12.2   Previous reviews

In December 2014, a high-quality overview of reviews was published by the National Institute for Health Research (NIHR) in the UK. The Practical Systematic Review of Self-Management Support for long-term conditions (PRISMS) study comprised an overview of systematic reviews of RCTs up to 1 June 2012, and was itself undertaken according to the principles of systematic reviewing. The PRISMS study included reviews of SMS interventions for asthma, chronic obstructive pulmonary disease, diabetes (Type 1 and Type 2), hypertension, and stroke.

In broad terms, the PRISMS study concluded that effective SMS interventions are multifaceted, disease-specific, tailored to the individual, and should be underpinned by a collaborative relationship between the patient and healthcare professional. The PRISMS study also included interventions that were applied to children, and included reviews of qualitative implementation studies. These were outside the terms of reference of this project and were not included in this report.

12.3   Additional evidence

This HTA updated the PRISMS reviews to April 2015. The inclusion of the most recent evidence is particularly relevant for telemedicine and computer-based interventions given the rapid rate of technological advance. We identified an additional 47 systematic reviews for the disease areas included in the PRISMS review. PRISMS did not include telehealth reviews as they deemed these to be typically about mode of delivery rather than content of what was delivered. Relevant telehealth interventions that incorporated a significant component of self-management support were, however, included in this updated review.

The PRISMS review did not include generic SMS interventions that were not tailored for specific diseases. Chronic disease self-management programmes such as the Stanford model are designed to be used in populations with a range of chronic

conditions. Generic interventions have the benefit of being potentially applicable to a large proportion of people with one or more chronic diseases. This study evaluated the evidence for generic interventions for which 26 systematic reviews were identified.

Ischaemic heart disease (IHD) and heart failure were also not included in the PRISMS review, but were identified by the HSE as relevant to the scope of this assessment. De novo overviews of reviews were carried out as part of this assessment, identifying 14 reviews of IHD interventions and 20 reviews of heart failure interventions.

Furthermore, corresponding to the reviews of clinical effectiveness, this assessment carried out systematic reviews of the cost-effectiveness literature. These reviews provide valuable evidence on the likely cost implications and cost-effectiveness of SMS interventions. We identified and reviewed 181 costing and cost-effectiveness studies.

In total, this study considered the evidence of over 2,000 RCTs as presented across 160 systematic reviews.

12.4   Summary of findings

The clinical effectiveness of self-management support interventions was reviewed in relation to each disease. A broad range of intervention types were assessed. Some intervention types were only applied to a single or small number of diseases.

Generic (non-disease-specific) self-management support interventions

As noted, a de novo overview of reviews was undertaken in respect of generic self-management support (SMS) interventions. The largest volume of evidence was retrieved for the chronic disease self-management programmes, mainly the Stanford programme. There is some evidence of short-term improvements in patient-reported outcomes such as self-efficacy, health behaviour (exercise) and health outcomes (pain, disability, fatigue, depression). Short-term improvements in health status were found for telephone-delivered cognitive-based therapy. There is insufficient evidence to determine if computer-based chronic disease self-management programmes are superior to usual care or standard programmes. There is some evidence that a range of SMS interventions can lead to a small, but significant reduction in healthcare utilisation; however, it is not possible to identify which types of SMS interventions or components contribute to this positive result. Based on the available evidence, the best possible format of generic self-management support, the diseases in which it is likely to be beneficial, and the duration of its effectiveness, if any, remain unclear.

Asthma

Good evidence was found that SMS interventions can improve quality of life and reduce hospital admissions and use of urgent or unscheduled healthcare in patients with asthma. While the optimal intervention format is unclear, the evidence suggests that the best asthma self-management should include education supported by a written asthma action plan, as well as improved skills training including the use of inhalers and peak flow meters. Behavioural change techniques were noted to be associated with improved medication adherence and a reduction in symptoms.

Chronic obstructive pulmonary disease (COPD)

The assessment found wide variation in the interventions and patient populations, thereby making it difficult to make recommendations on the most effective content of SMS. Very good evidence was found that education is associated with a reduction in COPD-related admissions with limited evidence found that it is associated with improvements in health-related quality of life. Very good evidence was found for pulmonary rehabilitation that included exercise therapy in improving health-related quality of life (HRQoL) and functional exercise capacity of people with COPD. However, because of the substantial variation in the design of pulmonary rehabilitation programmes, the optimal format, intensity and duration of such programmes are unclear. Good evidence was found that complex SMS interventions (that is involving multiple components including education, rehabilitation, psychological therapy, and integrated disease management and or multiple professionals delivered by a variety of means) are associated with improvements in HRQoL in patients with COPD. Some evidence was found that telehealth (as part of a complex intervention) decreases healthcare utilisation while some evidence was also found of improvements in health-related quality of life for nursing outreach programmes. Given the complexity of the interventions assessed, it is difficult to identify the optimal content of a SMS intervention for COPD. Nonetheless, the inclusion of education, exercise and relaxation therapy elements have emerged as important themes.

Diabetes

As the scope of this HTA was limited to adults aged 18 years and older, the majority of the evidence related to the management of Type 2 diabetes. Only two systematic reviews for SMS interventions in Type 1 diabetes were identified for inclusion in this overview of reviews. Very limited evidence was found that structured educational programmes lead to improved outcomes of quality of life and episodes of severe hypoglycaemia in adults with Type 1 diabetes. Very good evidence was found that education, including culturally-appropriate education, improves blood glucose control in the short term (less than 12 months) in adults with Type 2 diabetes, although

quality of life remains unaltered. Some evidence was found that self-management programmes are associated with small improvements in blood glucose control in the short term in Type 2 diabetes, while good evidence was found that behavioural interventions are associated with modest improvements in blood glucose control (HbA1c). Evidence of improvements in blood glucose control for a diverse range of SMS interventions — and in particular educational interventions which differ also in their frequency, intensity and mode of delivery — was also found. Given the complexity of SMS interventions assessed, it is not possible to provide clear recommendations on the optimal content and format of SMS for Type 2 diabetes, other than they should include an education component, with evidence suggesting that various models of delivery may be equally effective. Impact on resource utilisation was not assessed in any of the reviews.

Stroke

There is good evidence that general rehabilitation therapy delivered in early stroke recovery has a positive impact on activities of daily living (ADL) and extended ADL for stroke survivors. There is good evidence that virtual reality-based rehabilitation (that is, using commercial gaming consoles or specifically developed consoles adopted in clinical settings) improves upper limb function and ADL when used as an adjunct to usual care. Based on the available evidence for stroke, it is not possible to draw conclusions in relation to the effectiveness of self-management programmes or a range of interventions including motivational interviewing, psychosocial or lifestyle interventions delivered to stroke survivors. There is some evidence that provision of providing information improves patients and carers' knowledge of stroke and aspects of patients' satisfaction, with small reductions (which may not be clinically significant) in patients' depression scores. Some evidence of effect was also noted for improvements in health-related quality of life for stroke liaison emphasising education and information provision.

Ischaemic heart disease (IHD)

Good evidence was found that exercise programmes (including exercise-based cardiac rehabilitation) are associated with a significant reduction in mortality in suitable patient cohorts with follow-up periods greater than 12 months. Exercise-based interventions were also found to be associated with fewer rehospitalisations. Some evidence was found that patient-education interventions are associated with interim outcomes such as smoking cessation and blood pressure control. Limited evidence was found to demonstrate the effectiveness of behavioural modification interventions, although there were some reported positive effects on smoking cessation and symptom management. Limited evidence was found that home- and telehealth-based cardiac rehabilitation interventions achieve similar outcomes to centre-based cardiac rehabilitation. Interventions such as education, exercise and

behavioural changes are core components of cardiac rehabilitation, so the boundary between standard cardiac rehabilitation services and chronic disease self-management support is ill-defined.

Hypertension

Good evidence was found that self-monitoring of blood pressure, alone or using a range of additional support measures including telemedicine, is beneficial in lowering systolic and diastolic blood pressure. Limited evidence of effectiveness was found for patient-education interventions when used alone to improve medication adherence or blood pressure control. Some evidence was found that community pharmacist interventions, which include patient education, can lead to statistically significant reductions in systolic and diastolic blood pressure. However, for all interventions, the clinical significance of improvements in blood pressure control and medication adherence and the durability of the effect were unclear. As with the other chronic conditions, specific recommendations in relation to the optimal format of a SMS intervention for patients with hypertension is not possible, with evidence for a range of interventions, including education, delivered in a variety of formats. Given the heterogeneity of the patient population, tailoring the components to the individual patient may be beneficial.

Heart failure

Statistically significant reductions in the rate of hospital readmissions were reported for exercise interventions, telehealth interventions and home-visit programmes for patients with heart failure. Similarly, statistically significant reductions in mortality were reported for both telehealth interventions and home-visit programmes. However, despite positive results for telehealth interventions, concerns have been raised about these being the consistent standard of care for patients with heart failure due to inconsistent findings across studies and a lack of understanding about which elements of the intervention contribute to improving outcomes. Limited evidence of effect was found for patient education and behavioural modification interventions for patients with heart failure. As with ischaemic heart disease it is noted that interventions such as education, exercise and behavioural changes are core components of cardiac rehabilitation, so the boundary between standard cardiac rehabilitation services and chronic disease self-management support is ill-defined.

Evidence of cost-effectiveness

Evidence of cost-effectiveness for a wide range of SMS interventions in patients with chronic disease was generally of limited applicability to the Irish healthcare setting. To be cost-effective, an intervention must first be clinically effective; given the heterogeneity of interventions assessed in the clinical effectiveness review and the

variability in the format, intensity and mode of delivery of the interventions assessed, it is difficult to generalise the evidence. A common theme identified is that SMS interventions can typically be delivered at a relatively low cost per patient, although cost is noted to vary according to the intensity of the intervention provided. Therefore, if there is evidence of clinical benefit, typically the intervention will be cost-effective or may even be cost saving (usually driven by reductions or changes in healthcare utilisation). While international evidence suggest that self-management support interventions are potentially low cost on a per-patient level, the budget impact of these interventions could be substantial due to the large numbers of eligible patients.

12.5   Gaps in the evidence

One factor that may contribute to the inconsistent evidence on SMS is the lack of a clear definition of self-management across both primary studies and systematic reviews. Some of the telemedicine interventions, for example, enabled remote consultations between clinicians and patients, but the self-management aspect was a minor element of the overall intervention. The inclusion and exclusion criteria of identified systematic reviews were often based on very broad descriptions of interventions, adding to the heterogeneity of the data. A consensus on the definition of self-management would facilitate the identification of a more narrowly defined, but possibly less heterogeneous evidence-base.

With the exception of generic SMS interventions, the identified reviews related to disease-specific interventions. The included populations are likely to experience high levels of multimorbidity whereby patients have multiple chronic conditions, a number of which may be amenable to self-management. Providing a single disease-specific intervention may not be suitable for enabling successful self-management. Equally, exposure to numerous interventions may be counter-productive, placing an unsustainable burden on the individual. A systematic review of interventions for managing patients with multimorbidity found four studies that could be described as SMS interventions. The authors found that interventions that were linked to healthcare delivery or specific functional difficulties were more effective.[6] For people with multimorbidity, a coherent evidence-based approach that acknowledges their various conditions, and how they interact, is essential.

In many primary studies, interventions were implemented in addition to usual care. Because of this, many studies were structured in a manner that resulted in intervention group patients having more contact with clinical staff than the usual care group. The increased intensity of contact with health professionals may contribute to part of observed treatment effects. In some interventions, the benefit may be changing patterns of healthcare utilisation, such as the substitution of different health professionals (for instance, pharmacist support in place of general

practitioner consultations). Unfortunately, the available evidence does not support an analysis of which features of an intervention may contribute to observed effects on clinical outcomes.

Few of the included systematic reviews included outcomes of patient satisfaction. The lack of data regarding the patient experience means it was not possible to investigate the acceptability of SMS interventions to patients. As such interventions typically aim to improve or increase self-efficacy, it could be anticipated that these interventions may empower patients in their own care. However, some patients could perceive SMS negatively, for example, if they feel they have less clinician support. Further information on the patient experience would be beneficial and could give insights into why some types of SMS intervention are more effective than others.

The identified systematic reviews generally included a quality appraisal of the included primary studies, typically using the Cochrane Risk of Bias Tool or the Jadad score. These tools consider different aspects of study design such as randomisation and blinding. However, an important feature of studies is the quality of the implemented intervention, and this is not captured by the quality assessments. Poor implementation could occur in a variety of ways, such as poor quality educational material or malfunctioning equipment. Although some outcomes such as poor compliance or programme completion rates may be indicative of quality problems, they are not adequate for assessing treatment fidelity. A common audit or evaluation framework could support assessment of intervention quality, but could not be applied retrospectively. Consideration needs to be given to how the quality of intervention implementation and delivery can be evaluated.

12.6 Limitations

The evidence presented in this health technology assessment (HTA), and the approach used to obtain the evidence, are subject to a number of limitations that should be taken into account when considering the findings.

The review-of-reviews approach enabled an assessment of a large quantity of evidence for a range of intervention types across a number of disease areas in a relatively short period of time. Carrying out systematic reviews would not have been feasible and would have necessitated substantial resources to identify, acquire, evaluate and summarise primary evidence where others have already done this work to an acceptable standard. However, a review of reviews places one at a remove from the primary evidence and reliant on the quality of the available reviews. More recent RCTs may not be captured in this approach. However, given their typical sample sizes, it is not possible to draw strong conclusions about effectiveness based on a single RCT, or a number of small RCTs. Therefore it is unlikely that more recent

RCTs not captured in an overview of reviews would be sufficient to substantially alter recommendations informing major policy decisions. It is clear that the quality of the identified systematic reviews was variable. Reviews are, as with the primary evidence, at risk of bias. Some reviews were optimistic in their interpretation of the available evidence and concentrated on evidence showing positive effects. By evaluating the quality of the systematic reviews using a recognised method and focusing on high-quality reviews, we have minimised the risk of bias in our review.

The majority of the trials underpinning the clinical effectiveness data had relatively short-term follow-up of participants. The majority of systematic reviews were based on RCTs with no more than 12 months of follow-up. It is unclear whether effects observed at six or 12 months might be sustained over longer time horizons. Continued beneficial effects may be contingent on ongoing exposure to the intervention, and it is unclear whether good levels of compliance are likely to be maintained over longer periods. Two reviews included trials with 10 years of follow-up data, but that does not provide enough evidence to determine the potential longer-term impact of chronic disease self-management interventions. The length of follow-up also influences the types of outcomes included in studies, with some relying on risk factors or intermediate endpoints rather than clinical endpoints. Differences in mortality, for example, may be difficult to detect over six months in trials that are powered to detect differences in relation to a more common primary outcome. Trials with longer-term follow up could provide a stronger basis to evaluate both clinical outcomes and also data on whether sustained compliance is a potential issue.

Many of the primary studies were based on small sample sizes, which were sometimes presented as pilot or feasibility studies. Small sample sizes inevitably lead to imprecise effect estimates and an inability to detect a statistically significant effect. A benefit of the systematic review approach and meta-analysis techniques is that it enables the pooling of data across studies to improve precision. While this is useful for estimates of clinical effectiveness, this is less relevant for cost-effectiveness. Due to the greater variability in cost data, studies powered to detect a clinical effect are often underpowered to generate stable cost estimates. The cost-effectiveness data was mostly generated as part of an RCT, often with a small sample population. For this reason and because of differences between RCT and real world settings, cost estimates generated by RCTs should be viewed with caution.

There was a marked lack of consistency across studies in terms of the interventions, the definition of routine care, and the outcomes reported. Within a specific disease and for a particular intervention type there could still be substantial heterogeneity. This heterogeneity poses challenges in interpreting the available evidence and forming recommendations for practice. Where possible we have evaluated the

applicability of the evidence. That is, we assessed the extent to which the available data could be used to determine what would happen if the intervention was provided to the eligible patient population in Ireland. The applicability of the evidence is contingent on it reflecting the type of intervention that would be rolled out, that it was applied to similar population, that it has been compared to an approximation of routine care in Ireland, and that the outcomes are relevant to the Irish population. Due to the inconsistency of the evidence in many instances, it is only possibly to make broad statements regarding applicability.

The studies reporting costs and cost-effectiveness were generally found to be of poor quality. In many cases the studies used data collected as part of a small RCT. There is a risk of publication bias in that studies might be more likely to publish the cost data if they either observed a clinical effect or a reduction in costs. Studies that used modelling approaches made assumptions about the sustainability of effects observed with short-term follow-up. High-quality studies tested these assumptions and used sensitivity analyses to determine the impact of effects ceasing at the end of trial follow-up. The available modelling studies often extrapolated long-term outcomes on the basis of intermediate risk factors, for example, a reduction in A1c or blood pressure, using data such as the Framingham Heart Study. The cost-effectiveness data should be viewed in conjunction with the clinical effectiveness data to reduce the risk of biased interpretation, and to ensure that cost-effectiveness is only considered where there is consistent evidence of positive clinical effect.

12.7 Applicability of the evidence

Clinical effectiveness

A very substantial body of literature was reviewed for this HTA, describing the clinical effectiveness of both generic and disease-specific self-management support (SMS) interventions. The applicability of the evidence is a function of the study populations, spectrum of disease, definition of routine care, health system infrastructure, and other features that impact on patient outcomes. In most cases, it was found (with caveats) that the evidence reviewed was broadly applicable to the Irish healthcare setting. A key issue was often the definition of routine care and the extent to which it corresponded to routine care as provided in Ireland.

The healthcare setting must also be considered when evaluating the applicability of the evidence. Many of the primary studies originated from the US, and due to differences in the financing and provision of healthcare, this may impact on the applicability. For example, many of the economic evaluations for SMS interventions in diabetes related to specific insurance plans, medically underserved (low income or uninsured) individuals or specific ethnic groups (for example Hispanics or Latinos), all with limited relevance to the Irish healthcare setting.

It should be borne in mind that an overview of reviews makes use of pooled clinical effectiveness data, sometimes across a large number of primary studies, and that in many cases the data were very heterogeneous. Studies were often pooled despite the fact that they implemented a variety of different interventions that were only broadly similar. In many cases the pooled estimates gave an indication of the effectiveness of a broad type of intervention rather than a specific and well-defined programme. Although the pooled estimate may show limited effect, individual studies will have shown more or less effectiveness than the average effect. Similarly, as with any healthcare intervention, within studies, some patients will have experienced a greater treatment effect than others. However, it was not possible to determine patient subgroups for which certain intervention types may be more effective. Equally it could not be stated which specific programme types might be more effective within broad intervention groupings. In the event of a policy decision to systematically provide SMS interventions, it would be advisable to consider the findings of high-quality systematic reviews and the primary evidence they included to determine what implementation might generate the greatest treatment effect.

A number of reviews included outcomes of healthcare utilisation. In some cases, studies reported either reduced utilisation or a shift in utilisation from secondary to primary care. The applicability of this evidence must be considered in conjunction with the potential for unmet need in the Irish healthcare setting. Some interventions require an element of clinician contact, for example, to carry out periodic office-based measurements. For any currently underserved patient groups, such an intervention could generate additional but appropriate utilisation. Hence, predicted reductions in service use based on international data may not translate into equivalent reductions when rolled out in Ireland.

Cost-effectiveness

The data on costs and cost-effectiveness came from a wide range of settings, and were often RCT-based analyses. Estimates of cost-effectiveness or cost-utility, when reported, are probably of limited applicability. However, the per-patient cost of SMS interventions tended to be low, and this finding is anticipated to be applicable to the Irish setting. While per-patient costs are typically low, the overall budget impact could be substantial particularly for high-prevalence conditions.

12.8 Conclusions

What did we look at?

This HTA examined the clinical and cost-effectiveness of generic self-management support (SMS) interventions for chronic diseases and disease-specific interventions. The review of clinical effectiveness was restricted to SMS interventions evaluated through randomised controlled trials (RCTs) in adult populations. The study

considered in excess of 2,000 RCTs included across 160 systematic reviews. The quality of the primary studies underpinning those reviews was often poor. In addition, the study reviewed 181 costing studies.

What did we find?

SMS interventions comprise a heterogeneous group with little clarity or consistency between studies. There is a clear need for an agreed definition of what constitutes self-management support. For the purpose of this review, the 2003 definitions of self-management and self-management support developed by the US Institute of Medicine were used. Self-management support interventions aim to help patients to manage portions of their chronic diseases through education, training and support. In theory, by improving self-efficacy, patients should be better able to manage their condition potentially leading to better health outcomes, fewer acute events, and reduced healthcare utilisation.

Evidence of the clinical-effectiveness of chronic disease self-management support interventions provides a complex picture. Certain forms of disease-specific interventions have been shown to improve outcomes over periods of six to 12 months. Longer-term outcome data are generally not collected. In particular, very good evidence was found that:

- Exercise programmes for patients with ischaemic heart disease are associated with a significant reduction in mortality in studies with greater than 12-months follow up. Exercise-based interventions are also associated with fewer rehospitalisations.

- Education is associated with a reduction in COPD-related hospital admissions.

- Pulmonary rehabilitation that includes exercise therapy improves quality of life and functional exercise capacity of people with COPD.

- Education, including culturally-appropriate education, improves blood glucose control in the short term (less than 12 months) in adults with Type 2 diabetes, although quality of life remains unaltered.

- Exercise interventions are associated with statistically significant reductions in the rate of hospital readmissions for patients with heart failure. Similar significant reductions in hospital readmission and mortality are noted for telehealth interventions and home-visits programmes. However, concerns have been raised in relation to telehealth interventions becoming the standard of care due to inconsistent findings across studies and lack of understanding about which elements of the intervention contribute to improving outcomes.

Good evidence was found that:

- Complex SMS interventions (that is involving multiple components including education, rehabilitation, psychological therapy, and integrated disease management and or multiple professionals delivered by a variety of means) are associated with improvements in health-related quality of life in patients with COPD.

- SMS interventions can reduce hospital admissions and use of urgent scheduled and unscheduled healthcare in patients with asthma. Optimal asthma SMS support should include education supported by a written action plan as well as improved skills training including the use of inhalers and peak flow meters

- General rehabilitation therapy delivered in early stroke recovery has a positive impact on activities of daily living and extended activities of daily living. Good evidence was also found that virtual reality-based rehabilitation improved upper limb function and activities of daily living when used as an add-on to usual care.

- Behavioural interventions (specifically patient activation interventions) are associated with modest improvements in blood glucose control in adults with Type 2 diabetes.

- Self-monitoring of blood pressure, alone or in conjunction with a range of additional support measures — including telemedicine — is beneficial in lowering systolic and diastolic blood pressure.

Some evidence of effect was noted that:

- Provision of information improves patients and carers' knowledge of stroke and aspects of patient satisfaction in stroke survivors

- Stroke liaison which emphasises education and information provision improves health-related quality of life in stroke survivors

- Self-management programmes are associated with small improvements in blood glucose control in the short term in Type 2 diabetes patients

- Community pharmacist interventions, which include patient education, can lead to statistically significant reductions in systolic and diastolic blood pressure in patients with hypertension.

Based on the available evidence, the optimal format of generic self-management support, the diseases in which it is likely to provide benefit, and the duration of effectiveness, if any, remain unclear.

There is limited evidence regarding the cost-effectiveness of chronic disease self-management support. With the exception of some telehealth interventions and more intensive rehabilitation programmes, most SMS interventions have a relatively low

cost per patient to implement and in some instances can result in modest cost savings through reductions or shifts in healthcare utilisation. However, budget impact is likely to be substantial if implemented for all eligible patients. Most economic analyses were conducted alongside randomised controlled trials, limiting their ability of determine if observed cost savings could be sustained. The costing methodology and perspective adopted differed greatly between studies making it difficult to summarise and aggregate findings.

Is it relevant?

The data from the primary studies was very heterogeneous, reflecting the very wide range of interventions that have been implemented. Despite the many limitations of the available evidence, the findings of the clinical effectiveness are broadly applicable to the Irish healthcare setting. The extent to which the clinical effectiveness data apply to Ireland depends on the definition of routine care, the adherence to the stated standard of care, and the similarities of the healthcare systems. Evidence of cost-effectiveness for a wide range of interventions was generally of limited applicability to the Irish healthcare setting. International data suggest a relatively low cost per patient of SMS interventions, however, consideration must be given to the size of the population, particularly for high prevalence conditions, when considering the potential budget impact of implementing SMS.

What is the bottom line?

SMS interventions have the potential to improve patient outcomes through improved self-efficacy. This HTA gives the evidence base for the SMS interventions that should be prioritised and for which diseases. Where chronic disease self-management support interventions are provided, it is critical that the implementation and delivery of the interventions are subject to routine and ongoing evaluation. This would help to ensure that they are delivering benefits to patients, and allow the content and format of the interventions to be refined. Evaluation will also provide a longer-term perspective not currently available in the literature and will support decisions about the optimal delivery of such interventions. The best evidence of benefit was found for the disease-specific interventions.

Appendix A3

Appendix A3.1 – Search details

Clinical Effectiveness Review Basic search terms:

Chronic disease terms	(Chronic disease[Mesh], chronic health/condition/ illness, long term illness/disease/ condition, diabetes[Mesh], asthma[Mesh], chronic obstructive pulmonary disease[Mesh], stroke[Mesh], hypertension[Mesh], heart failure[Mesh], coronary artery disease[Mesh], ischemic heart disease[Mesh])

AND

Self-management terms	(self care[Mesh], self management, self monitor, self help, self medication, self administration, diagnostic self evaluation[Mesh], self regulation, self treat, self test, self efficacy[Mesh]) (telemedicine[Mesh], e-Health, m-Health, telecare, e-Therapy, telenursing, telemonitor, Computer-Assisted Instruction[Mesh], telephone[Mesh], Cell Phones[Mesh]), Text Messaging[Mesh]), SMS, Self help groups[Mesh], group based, Social learning theory, Behaviour change theory, Behaviour change program, Behaviour change model, motivational interview, peer led, peer support, lay led, lay support, health coach, Action plan, Care plan, Patient education as topic[Mesh], Flinders program/model, chronic care model, expert patients programme, Stanford model/program, internet[MeSH Terms], pulmonary rehab, cardiac rehab)

AND

Systematic review terms or filter	(systematic review, review[Publication Type]), Meta-analysis[Publication Type], Meta-Analysis as Topic[Mesh], meta review, meta-synthesis, overview of reviews, review of reviews, cochrane review)

Clinical Effectiveness Review Basic search strategy:

Phase I	Search from 2009 to February 2015.
Phase IIa	Use PRISMS results prior to 2012. New search from 2012 to April 2015.
Phase IIb	Stroke and hypertension: Use PRISMS results prior to 2012. New search from 2012 to April 2015.
	Heart failure and ischaemic heart disease: Search from 2009 to April 2015.

Appendix A6 - COPD

Table A6.1 Results of meta-analyses from PRISMS review and the systematic reviews from the updated search. Table adapted from the PRISMS review.

Reference and weighting Outcome	Intervention and comparator	Outcome	Time (from initiation of intervention)	Sample size	Significance	ES (95% CI)
Effing (2007)[139]***	Self-management education and usual care (Note: In the majority of studies included in meta-analyses, action plans for self-treatment of exacerbations were assessed).	**Hospital admissions:**				
		COPD-related hospital admissions vs. regular care	-	7 RCTs	++	OR 0.64 (0.47 to 0.89); p=0.007
		HRQoL:				
		SG-RQ total vs. usual care	-	7 RCTs	+	WMD–2.58 (–5.14 to–0.02); p=0.05
		SG-RQ impact vs. usual care	-	7 RCTs	+*	WMD–2.83 (–5.65 to–0.02)
		SG-RQ symptom score vs. usual care	-	7 RCTs	0	WMD–1.45 (–4.41 to 1.51)
		SG-RQ PA vs. usual care	-	7 RCTs	0	WMD–2.88 (–5.90 to 0.13)
Tan (2012)[140]***	Disease-specific education and usual care	**Hospital admissions:**				
		COPD-related admissions vs. usual care	12 months	4 RCTs	+++	OR=0.55 (0.43 to 0.71); p<0.00001
		HRQoL:				
		SG-RQ impact vs. usual care	12 months	6 RCTs	+	WMD–3.78 (–6.82 to–0.73); p=0.02
		SG-RQ total and other domains vs. usual care	3 and 6 months	6 RCTs	0	NR
Turnock (2005)[141]**	Action plans and usual care	**Hospital admissions:**				
		Hospital admissions vs. usual care	12 months	2 RCTs	0	WMD 0.16 (–0.09 to 0.42)
		HRQoL:				
		SG-RQ overall vs. usual care	6 months	2 RCTs	0	WMD–1.91 (–5.46 to 1.63)
		SG-RQ symptoms vs. usual care	6 months	2 RCTs	0	WMD–4.78 (–10.81 to 1.24)
		SG-RQ activity vs. usual care	6 months	2 RCTs	0	WMD–2.43 (–7.37 to 2.50)
		SG-RQ impact vs. usual care	6 months	2 RCTs	0	WMD–0.62 (–4.45 to 3.21)
		SG-RQ overall vs. usual care	12 months	2 RCTs	0	WMD–0.32 (–3.34 to 2.70)

Reference and weighting Outcome	Intervention and comparator	Outcome	Time (from initiation of intervention)	Sample size	Significance	ES (95% CI)
		SG-RQ symptoms vs. usual care	12 months	2 RCTs	0	WMD 1.87 (−3.27 to 7.00)
		SG-RQ activity vs. usual care	12 months	2 RCTs	0	WMD−2.82 (−6.84 to 1.19)
		SG-RQ impact vs. usual care	12 months	2 RCTs	0	WMD 1.16 (−2.21 to 4.53)
Wong (2012)[143]***	Home care by outreach nursing vs. usual care, without respiratory nurse/health worker input	**Hospital admissions:**				
		Hospitalisations vs. routine care	–	5 RCTs	0	Peto OR 1.01 (0.71 to 1.44); p=0.95
		HRQoL:				
		SG-RQ total vs. routine care	–	4 RCTs	+	MD−2.60 (−4.81 to−0.39); p=0.02
		SG-RQ activity vs. routine care	–	3 RCTs	0	NR
		SG-RQ impact vs. routine care	–	3 RCTs	0	NR
		SG-RQ symptoms vs. routine care	–	3 RCTs	0	NR
Walters (2010)[127]**	Action plans with limited patient education only for exacerbations of COPD (Cochrane review)	Health care utilisation - hospital admission	12 months	2 RCTs; 205 participants	0	MD 0.23; 95% CI -0.03 to 0.49
		ED visits	12 months	2 RCTs; 201 participants	0	MD 0.37 (95% CI -0.50 to 1.24); I²=81%
		GP visits	12 months	3 RCTs; 256 participants	0	MD 0.53; -0.45, 1.50
		Use of medications (number of courses of oral corticosteroids)	12 months	2 RCTs; 200 participants	+	MD 0.74; 95% CI 0.12 to 1.35; I²=0%
		Use of medications (treated with at least one course of antibiotics for an acute exacerbation)	6-12 months	3 RCTs; 349 participants	++	OR 2.02; 95% CI 1.29 to 3.17
		HRQoL - SGRQ	6 months and 12 months	4 RCTs; 412 participants	0	0.54 (-1.98. 3.05) ; I²=3.1% (NS at 6 months or 12 months alone)
Cruz (2014)[133]**	Home telemonitoring effectiveness in COPD	**Health care utilisation:**				
		Hospitalisation rates		6 RCTs, 2 NRCTs; 486 participants	+	RR =0.72 (95% CI 0.53 to0.98); Z=2.12; p=0.034; I²=4.73%
		Mean number of hospitalisations		3 RCTs, 1 NRCT; 244 participants	0	SMD=-0.06 (95% CI-0.32 to0.19); Z=0.50; p=0.617; I²=16.42%)
		Length of hospital stay		3 RCTs, 1 NRCT; 244 participants	0	SMD=0.06 (95% CI -0.19 to0.31); Z=0.48; p=0.635;

Reference and weighting Outcome	Intervention and comparator	Outcome	Time (from initiation of intervention)	Sample size	Significance	ES (95% CI)
						I²=0%
		ED visit rates		4 RCTs; 194 participants	0	RR=0.68 (95% CI 0.38 to1.18); Z=1.34; p=0.179; I²=22.53%
		Mean number of ED visits	4-6 months	1 RCT, 1NRCT; 160 participants	0	SMD=0.20 (95% CI -0.49 to0.88); Z=0.56; p=0.576). I²=74.81%
		Health outcomes:				
		Mortality rates		3 RCTs, 1 NRCT; 294 participants	0	RR=1.43 (95% CI 0.40 to 5.03);Z=0.55; p=0.582; I²=0%
		Mean change (i.e., posttest–pretest) of total and sub-dimension scores of the SGRQ		2 RCTs ;	+	SMD =0.53 (95% CI -0.97 to-0.09); Z=2.35; p=0.019; I I²=17.74%
Dickens (2013) [(129)]∗∗∗	Complex interventions that reduce urgent care use in COPD	Use of urgent healthcare	1-24 months	32 RCTs; 3,941 participants	+++	The odds of urgent healthcare use were 32% lower in the intervention group; OR=0.68 (95% CI 0.57 to 0.80). I²=37.4%
Kamei (2012)[(134)]∗	Telehome monitoring-based telenursing for patients with COPD (included patients with mainly severe COPD)	**Health care utilisation**				
		Hospitalisation in patients with severe and very severe COPD	3-12 months	4 RCTs, 2 NRCT; 450 participants	++	RR=0.81; 95% CI=0.69–0.95; I²=0%
		Hospitalisation in patients with moderate COPD	3-12 months	4 RCTs, 2 NRCT; 100 participants	0	RR=0.55; 95% CI=0.22–1.36; I² not reported.
		Hospitalisation in all COPD patients	3-12 months	4 RCTs, 2 NRCT; 550 participants	+	RR=0.80; 95% CI=0.68–0.94; I²=0%
		Comparison of hospitalisation by THMTN duration for patients receiving THMTN for ≤3, 6 and 12months compared to CT/C	≤3 months 6 months 12 months	137 patients 155 patients 258 patients	0	RR=0.64; 95% CI=0.31–1.33; RR=0.78; 95% CI=0.50–1.20; RR=0.80; 95% CI=0.64–1.01;
		Number of emergency department visits	3-12 months	4 RCTs; 335 participants	+++	RR=0.52; 95% CI=0.41–0.65; I²=0%
		Disease exacerbations in severe and very severe COPD patients 3 months after THMTN	3-12 months	2 RCTs; 138 participants	+++	RR=0.57; 95% CI=0.41–0.79; I²=0%
		Mean number of hospitalisations in severe COPD patients	6-12 months	5 RCTs; 453 participants	++	MD=-0.14; 95%; CI=-0.19 to -0.09; P<0.001; I²=0%

Reference and weighting Outcome	Intervention and comparator	Outcome	Time (from initiation of intervention)	Sample size	Significance	ES (95% CI)
		Mean duration of bed days of care in moderate to very severe COPD patients	1-6 months	2 RCTs; 215 participants	++	MD=-0.76; P<0.001; 95% CI=-0.79 to-0.73
		Mortality in moderate to very severe COPD patients	1-12 months	5 RCT; 374 patients	0	RR=1.36; 95% CI=0.77–2.41; P=0.29; I²=0%
Kruis (2013)[128]***	Integrated disease management interventions (chronic care management) and controls (varying from usual care or no treatment to single interventions, mono-disciplinary interventions)	**QoL:**				
		SGRQ – Short term	3-12 months	13 studies; 1425 participants	+++ (p<0.001)	MD -3.71 in favor of IDM (95% CI of -5.83 to -1.59); I² = 56%
		SGRQ – Long term	18, 24 months	2 studies; 189 participants	0	MD -0.22; 95% CI -7.43 to 6.99, I² = 54%
		Exercise capacity:				
		6MWD – Short term	12 months	14 studies; 871 participants	+++	Improved 6MWD by a statistically and clinically relevant 43.86 meters (95% CI 21.83 to 65.89); I² = 83%. Restriction to studies with adequate allocation concealment reduced effect estimate to 15.15 meters, still statistically significant (95% CI 6.37 to 23.93, P < 0.001), but no longer clinically relevant.
		6MWD – Long term	24 months	2 studies; 184 participants	++	Improved 6MWD by 16.8 meters (MD 16.84; 95% CI 3.01 to 30.67), I² = 0%
		Maximal exercise capacity (Watts) using the cycle ergometer test		4 studies; 298 participants	+++	IDM statistically significantly improved the maximal exercise capacity by 7 Watts (MD 6.99; 95% CI 2.96 to 11.02, P < 0.0001)
		Exacerbations:				
		Number of patients experiencing at least one exacerbation - short-term	12 months	2 studies; 407 participants	0	OR 1.21 (95% CI 0.77 to 1.91); homogenous. P=0.42; No statistically or clinically relevant difference between

Reference and weighting Outcome	Intervention and comparator	Outcome	Time (from initiation of intervention)	Sample size	Significance	ES (95% CI)
						groups
		Number of patients experiencing at least one exacerbation - long-term	24 months	2 studies; 301 participants	0	OR 1.53; 95% CI 0.90 to 2.60, P = 0.12; homogenous.
		Hospital admissions, all causes - short-term	12 months	2 studies; 226 participants	0	OR 0.62; 95% CI 0.36 to 1.07, P = 0.49. I^2= 0%
		Hospital admissions, all causes - long-term	24 months	2 studies; 283 participants	0	OR 0.78; 95% CI 0.38 to 1.57; P=0.50; I^2 = 53%
		Respiratory-related admissions - short-term	12 months	7 studies; 1153 participants	+	OR 0.68; 95% CI 0.47 to 0.99, P = 0.04; homogenous
		Respiratory-related admissions - long-term	24 months	1 study; 179 participants	0	OR 0.59; 95% CI 0.28 to 1.22, P = 0.16
		Hospital days per patient - short-term	12 months	6 studies; 741 participants	++	Patients treated with IDM on average discharged nearly 4 days earlier compared to control, CI 6 to 2 days (MD -3.78; 95% CI -5.90 to -1.67, P < 0.001); I^2 = 55%.
		Hospital days per patient - long-term	24 months	1 study; 175 participants	0	MD 0.60; 95% CI -3.01 to 4.21, P = 0.74
		Emergency Department (ED) visits - short-term	12 months	4 studies; 1161 participants	0	OR 0.64; 95% CI 0.33 to 1.25; I^2 = 71%
		Dyspnoea - MRC Dyspnoea Scale		3 studies; 345 participants	+++	Dyspnoea improved in IDM group by -0.30 points (MD -0.30; 95% CI -0.48 to -0.11, I^2 = 0%, P < 0.001)
		Dyspnoea – Borg score		3 studies; 145 participants	0	MD 0.14; 95% CI -0.70 to 0.98, P = 0.74, I^2 = 39%)
		Mortality	12 months (4) 24 months (1)	4 studies; 1,113 participants 1 study; 122 participants	0	Short-term (OR 0.96; 95% CI 0.52 to 1.74, P = 0.33; I^2 = 59%). Long-term (OR 0.45; 95% CI 0.16 to 1.28, P = 0.13)
		Lung function		10 studies	0	-

Reference and weighting Outcome	Intervention and comparator	Outcome	Time (from initiation of intervention)	Sample size	Significance	ES (95% CI)
		Anxiety and depression - HADS		2 studies; 316 participants	0	Anxiety (MD 0.22; 95% CI -0.41 to 0.85, I² = 0%), depression (MD 0.21, 95% CI -0.39 to 0.81, I² = 0%)
		Anxiety and depression - MACL		1 study (55 participants)	0	-
Lundell (2014)[135]**	Telehealthcare for COPD (making pulmonary rehab more accessible)	Physical activity	12 months	1 RCT; 125 participants	+++	SMD -0.081 (95% CI: -0.918 to 0.755)
		Physical capacity:				
		6MWD		6 RCTs; 533 participants	0	MD-1.3 m (95% CI: -8.1 to 5.5)
		Dyspnoea:				
		Chronic Respiratory Questionnaire, Dyspnoea subscale (CRQ-D), Medical Research Council (MRC) Dyspnoea scale, and Shortness of Breath Questionnaire (SOBQ)		7 RCTs; 826	0	SMD, 0.088; 95% CI 0.056 to 0.233; P=0.232
Zwerink (2014)[131]***	Self management for patients with COPD (Cochrane review)	**Hospitalisations:**				
		Respiratory-related hospitalisations vs. usual care or active intervention	2-24 months	10 studies; 1749 participants	+++	OR 0.57, 95% CI 0.43 to 0.75; P<0.001
		All cause hospitalisations vs. usual care or active intervention	2-24 months	7 studies, 1365 participants	+	OR 0.60, 95% CI 0.40 to 0.89; P=0.011
		HRQoL:				
		SGRQ intervention vs. usual care or active intervention	2-24 months	10 RCTs; 1413 participants	+++	MD -3.51, 95% CI -5.37 to -1.65, P<0.001
		Mortality:				
			2-24 months	9 studies; 2134 participants	0	OR 0.79, 95% CI 0.58 to 1.07, P=0.13
		Dyspnoea:				
		Medical Research Council Scale ((m)MRC) intervention vs. usual care or active intervention	2-24 months	3 studies; 119 participants	++	MD -0.83, 95% CI -1.36 to -0.30; P=0.002

Reference and weighting Outcome	Intervention and comparator	Outcome	Time (from initiation of intervention)	Sample size	Significance	ES (95% CI)
		Exercise capacity:				
		6MWD vs. usual care or active intervention	2-24 months	6 studies; 570 participants	0	MD 33.69 m, 95% CI -9.12 to 76.50; P=0.12
McLean (2011)[136]***	Telehealthcare for COPD (Cochrane review)	Quality of life: SRGQ		2 RCTs; 253 participants)	0	MD -6.57, 95% CI -13.62 to 0.48, P=0.07 minimally clinically significant change although the CIs are very wide
		Emergency department visits	12 months	3 RCTs; 449 participants	++	OR 0.27 (95% CI 0.11 to 0.66) P=0.005
		Hospitalisations	12 months	4 RCTs; 604 participants	+++	OR 0.46 (95% CI 0.33 to 0.65); P < 0.00001
		Deaths	12 month	3 RCTs; 503 participants	0	OR 1.05 95% CI 0.63 to 1.75; P=0.86
Jordan (2015)***[130]	Supported self-management for patients with moderate to severe COPD	All-cause mortality		6 RCTs; 1179 participants	0	HR 1.15 (95% CI 0.79 to 1.67); P=0.47; I^2=0% +++ moderate quality
		Hospital admissions		7 RCTs; 1217 participants	0	HR 0.78 95% CI 0.52 to 1.17; P=0.23; I^2= 70.9% ++; low quality
		ED visits		5 RCTs; 932 participants	-	Not combined RR ranged from 0.27 to 1.06 ++; low quality
		HRQoL: SGRQ		6 RCTs; 845 participants	++	MD 3.84-point improvement (95% CI 1.29 to 6.40 points); P=0.003;
McCarthy (2015)[137]***	Pulmonary rehabilitation for COPD	HRQoL: CRQ - Fatigue:		19 RCTs; 1291 participants	+++	MD 0.68, 95% CI 0.45 to 0.92; P<0.001; Tau² = 0.15; I^2 = 64%
		HRQoL: CRQ - Emotional function:		19 RCTs; 1291 participants	+++	MD 0.56, 95% CI 0.34 to 0.78; P<0.001; Tau² = 0.12; I^2 = 58%
		HRQoL: CRQ - Mastery:		19 RCTs; 1212 participants	+++	MD 0.71, 95% CI 0.47 to 0.95; P<0.001; Tau² = 0.16; I^2 = 63%;
		HRQoL: CRQ - Dyspnoea:		19 RCTs; 1283	+++	MD 0.79, 95% CI 0.56 to 1.03;

Reference and weighting Outcome	Intervention and comparator	Outcome	Time (from initiation of intervention)	Sample size	Significance	ES (95% CI)
				participants		19 trials; 1283 participants; P<0.001; Tau² = 0.15; I² = 63%;
		HRQoL: SGRQ total		19 trials; 1146 participants;	+++	MD -6.89, 95% CI -9.26 to -4.52; P<0.001; Tau² = 13.17; I² = 59%;
		HRQoL: SGRQ symptoms		19 trials; 1153 participants;	+++	MD -5.09, 95% CI -7.69 to -2.49; P<0.001; Tau² = 7.79; I² = 26%;
		HRQoL: SGRQ impact		19 trials; 1149 participants;	+++	MD -7.23, 95% CI -9.91 to -4.55; P<0.001; Tau² = 17.94; I² = 58%;
		HRQoL: GRQ activity		19 trials; 1148 participants;	+++	MD -6.08, 95% CI -9.28 to -2.88; P<0.001; Tau² = 27.01; I² = 64%;
		Maximal exercise capacity		16 studies; 779 participants	++	MD 6.77, 95% CI 1.89 to 11.65; P=0.007; Tau² = 40.97; I² = 74%;
		Functional exercise capacity – 6MWD		38 trials; 1879 participants: 1012 actively treated, 867 controls	+++	MD 43.93 m, 95% CI 32.64 to 55.21; P<0.001; Tau² = 713.49; I² = 74%;
		Functional exercise capacity – ISWT		8 trials; 694 participants		MD 39.77, 95% CI 22.38 to 57.15; P<0.001; Tau² = 181.56; I² = 32%

Key: **NR** = Not reported; **SMS** = Short Messaging Service; **SGRQ** = St. George's Respiratory Questionnaire;* **6MWD** = 6 minute walking distance; **MACL** = Mood Adjective Check List; **CT/C** = Conventional treatment/care; **ISWT** = Incremental shuttle walk test;

** The SGRQ is a disease-specific, validated questionnaire (scale from 0 (good health) to 100 (worse health status)). A negative sign indicates improvement, and the minimal clinically important difference (MCID) is -4 points.

Table A6.2 Summary of results from systematic reviews, Table extracted from PRISMS review and systematic reviews from updated search.

Reference and weighting Outcome	Focus	RCTs, n; Participants, n; Date range	Synthesis	Main results	Main conclusions (review author); *Important quality concerns (review author)*
Bentsen (2012)[(138)]*	Self-management interventions that improve COPD patients' HRQoL .	4 RCTs; 529; 2003–11	Narrative	Self-management interventions reduced the burden on patients and improved patient activity and total health. Note: The SMS interventions included patient education (group and individual), exercises (group and individual), a self-help book, an individual action plan and discussion therapy group.	Self-management interventions tend to improve QoL of patients with COPD. Further RCTs are recommended to confirm these benefits. Involvement of nursing in health-care services is suggested to develop these interventions. *Narrative synthesis broad and unclear on how RCT findings are related to conclusions made. Potential bias towards nurses rather than general HCPs*
Effing (2007)[(139)]***	Settings, methods and efficacy of COPD self-management education programmes on health outcomes and use of health-care services	13 RCTs; 2239; 1987-2005	Meta-analysis	**Hospital admissions:** clinically and statistically significant reduction in probability of at least one hospital admission among patients receiving self-management education compared with those receiving regular care [OR 0.64 (95% CI 0.47 to 0.89)] **HRQoL:** SG-RQ total and domain scores in the self-management groups were all lower (indicating a better HRQoL) or equal to the scores in the usual care groups. The differences on the SG-RQ total [WMD −2.58 (95% CI−5.14 to−0.02)] and impact scores [WMD −2.83 (95% CI−5.65 to−0.02)] reached statistical significance at the 5% level, but did not reach the clinically important difference of 4 points. No significant relevant difference was found on the SG-RQ symptom score [WMD−1.45 (95% CI−4.41 to 1.51)] or the SG-RQ domain PA [WMD−2.88 (95% CI −5.90 to 0.13)]	Self-management education is associated with reduction in hospital admissions with no indication of detrimental effects on other outcomes. Because of heterogeneity in interventions, study populations, follow-up time and outcome measures, data are insufficient to formulate clear recommendations regarding form and contents of self-management education programmes in COPD. There is an evident need for more large RCTs with a long-term follow-up, before more conclusions can be drawn. *Publication bias was not measured.*
			Narrative	Hospital admissions: in the 3 studies which could not be meta-analysed no significant differences found between the two arms.	

| | | | | Though 24-month results on hospital admission (all causes) in one of the trials showing a significant reduction of −0.44 hospitalisations per patient/year in favour of the self-management education group HRQoL: No differences in SG-RQ scores after 12 months of follow-up were found. With the CRQ, two out of four HRQoL dimensions (fatigue and mastery) showed a significant improvement after a follow-up of 12 months General QoL: evidence showed significant improvement in total function measured by the SIP in the control group, better physical function and total function in favour of the intervention group. There is also a suggestion of significantly improved scores for the well-being dimension and the perceived III in one of the intervention groups (nurse-assisted collaborative management) compared with usual care. | |
| **Tan (2012)[140]***** | Disease-specific education in COPD | 12 RCTs; 2103; 1997–2010 | Meta-analysis | **Hospital admissions:** there was a significant reduction in hospital admission rates among patients receiving a disease-specific education programme compared with those receiving usual care [fixed effects model, OR 0.55 (95% CI 0.43 to 0.71);p<0.00001] **HRQoL:** the SG-RQ total and domain scores in the disease management groups were all lower (indicating higher HRQoL) or equal to the usual care groups scores at the 12-month intervention period. At 12-months follow-up only SG-RQ impact was significantly better, with no significant differences in other SG-RQ scores. Results after a 3- or 6-month intervention: no statistically significant changes were observed in any of the SG-RQ scores. The statistical heterogeneity for the outcome (SG-RQ impact scores after 6-month intervention) may be related to the outlying effects reported in one study. Its removal led to a lower statistic (59% | A meta-analysis on these studies revealed a positive relationship between disease-specific education programmes and HRQoL scores (as measured by the SG-RQ). Although significant effects were not detected across all HRQoL, findings suggest that education programmes have the potential to be a valuable intervention for COPD patients. Results provide a foundation for future research in this area, with more rigorously designed, large, randomised studies. |

				vs. 0%). One trial could not be used in the meta-analysis because of a lack of data	
Turnock (2005)[141]**	Action plans for the management of COPD	3 RCTs; 367; 1997–2004	Meta-analysis	**Hospital admissions:** no evidence of a significant effect on the number of hospital admissions over 12 months from two studies [WMD 0.16 (95% CI−0.09 to 0.42)] **HRQoL (at 6 months):** no statistically significant differences between groups for HRQoL. Overall HRQoL [WMD −1.91 (95% CI−5.46 to 1.63)]; symptoms [WMD −4.78 (95% CI−10.81 to 1.24)]; activity [WMD −2.43 (95% CI−7.37 to 2.50)]; impacts [WMD−0.62 (95% CI −4.45 to 3.21)] **HRQoL (at 12 months):** no statistically significant difference between groups for HRQoL. Overall HRQoL [WMD −0.32 (95% CI−3.34 to 2.70)]; symptoms [WMD 1.87 (95% CI −3.27 to 7.00)]; activity [WMD −2.82 (95% CI−6.84 to 1.19)]; impacts [WMD 1.16 (95% CI −2.21 to 4.53)	Action plans to date have not shown any significant reduction in the use of health-care resources, or improved clinical outcomes. However, the lack of evidence to support the role of action plans in COPD management should not be necessarily seen as the evidence of lack of efficacy, at this time a WAP without a broader self-management plan cannot be recommended for widespread adoption in primary care.
Wong (2012)[143]***	Outreach respiratory health-care worker programmes for COPD patients	9 RCTs; 1498; 1987–2006	Meta-analysis	**Hospital admissions (meta-analysis):** no significant change in the number of hospitalisations with the intervention [Peto OR 1.01 (95% CI 0.71 to 1.44)] **Hospital admissions (subgroup analysis):** after excluding an outlying study, a statistically significant increase in the number of hospitalisations in patients receiving the intervention was reported [Peto OR 1.59 (95% CI 1.02 to 2.47)] **HRQoL:** significantly improved with the intervention [MD −2.60 (95% CI−4.81 to−0.39)]. No statistically significant reductions in SG-RQ subscores of activity, impact and symptom	Outreach nursing programmes for COPD improved disease-specific HRQoL. However, the effect on hospitalisations was heterogeneous, reducing admissions in one study, but increasing them in others, therefore we could not draw firm conclusions for this outcome. Other narrative findings regarding HRQoL were more heterogeneous
			Narrative	**HRQoL:** across other individual studies that could not be pooled, there were heterogeneous findings for the 'physical score' in the SIP and a range of HRQoL scores	

Walters (2010)[127]**	Action plans with limited patient education only for exacerbations of COPD (Cochrane review)	5 RCTs; 574 participants; 1997–2008		No evidence that action plans reduced health care utilisation; assessed by hospital admission, emergency department visits and GP visits. Use of action plans associated with increased initiation of treatment for acute exacerbations. Oral corticosteroid use increased over 12 months with a significant increase in odds of being treated with antibiotics over 12 months.	There is evidence that action plans with limited COPD education aid recognition of, and response to, an exacerbation with initiation of antibiotics and corticosteroids. Note: They interpret increased medication use as a positive effect.
Cruz (2014)[133]**	Home telemonitoring effectiveness in COPD	7 RCTs + 2 NRCTs; 587 participants; 2006–2013	Meta-analysis	Significant differences found for hospitalisation rates (RR =0.72; 95% CI=0.53–0.98; p=0.034). No differences in other healthcare utilisation outcomes observed.	The findings provide limited evidence of the effectiveness of home telemonitoring to reduce healthcare utilisation and improve health-related outcomes in patients with COPD. Although this intervention appears to have a positive effect in reducing respiratory exacerbations and hospitalisations and improving HRQOL, there is still no clear indication that it reduces healthcare utilisation and associated costs. *One limitation of this review concerns the exclusion of six studies written in languages other than English, Portuguese and Spanish, since they could be relevant for the scope of the review. The number of studies included in the meta-analysis was insufficient (n<5) to measure publication bias*
Dickens (2013)[129]***	Complex interventions that reduce urgent care use in COPD	32 RCTs; 3941 participants; 1988–2012	Meta-analysis	When study effects were grouped according to the components of interventions used, significant effects seen for interventions that included general education (OR=0.66, 95% CI=0.55, 0.81), Exercise (OR=0.60, 95% CI=0.48, 0.76) and relaxation therapy (OR=0.48, 95% CI=0.33, 0.70)	Use of urgent healthcare in patients with COPD was significantly reduced by complex interventions. Complex interventions among people with COPD may reduce the use of urgent care, particularly those including education, exercise and relaxation. *The effects of different complex interventions were moderately heterogeneous, so the pooled effect from all included studies must be interpreted with caution. The pooled effects across a wide range of complex interventions of varying intensities, delivered in varying settings by different professionals tells us little about which interventions might be most effective in reducing the use of urgent care. We focused entirely on reduction in use of urgent care and we did not*

					record medical outcomes, such as health status, morbidity of HRQoL. As such we can draw no inferences about effects of these complex interventions in these other domains and cannot determine whether the reductions in the use of urgent care were due to a reduction in the need for urgent care, due to improved health, or simply due to the substitution of urgent care by scheduled care, delivered as part of the study intervention.
Kamei (2012)[134]*	Telehome monitoring-based telenursing for patients with COPD (included patients with mainly severe COPD)	9 RCTs; 550 participants; 2006–2011	Meta-analysis	THMTN decreased hospitalisation rates, emergency department visits, exacerbations, mean number of hospitalisations, and mean duration of bed days of care in severe and very severe COPD patients. Hospitalisation rates and emergency department visits were comparable between patients undergoing THMTN of different durations. In addition, THMTN had no effect on mortality.	THMTN significantly decreases the use of healthcare services; however, it does not affect mortality in severe and very severe COPD patients.
Kruis (2013)[128]***	Integrated disease management interventions (chronic care management)	26 trials; 2997 participants; 1991–2011	Meta-analysis	**QoL:** Pooled data showed statistically and clinically relevant improvements in disease-specific QoL on CRQ in IDM group: dyspnoea (MD 1.02; 95% CI 0.67 to 1.36); fatigue (0.82; 95% CI 0.46 to 1.17); emotional (0.61; 95% CI 0.26 to 0.95) and mastery (0.75; 95% CI 0.38 to 1.12). All domains (dyspnoea, fatigue, emotional and mastery) exceeded the minimum clinically relevant difference until 12 months follow-up. Only 2 studies measured long-term results on CRQ, positive effect maintained for fatigue, emotion and mastery domains at 24 months follow-up. **Functional exercise capacity:** Improvement of 7 Watts and 44 meters in favor of the IDM group. Sensitivity analysis of 6MWD lowered effect to 15 meters. Note: The clinical significance of these findings is unclear. **Hospitalisations:** Total number of patients with at least one respiratory related hospital	In these COPD participants, IDM not only improved disease-specific QoL and exercise capacity, but also reduced hospital admissions and hospital days per person. It is possible that patients who have learned from education and have an action plan may recognise exacerbations at an early stage and can start medical treatment directly. It is therefore likely that further worsening of health status and hospital admissions can be prevented in these patients.

				admission decreased from 27 per 100 to 20 per 100 patients in favor of intervention group, with NNT of 15 patients to prevent 1 being admitted to hospital over 3 to 12 months.	
			Meta-analysis	Evidence for efficacy of integrated disease management (IDM) programmes of at least 3 months, for up to 12 months follow-up. **QoL, exercise capacity:** Positive effects on disease-specific QoL and exercise capacity in studies containing an exercise program, suggesting exercise training is an important element in an IDM program. Long-term effects still unclear, only a few studies evaluated these. Magnitude of improvement in disease-specific QoL clinically relevant, especially using the Chronic Respiratory Questionnaire (CRQ). **Hospital admissions:** 7 hospital admissions related to respiratory problems can be prevented for every 100 patients treated with IDM for 3 to 12 months, NNT of 15 patients to prevent 1 being admitted. Hospitalisation decreased by 3 days in patients treated with IDM compared to controls. Effects of IDM on the total number of patients suffering at least one exacerbation still remain unclear.	
Lundell (2014)[135]**	Telehealthcare for COPD (making pulmonary rehab more accessible)	9 RCTs; 982; 1996–2013	Meta-analysis	Physical activity level: significant effect favoring telehealthcare (MD, 64.7 min; 95% CI, 54.4–74.9). No difference between groups was found for physical capacity (MD, 1.3 m; 95% CI,8.1–5.5) and dyspnoea (SMD, 0.088; 95% CI,0.056–0.233).	The use of telehealthcare may lead to improvements in physical activity level in patients with COPD although the results should be interpreted with caution given the heterogeneity in studies.
Zwerink (2014)[131]***	Self management for patients with COPD (Cochrane review)	29 studies (23 on 3189 participants vs. usual care; 6 on 499 participants vs. different	Meta-analysis	**HRQoL:** significant improvement with intervention [MD -3.51, 95% CI -5.37 to -1.65] **Respiratory related hospitalisations:** significant reduction [OR 0.57, 95% CI 0.43 to 0.75] **All cause hospitalisations:** Some evidence in favour of intervention [OR 0.60; 95% CI	Self management interventions in patients with COPD are associated with improved HRQoL as measured by the SGRQ, a reduction in respiratory-related and all cause hospital admissions, and improvement in dyspnoea as measured by the (m)MRC. No statistically significant differences were found in other outcome parameters.

				0.40 to 0.89] **Mortality:** No significant effect of intervention [OR 0.79, 95% CI 0.58 to 1.07] **Dyspnoea:** Strong evidence in favour of intervention [MD -0.83, 95% CI -1.36 to -0.30] **Exercise capacity:** No significant effect of intervention [MD 33.69 m, 95% CI -9.12]	However, heterogeneity among interventions, study populations, follow-up time and outcome measures makes it difficult to formulate clear recommendations regarding the most effective form and content of self management in COPD.
McLean (2011)[136]***	Telehealthcare for COPD (Cochrane review)	10 RCTs; 1004; 1990–2009	Meta-analysis		Telehealthcare in COPD appears to have a possible impact on the number of times patients attend the ED and hospital.
Jordan (2015) [130]***	Supported self-management for patients with moderate to severe COPD	10 RCTs; 1533; 2000-2012	Meta-analysis	Meta-analysis identified no evidence of benefit of post-discharge SM support on admissions [hazard ratio (HR) 0.78, 95% confidence interval (CI) 0.52 to 1.17], mortality (HR 1.07, 95% CI 0.74 to 1.54) and most other health outcomes. A modest improvement in HRQoL was identified but this was possibly biased due to high loss to follow-up.	There was little evidence of benefit of providing SMS to patients shortly after discharge from hospital, although effects observed were consistent with possible improvement in HRQoL and reduction in hospital admissions. It was not easy to tease out the most effective components of SMS support packages, although interventions containing exercise seemed the most effective.
McCarthy (2015)[137]***	Pulmonary rehabilitation for COPD	65 RCTs; 3822; 1997-2013	Meta-analysis		Results of the meta-analysis strongly support pulmonary rehabilitation, including at least four weeks of exercise training, as part of the spectrum of treatment for patients with COPD. We found clinically and statistically significant improvements in important domains of HRQoL, including dyspnoea, fatigue, emotional function and mastery, in addition to the six minute walk/distance test - a measure of functional exercise.

Key: **CCM** = Chronic care model; **ED** = Emergency department; **HCP** = Health care professionals; **NNT** = Numbers needed to treat; **OR** = Odds ration; **PEFR** = Peak expiratory flow rate; **QoL** = Quality of life; **RCT** = Randomised controlled trial; **SMD** = Standardised mean difference; **WAPs** = Written action plans.

Table A6.3 Summary of quality appraisal of cost-effectiveness studies.

Study	Quality	Notes
Bakerly (2009)	Moderate	GP costs not included in retrospective group
Bourbeau (2006)	Moderate	Relatively short time horizon (1 year), small RCT, no sensitivity analysis
Cecins (2008)	Poor	Lack of data on how costs were calculated
Chandra (2012)	High	
Chuang (2011)	Poor	Lack of data on how costs and benefits were estimated
De San Miguel (2013)	Poor	Relatively short time horizon (6 months), no sensitivity analysis
Dewan (2011)	High	
Farrero (2001)	Poor	GP costs omitted, lack of data on how cost and benefits were valued
Gallefoss (2004)	Moderate	Relatively short time horizon (1 year), no health-related quality of life data, sensitivity analysis unclear
Gillespie (2013)	Moderate	
Golmohammadi (2004)	Poor	No disaggregation of costs, perspective unclear, poor applicability
Griffiths (2001)	High	
Haesum (2012)	Moderate	Relatively short time horizon (10 months), no sensitivity analysis
Hernandez (2003)	Moderate	Eight week follow up, unclear valuation of costs and benefits
Hoogendoorn (2010)	High	
Jodar-Sanchez (2014)	Moderate	Short time horizon (4 months) and no GP costs included
Jordan (2015)	High	Exploratory study only due to substantial uncertainty surrounding efficacy of intervention.
Khdour (2011)	High	
Liu (2013)	Poor	Lack of data on cost and benefits included
Monninkhof (2004)	Moderate	Relatively short time horizon (1 year)
Pare (2013)	Moderate	Lack of data on how hospitalisation costs were calculated, no discounting, no sensitivity analysis
Stoddart (2015)	High	
Taylor (2012)	Moderate	Relatively short time horizon (6 months)
Tinkelman (2003)	Poor	Lack of data on how costs were estimated
Van Boven (2014)	High	
Vitacca (2009)	Poor	Relatively short time horizon (1 year), not all patient costs included, no sensitivity analysis

Table A6.4 Cost-effectiveness studies investigating SMS education programmes

Study	Intervention	Population	Study Design	Clinical outcomes and QALYs	Costs	Results
Bourbeau (2006)[145]	Multi-faceted education programme with phone follow-up, WAP, on demand access to a case manager and an exercise bike	Patients with moderate- severe COPD and a history of ≥hospitalisation for exacerbation in the preceding year. Mean age 69.5 years	Country: Canada Study design: RCT (n=191) Perspective: Health care payer DR:N/A Time horizon: 1 year (CAD$ 2004)	Decrease in frequency of hospitalisations, ED visits, unscheduled visits and days in hospital in the IG relative to usual care	Based on a case management load of 14 patients pa, the cost of the self management intervention was $3,778 (€2,953)/pp; the net difference in total healthcare costs (healthcare plus intervention costs) was $440 (€344) (p=0.68) between the IG and the CG. Scenario analysis indicated that the intervention became cost-saving with increasing case management load (case load 50 patients pa: net difference = $2149 (-€1,680) (CI $38-$4258 (€30-€3,328) (p=0.046)	At a case-load of 14 patients pa. ICER $4214 (€3,293) hospitalisation prevented, reducing to $1326 (€1,036)/hospitalisation prevented at a case-load of 50 patients per annum.
Gallefoss (2002)[152]	Education programme (2 x 2hr group sessions, 1 individual education session plus 1-2 individual physiotherapist sessions) plus WAP	Adults < 70 years without severe disease. Mean age 57.5 years	Country: Norway Study design RCT (n=62) Perspective: Societal DR: N/A Time horizon:1 year (NOK 1994)	Relative to CG, IG had 85% decrease in GP visits (mean 0.5 vs 3.4 p<0.0001), increased satisfaction with GP (100% vs 78%, p=0.023), and a reduction in use of rescue medications (p=0.003), reductions in days in hospitals and absenteeism were not significant	The mean cost of the intervention was NOK 1600 (€177) per patient consisting of NOK 900 (€99) for education and NOK 700 (€77) for patient time costs. Mean annual total costs for the CG and IG were NOK 19,900 (€2,199) vs NOK 10,600 (€1,171), p=0.581) There was a significant reduction in total costs relative to the CG (p=0.003) The savings in total costs per patient excluding the intervention costs were NOK 7700 (€851)	Cost benefit from societal perspective is 214:1031, meaning that for every NOK spent on patient education, there was a saving of NOK 4.8 (€1).

Khdour (2011)[160]	Pharmacy-led education with WAP and two follow-up phone calls and two follow up OPD visits vs usual care (2 OPD visits in one year)	Adult COPD patients over 45 years (>86% moderate-severe COPD) Mean age 66.4 years.	Country: N. Ireland Study design: RCT one year follow-up (n=127) Perspective: Healthcare provider DR: N/A Time horizon: 1 year (GB£ 2006/07)	Mean differential QALY (EQ5D) was 0.065 (p=0,051); and decrease in hospital bed days (60%, p=0.007), ED visits (48%, p=0,016), unscheduled GP visits 38% p=0.003 and the mean number of antibiotic/steroid courses 23% p=0.023; no difference in scheduled GP visits.	Mean cost pp of the self management intervention was £381 (€571). Total mean healthcare cost were £671 (€1,005) lower (p=0.065) for the IG (i.e. cost saving relative to CG).	Education was found to be dominant, that is less expensive and more effective than usual care during one year follow-up
Monninkhof (2004)[162]	Education programme with physiotherapy-led exercise classes (1-2/week x 2 years) and self-management plan (COPE SMS programme)	Patients aged 40-75 years old with moderate to severe COPD. Mean age 65 years	Country: The Netherlands Study Design CUA alongside RCT with one year follow-up (n=248) Perspective: Societal Discount: N/A Time horizon: 1 year (Netherlands € 2002)	No measurable beneficial effects were found for QALYs or HRQoL (SGRQ) scores.	The self-management programme-specific costs amounted to €642 (€713) per patient. The incremental cost difference amounted to €838 (€931) per patient per year in favour of usual care.	Authors concluded that the COPE self-management programme is not efficient in the management of patients with moderate to severe COPD
Taylor (2012)[165]	7-week SMS educational programme delivered by lay tutor (BELLA) plus usual care vs usual care	COPD patients >35 years, with ≥ unscheduled visit in previous year (moderate-severe COPD) Mean age 69.5 years	Country: UK Study design RCT 6 month follow-up (n=116) Perspective: Healthcare payer Discount: N/A Time horizon: 6 months (GB£ 2008)	EQ-5D scores deteriorated in both groups from baseline, but the decline was smaller in the intervention group (difference 0.12, 95% CI -0.02 to 0.26)	Total cost of the intervention was £30,000 (€42,181) for seven courses. Mean total cost of health care (including intervention) in intervention arm was £877/pp (€1,233) SD £1218 (€1,713) compared to £395/pp (€555) SD: £822 (€1,156) in control.	The ICER was £11,710 (€16,465) per QALY gained over 6 months from a provider perspective.

Key: **CDSM** – chronic disease self-management; **CI** Confidence Interval; **CG**: Control Group; COPD – chronic obstructive pulmonary disease; **HRQoL** – health related quality of life **ICER** – incremental cost effectiveness ratio; **pa** – per annum; **pp** – per patient; **IG**: intervention group; **QALY** – quality adjusted life year; **RCT** – randomised controlled trial; **SD**: Standard Deviation; **SMS** – self-management support; **SGRQ**-St George respiratory questionnaire; WAP – written action plan.

Table A6.5 COPD: Studies assessing pulmonary rehabilitation programmes for COPD

Study	Intervention	Population	Study Design	Clinical outcome and QALY	Costs	Results
Cecins (2008)[146]	Pulmonary rehabilitation programme with twice weekly exercise classes for 8 weeks.	Adults with stable moderate to severe COPD Mean age 67.5 years.	Country: Australia Study design: Pre-and Post-intervention design with 1 year follow-up (n=256) Perspective: N/R Discount rate: N/R Time horizon: 1 year (AUS $ 2003)	Clinically significant improvement in 6MWD and all domains CRDQ (p<0.001)	51% reduction in total hospital admissions resulted in net savings in hospitalisations of $397,032 (€370,520). Estimated cost of providing rehab to 256 participants was $93,440 (€87,200) $292 (€273)/per patient).	Authors concluded savings achieved far outweighed cost of the programme.
Chandra (2012)[147]	Pulmonary rehabilitation 4 week programme with full MDT input including social worker and GP vs usual care	Start age 68 years, 46% females, mix of moderate and severe COPD	Country: Canada Study design: Modelling study Perspective: Healthcare provider Discount:5% Time Horizon: Lifelong (CAN $ 2008)	Incremental life years 0.4 and incremental QALYs 0.3	The incremental intervention cost per patient was $1,527 (€1,097).	The ICER was calculated to be $17,938 (€12,885) per QALY and $14,616 (€10,502) per life year
Gillespie (2013)[153]	Pulmonary rehabilitation 8-week programme with nurse and physiotherapist only vs usual care	Adults with mild to moderate disease from GP practice	Country: Ireland Study design: Cost-effectiveness alongside cluster RCT with 22 week follow-up (n=350) Perspective: Healthcare provider Discount: N/A Time Horizon: 22 weeks (Irish € 2009)	There was a higher CRQ score in the intervention arm of 1.11 (0.35, 1.87 p<0.01) and 0f 0.002 (-0.006, 0.11; p=0.63) QALYs compared to control group.	The cost of the intervention was estimated at €822 (€948) per participant €564 (€650) healthcare costs + €258 (€297) for patient costs). The intervention group had an increased total mean healthcare cost of €944 (€1,088) and €261 (€301) in total patient costs.	The ICER was €850 (€980) per unit increase in the CRQ Total score and €472,000 (€544,099) per additional QALY gained. Therefore cost effective for disease specific scores only.
Golmohammadi (2004)[154]	Pulmonary rehabilitation 6 to 8 week programme with 2-3 weekly classes with MDT input vs usual care	Adults older than 45 years with varying severity of COPD	Country: Canada Study design: Pre- and post-intervention costing study (n=210) Perspective: Healthcare provider Discount: N/A Time Horizon:1 year (Can $ 2003)	Overall improvement in SGRQ scores was 4.85% (p=0.001) or about 193 units.	The average cost for each person who started the programme was $1092 (€869). The average reduction of total health care costs after the programme was $344 (€274) per person per year. (p=0.02)	Authors concluded pulmonary rehabilitation is cost-effective in the community.

Griffiths (2001)[155]	Outpatient multidisciplinary 6-week pulmonary rehabilitation programme (18 x 1/2 day visits) including education, exercise, individual goal setting, dietary intervention, physiotherapy and occupational therapy versus standard care.	Patients with COPD (mainly) or other chronic disabling pulmonary pathologies (FEV1 < 60% predicted with < 20% reversibility to inhaled β agonist) referred by primary and secondary care physicians for rehabilitation	Country: UK Study design: CUA alongside RCT with one year follow-up, n=200 patients. Perspective: Health service (primarily) Time horizon: 12 months (cost year not reported - RCT published in 2000)	The incremental utility of adding pulmonary rehabilitation was 0.030 (95% CI 0.002 to 0.058) QALYs per patient, p=0.03.	Rehabilitation programme for up to 20 patients cost £12,120 (64% staff costs, 4% equipment and consumables, 15% transport, 17% overhead) equating to £725 per patient based on an attendance of 17 patients /programme. The mean incremental cost saving of adding rehabilitation to standard care was £152 (95% CI –881 to 577) per patient, p=NS. No significant difference was observed in the overall cost of care between the control and rehabilitation groups.	Authors concluded that outpatient pulmonary rehabilitation produces cost per QALY ratios within bounds considered to be cost effective and is likely to result in financial benefits to the health service. The cost-effectiveness acceptability curve indicated the probability of the cost per QALY generated for the intervention being < £17,000 is 0.95, with a probability of 0.64 that it is cost saving.
Hoogendoorn (2010)[158]	Community rehabilitation programme with twice weekly physiotherapy sessions for four months and nurse education and dietician, followed by 20 month maintenance vs usual care	Adults with gold stage 2 or 3	Country: Netherlands Study design: RCT with 2 year follow up (n=199) Perspective: Societal and third party payer Discount: N/A Time Horizon: 2 years (Dutch € 2007)	Net improvement in intervention group of 13% in SGRQ score and -17% in control. Incremental QALY of 0.08 (95% CI -0.01-0.18)	The cost of the intervention for two year was €1,650 (€1,758) per patient. Mean total costs for two years, irrespective of whether they were related to COPD or not, were €13,565 (€14,453)/pp for the INTERCOM group and €10,814 (€11,522)/pp for the usual care group. Total direct healthcare costs were €2,751 (€2,931) (95% CI- €631-€6372) (-€672-€6,789) higher in the INTERCOM group.	ICER was €32,425 (€34,548) per QALY from societal and €25,309 (€26,966) per QALY from a third party payer's perspective

Key: **COPD** = chronic obstructive pulmonary disease; **CRQ** = chronic respiratory disease questionnaire; **ICER** = incremental cost-effectiveness ratio; **MDT** = multi-disciplinary team; **pp** = per patient; **QALY** = quality-adjusted life year; **SGRQ** = St George's Respiratory Questionnaire.

Table A6.6 Cost-effectiveness studies examining telemedicine interventions

Study	Intervention	Population	Study design	Clinical outcomes and QALY	Costs	Findings
De San Miguel (2013)[149]	Telehealth monitoring with nurse monitoring and advice and website accessible to GP	Members with a diagnosis of COPD and receiving domiciliary oxygen. Mean age 72.5 years	Country: Australia Study design: Costing study alongside RCT (n= 80) Perspective: Healthcare provider Discount rate: N/A Time horizon: 1 year (Aus $ 2005)	There was no statistically significant difference in CRQ-SAS scores between groups, except for mastery domain.	The annualised net savings in the telehealth group was $2,931 (€2,425) per person (driven by fewer hospitalisations)	Authors concluded that remote monitoring resulted in fewer health service contacts and thus in cost savings.
Haesum (2012)[156]	Telehealth monitoring from a range of healthcare professionals and monthly telerehabilitation team meetings online	Adult COPD patients Mean age 68 years.	Country: Denmark Study design: CUA alongside RCT (n=111) Perspective: Healthcare provider Discount rate:3% for capital costs Time horizon:10 months (Danish KOR 2010 (reported as € where 100€=750 DKK))	Incremental QALY gain for intervention group was 0.013 and -0.014 for control.	Total healthcare costs were €7862 (€6,394) (95% CI €4,818-€10,906) (€4,249-€9,621) for intervention group (including intervention equipment costs of €677 (€597) and €8,150 (€7,188) (95% CI €5879-€10420) (€5,185; €9,189) for control group	Intervention was less costly and more effective than rehabilitation in control group.
Jodar-Sanchez (2014)[159]	Telehealth monitoring by a call centre with case manager review of results	Severe COPD with LTOT Mean age 72.7 years	Country: Spain Study design: CUA alongside RCT (n=45) Perspective: Healthcare provider Discount rate; N/A: Time horizon:4 months (Spanish € 2014)	The average QALY gain was 0.0059 for the TG and 0.0006 for the CG, resulting in an incremental QALY gain of 0.0053.	The average total cost was €2300 (€2862)/pp in the intervention group and €1103 (€1372)/pp for the controls resulting in an incremental cost of €1196 (€1488) (95% CI €-498-€2892 (-620; 3,598)).	The ICER was €223,726 (€278,379) per QALY gained

Pare (2013)[163]	Telehealth monitoring with case manager advice and pre-programmed computer generated advice.	Severe COPD 68% females Mean age 68.2 years	Country: Canada Study design: Costing study alongside RCT (n=120) Perspective: healthcare provider Discount rate: N/R Time horizon: 21.5 months (CAD $ 2010)	Reduced hospitalisations and length of stay	There was a net saving of $1613 (€1,103) per patient year in the tele-homecare group compared to controls, resulting in a net gain of 14%.	Authors concluded that despite positive results future research needed to confirm cost-effectiveness.
Stoddart (2015)[164]	Telehealth monitoring with telephone follow-up by responsible physician	Adults with an admission for exacerbation of COPD in the previous year with varied disease severity Mean age 68.9 years	Country: UK Study design: CUA alongside RCT (n= 256) Perspective: Healthcare provider Discount rate: 3.5% for equipment cost Time horizon: 1 year (GB £ 2010)	The mean difference in QALYs was 0.0167 when adjusted for baseline differences.	The mean overall cost of tele-homecare was £568 (€756) per patient. The mean overall health care costs per patient were £11906 (€15,834) in the telemonitoring arm and £9613 (€12,792) in the usual care arm.	The mean ICER was £137,277 (€182,673) per QALY.
Vitacca (2009)[168]	Telehealth monitoring	Chronic respiratory failure with HMV or LTOT Mean age 61.1 years	Country: Italy Study design: Costing study alongside RCT (n=101) Perspective: Healthcare provider Discount rate: N/A Time horizon: One year (Italy € cost year NR)	Fewer hospitalisations in intervention group	The cost of the intervention ranged from €903 to €1008 per patient. The mean direct healthcare costs per patient excluding the intervention were €8,907(+/-€17,580) and €14,728(+/-€28,694) in the IG and CG respectively	Authors concluded that in severe and frail chronic respiratory failure patients a nurse-led tele-assistance programme can reduce hospitalisations.

Key: **CG** = control group; **COPD** = chronic obstructive pulmonary disease; **CUA** = cost-utility analysis; **ICER** = incremental cost-effectiveness ratio; **IG** = intervention group; **LTOT** = long term oxygen treatment; **RCT** = randomised controlled trial.

Table A6.7 Cost-effectiveness studies assessing case management interventions

Study	Intervention	Population	Study design	Clinical outcomes and QALY	Costs	Findings
Farrero (2001)[151]	Home case management with quarterly home visits and monthly telephone reviews by nurse	Adults receiving LTOT Mean age 69 years.	Country: Spain Study design: Costing study alongside RCT (n=122) Perspective: Provider Discount rate: N/A Time horizon: 1 year (Pesetas cost year NR)	No difference in QoL scores or arterial blood gases. Similar and significant decreases in FVC and FEV at f/up	The cost of the intervention was estimated at 6.7 million pesetas and this resulted in net savings of 8.1 million pesetas for the study period, mainly driven by reduced hospitalisations and ED visits in intervention group.	Authors concluded that for selected group of patients with severe COPD such as those receiving LTOT, hospital based case management can be cost-effective
Chuang (2011)[148]	Regular (at least weekly) telephone education and management calls from nurse, with written action plan and liaison with GP	Members of care organisation with confirmed diagnosis of COPD.	Country: USA Study design: Costing study alongside RCT (n=141) Perspective: Insurance provider Discount rate: N/A Time horizon: 1 year (US$ cost year NR)	Decreased healthcare utilisation in intervention group but not statistically significant	Total programme costs were $225,012. The saving in all paid claims at twelve months was $328,760 resulting in a 46% return in investment.	Authors concluded their programme provided high-quality cost-effective care.
Hernandez (2003)[157]	Case management facilitating early discharge through initial nurse home visit and continued home or telephone follow-up for eight weeks post-discharge	Adults presenting to ED with COPD exacerbation (moderate disease) Mean age 70.8 years	Country: Spain Study design: Costing study alongside RCT (n=222) Perspective: Public insurer Discount rate: N/A Time horizon:8 weeks (Spain € 2000)	Intervention group showed higher improvement in HRQL, a higher percentage of patients in the home hospitalisation group had a substantial improvement in knowledge of the disease, compliance on inhalation technique and rehabilitation at home compared to control	The average overall healthcare cost per patient in the intervention group was only 62% of the average cost calculated for control patients; €1255 (€1827) and €2033 (€2960), respectively (p=0.003)	Authors concluded that home hospitalisation of selected COPD exacerbations can result in better outcomes at lower costs than conventional care.

Liu (2013)[161]	Home-based case management daily measurements, telephone review and home visits as required	Cohort 1 is a mix of disease severity, Cohort 2 is mix of end stage disease	Country: USA Study design: Economic evaluation, modeling study Perspective: Public insurer Discount rate: 3.5% Time horizon: Cohort 1 for 20 years, cohort 2 for 10 years (US $ 2011)	Cohort 1 had incremental life years gained of 0.48 and QALY of 0.4; Cohort 2 had incremental life years of 0.36 and QALY of 0.22	Cohort 1: incremental lifetime saving per person of $2,900 (€2651) Cohort 2: incremental $16,100 (€14,719) lifetime saving per person	Base case analysis showed a mean cost saving of $7,250 (€6,628) per QALY gained in cohort 1 and mean cost savings of $73,187 (€66,909) per QALY gained in cohort 2.
Tinkelman (2003)[166]	Case management with access to helpline, regular telephone review, personalised action plan, educational materials and home visits	35-89 year old in national Jewish disease management programme with a range of disease severity. Mean age 64 years.	Country: USA Study design Pre and post intervention (n= 349) Perspective: N/R Discount: N/A Time horizon: 1 year (US$ 1996)	Activity component improved by 7.0 units (10.2%, $p < 0.001$), symptoms by 4.4 units (8.7%, $p < 0.002$) and total score by 1.9 units (3.7%, $p = 0.057$).	The cost of the programme was $223,500 (€358,268) (average of $635 (€1,018) per patient). Savings from reduced hospitalisations and ED visits of $672,000 (€1,077,208).	Case management is supportive of physician care and can be cost effective.

Key: **COPD** = chronic obstructive pulmonary disease; **CUA** = cost-utility analysis; **ICER** = incremental cost-effectiveness ratio; **LTOT** = long term oxygen treatment; **QALY** = quality-adjusted life year; **RCT** = randomised controlled trial.

Table A6.8 Cost-effectiveness studies examining other SMS interventions

Study	Intervention	Population	Study design	Clinical outcomes and QALYs	Costs	Results
Bakerly (2009)[(144)]	Integrated care with education session, early discharge and self-management plan shared with GP.	Adult COPD patients with moderate disease	Country: UK Study design: Non-randomised study (n=225) with and matched retrospective control group Perspective: Healthcare provider Discount rate: N/A Time horizon: 1 year (GB£ Mixed cost years 2006 and 2007)	None reported	The total mean healthcare cost per patient in the integrated care group was £1653 (95%CI, £1521–1802) compared to £2256 (95%CI, £2126–2407). Resulting in savings of £600. (p<0.001)	Authors concluded further research was needed due to changing commissioning landscape and difficulties with study design
Chandra (2012)[(147)]	Intensive counseling for smoking cessation 90 minute duration	Start age of 48 years, 37% females with moderate COPD	Country: Canada Study design: Economic modeling study Perspective: Healthcare provider Discount rate:5% Time horizon: Lifelong (CAD $ 2006)	0.62 life years gained and 0.58 QALY gained	The intervention resulted in incremental lifetime cost savings of $2,245 (€1,674)	Intervention was dominant being less costly and more effective than usual care.

Jordan (2015)[130]	Low, moderate or high intensity nurse-led SMS programme delivered within six weeks of hospital discharge for an acute exacerbation compared with usual care	Cohort with a start age of 72 years, 47.4% male with 39.4% current smokers	Country: UK Study design: Economic evaluation modeling Perspective: Healthcare provider Discount rate: N/R Time horizon:30 years (GB£ 2012)	Incremental QALY was 0.0831	Incremental cost was £683 (€854). The ICER was £8,218 (€10,270) per QALY gained. Applying the high intervention estimate of £671 (€839) per patient increased the ICER to £9,257 (€11,568). Applying the low estimate of £85 (€106) decreased the ICER to £1033 (€1291).	Considerable uncertainty was noted around the impact on readmissions, the authors highlighted that the model-based analysis should be viewed as speculative The main drivers of the model were the effect on hospital readmissions, duration of the effect, and the cost of the programme. To be cost-effective, the programme needed to cost no more than £2,200 (€2,749) if there was an18% reduction in readmissions. The sensitivity analysis suggested that SM support had a probability of 68% of being cost-effective at a threshold ICER of £20,000 (€24,994) per QALY.
Van Boven (2014)[167]	Community pharmacy intervention to improve medication adherence	Cohort with mean age of 70 years, 66% male	Country: Belgium Study design: Modeling study based on RCT with 3 month follow up (n=734), Perspective: Healthcare payer Discount Rate:3% cost, 1.5% effect Time horizon: 1 year (Belgian € 2013)	In the intervention group inhalation scores were improved with 13.5% (95%CI: 10.8-16.1; P < 0.0001); medication adherence was improved from 85.70% to 94.21% (difference: 8.51%, 95%CI: 4.63-12.4; P < 0.0001) and there was a lower hospitalisation rate was observed (9 vs 35; Rate ratio: 0.28, 95%CI: 0.12-0.64; P = 0.003) Small QALY increase was observed (<0.001 QALY)	Cost saving of €227 (€227) (95% CI €58-€403 (€58-€403)) per patient in the intervention group within the one year time horizon. The total costs per patient for intervention and usual care were €2,221 (€2,219) and €2,448 (€2,446) respectively.	Authors concluded that improving inhaler adherence in community pharmacies is a cost-saving strategy compared with usual care.

References[*]

(1) Adams K, Greiner AC, Corrigan JM. *Report of a summit : the 1st Annual Crossing the Quality Chasm Summit : a focus on communities pg. 57* [Online]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK215518/pdf/Bookshelf_NBK215518.pdf.

(2) Taylor SJC, Pinnock H, Epiphaniou E, Pearce G, Parke HL, Schwappach A, et al. *A rapid synthesis of the evidence on interventions supporting self-management for people with long-term conditions: PRISMS - Practical systematic Review of Self-Management Support for long-term conditions*. 2014.

(3) Corbin JM, Strauss AL. *Unending Work and Care: Managing Chronic Illness at Home.* San Francisco, CA: Jossey-Bass Publishers; 1988.

(4) Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev.* 1977; 84(2): pp.191-215.

(5) Lorig KR, Holman H. Self-management education: history, definition, outcomes, and mechanisms. *Ann Behav Med.* 2003; 26(1): pp.1-7.

(6) Smith SM, Soubhi H, Fortin M, Hudon C, O'Dowd T. Managing patients with multimorbidity: systematic review of interventions in primary care and community settings. *BMJ.* 2012; 345 p.e5205.

(7) New Zealand Guidelines Group. *A systematic review of the literature on health behaviour change for chronic care* [Online]. Available from: http://www.health.govt.nz/system/files/documents/publications/rapide-chronic-care-systematic-review.pdf.

(8) Wagner EH, Austin BT, Von KM. Improving outcomes in chronic illness. *Manag Care Q.* 1996; 4(2): pp.12-25.

(9) Wagner EH, Coleman K, Reid RJ, Phillips K, Abrams MK, Sugarman JR. The Changes Involved in Patient-Centered Medical Home Transformation. *Prim Care Clin Off Pract.* 2012; 39(2): pp.241-59.

(10) Coulter A, Roberts S, Dixon A. *Delivering better services for people with long-term conditions. Building the house of care.* [Online].

(11) Coulter A, Entwistle VA, Eccles A, Ryan S, Shepperd S, Perera R. Personalised care planning for adults with chronic or long-term health conditions. *Cochrane Database Syst Rev.* 2015; 3 p.CD010523.

(12) Stanford School of Medicine. *Stanford Patient Education Research Center. Chronic Disease Self Management* [Online]. Available from: http://patienteducation.stanford.edu/.

(13) Self Management UK. *Expert Patients Programme* [Online]. Available from: http://selfmanagementuk.org/services/programmes.

(14) Flinders University. *The Flinders Programme^{TM}* [Online]. Available from: https://www.flinders.edu.au/medicine/sites/fhbhru/self-management.cfm.

---

[*] All online references accessed at the time of preparing this report.

(15) Simmons LA, Wolever RQ. Integrative Health Coaching and Motivational interviewing: Synergistic Approaches to Behavior Change in Healthcare. *Glob Adv Health Med.* 2013; 2(4): pp.28-35.

(16) World Health Organisation (WHO). *Telemedicine* [Online]. Available from: http://www.who.int/goe/publications/goe_telemedicine_2010.pdf.

(17) Sood S, Mbarika V, Jugoo S, Dookhy R, Doarn CR, Prakash N, et al. What is telemedicine? A collection of 104 peer-reviewed perspectives and theoretical underpinnings. *Telemed J E Health.* 2007; 13(5): pp.573-90.

(18) World Health Organisation (WHO). *A health telematics policy in support of WHO's Health-For-All strategy for global health development: report of the WHO group consultation on health telematics, 11-16 December, Geneva, 1997.* [Online]. Available from: http://apps.who.int/iris/bitstream/10665/63857/1/WHO_DGO_98.1.pdf.

(19) Kung J, Chiappelli F, Cajulis OO, Avezova R, Kossan G, Chew L, et al. From Systematic Reviews to Clinical Recommendations for Evidence-Based Health Care: Validation of Revised Assessment of Multiple Systematic Reviews (R-AMSTAR) for Grading of Clinical Relevance. *Open Dent J.* 2010; 4 pp.84-91.

(20) Shea BJ, Grimshaw JM, Wells GA, Boers M, Andersson N, Hamel C, et al. Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. *BMC Med Res Methodol.* 2007; 7 p.10.

(21) Guyatt GH, Oxman AD, Schunemann HJ, Tugwell P, Knottnerus A. GRADE guidelines: a new series of articles in the Journal of Clinical Epidemiology. *J Clin Epidemiol.* 2011; 64(4): pp.380-2.

(22) Jadad AR, Moore RA, Carroll D, Jenkinson C, Reynolds DJ, Gavaghan DJ, et al. Assessing the quality of reports of randomized clinical trials: is blinding necessary? *Control Clin Trials.* 1996; 17(1): pp.1-12.

(23) Higgins JP, Lane PW, Anagnostelis B, nzures-Cabrera J, Baker NF, Cappelleri JC, et al. A tool to assess the quality of a meta-analysis. *Res Synth Methods.* 2013; 4(4): pp.351-66.

(24) Evers S, Goossens M, de VH, van TM, Ament A. Criteria list for assessment of methodological quality of economic evaluations: Consensus on Health Economic Criteria. *Int J Technol Assess Health Care.* 2005; 21(2): pp.240-5.

(25) Jaime CJ, Eddy DM, Kan H, Kaltz C, Patel B, Eldessouki R, et al. Questionnaire to assess relevance and credibility of modeling studies for informing health care decision making: an ISPOR-AMCP-NPC Good Practice Task Force report. *Value Health.* 2014; 17(2): pp.174-82.

(26) Organisation for Economic Co-operation and Development (OECD). *Purchasing Power Parities (PPP) Statistics* [Online]. Available from: http://stats.oecd.org/Index.aspx?DataSetCode=PPPGDP.

(27) Boult C, Green AF, Boult LB, Pacala JT, Snyder C, Leff B. Successful models of comprehensive care for older adults with chronic conditions: Evidence for the institute of medicine's "retooling for an Aging America" report. *J Am Geriatr Soc.* 2009; 57(12): pp.2328-37.

(28) Franek J. Self-management support interventions for persons with chronic disease: an evidence-based analysis. *Ont Health Technol Assess Ser.* 2013; 13(9): pp.1-60.

(29) Inouye J, Braginsky N, Kataoka-Yahiro M. Randomized clinical trials of self-management with Asian/Pacific Islanders. *Clin Nurs Res.* 2011; 20(4): pp.366-403.

(30) Jonker AA, Comijs HC, Knipscheer KC, Deeg DJ. Promotion of self-management in vulnerable older people: a narrative literature review of outcomes of the Chronic Disease Self-Management Program (CDSMP). *Eur J Ageing.* 2009; 6(4): pp.303-14.

(31) Quinones AR, Richardson J, Freeman M, Fu R, O'Neil ME, Motu'apuaka M, et al. Educational group visits for the management of chronic health conditions: a systematic review. *Patient Educ Couns.* 2014; 95(1): pp.3-29.

(32) Beratarrechea A, Lee AG, Willner JM, Jahangir E, Ciapponi A, Rubinstein A. The impact of mobile health interventions on chronic disease outcomes in developing countries: a systematic review. *Telemed J E Health.* 2014; 20(1): pp.75-82.

(33) Muller I, Yardley L. Telephone-delivered cognitive behavioural therapy: A systematic review and meta-analysis. *Journal of Telemedicine and Telecare.* 2011; 17(4): pp.177-84.

(34) Wootton R. Twenty years of telemedicine in chronic disease management--an evidence synthesis. *J Telemed Telecare.* 2012; 18(4): pp.211-20.

(35) Bossen D, Veenhof C, Dekker J, de BD. The effectiveness of self-guided web-based physical activity interventions among patients with a chronic disease: a systematic review. *J Phys Act Health.* 2014; 11(3): pp.665-77.

(36) de Jong CC, Ros WJ, Schrijvers G. The effects on health behavior and health outcomes of Internet-based asynchronous communication between health providers and patients with a chronic condition: a systematic review. *J Med Internet Res.* 2014; 16(1): p.e19.

(37) Eland-de KP, van Os-Medendorp H, Vergouwe-Meijer A, Bruijnzeel-Koomen C, Ros W. A systematic review of the effects of e-health on chronically ill patients. *J Clin Nurs.* 2011; 20(21-22): pp.2997-3010.

(38) Kuijpers W, Groen WG, Aaronson NK, van Harten WH. A systematic review of web-based interventions for patient empowerment and physical activity in chronic diseases: relevance for cancer survivors. *J Med Internet Res.* 2013; 15(2): p.e37.

(39) McDermott MS, While AE. Maximizing the healthcare environment: a systematic review exploring the potential of computer technology to promote self-management of chronic illness in healthcare settings. *Patient Educ Couns.* 2013; 92(1): pp.13-22.

(40) Paul CL, Carey ML, Sanson-Fisher RW, Houlcroft LE, Turon HE. The impact of web-based approaches on psychosocial health in chronic physical and mental health conditions. *Health Educ Res.* 2013; 28(3): pp.450-71.

(41) Samoocha D, Bruinvels DJ, Elbers NA, Anema JR, van der Beek AJ. Effectiveness of web-based interventions on patient empowerment: a systematic review and meta-analysis. *J Med Internet Res.* 2010; 12(2): p.e23.

(42) Desroches S, Lapointe A, Ratte S, Gravel K, Legare F, Turcotte S. Interventions to enhance adherence to dietary advice for preventing and managing chronic diseases in adults. *Cochrane database of systematic reviews (Online).* 2013; 2 p.CD008722.

(43) Panagioti M, Richardson G, Murray E, Rogers A, Kennedy A, Newman S, et al. Reducing Care Utilisation through Self-management Interventions (RECURSIVE): a systematic review and meta-analysis. *Database of Abstracts of Reviews of Effects.* 2014; pp.1-200.

(44) Simmons LA, Wolever RQ, Bechard EM, Snyderman R. Patient engagement as a risk factor in personalized health care: a systematic review of the literature on chronic disease. *Genome Med.* 2014; 6(2): p.16.

(45) Kivela K, Elo S, Kyngas H, Kaariainen M. The effects of health coaching on adult patients with chronic diseases: A systematic review. *Patient Education and Counseling.* 2014; 97(2): pp.147-57.

(46) Ontario Health Technology Assessment. In-home care for optimizing chronic disease management in the community: an evidence-based analysis. *Ont Health Technol Assess Ser.* 2013; 13(5): pp.1-65.

(47) O'Halloran PD, Blackstock F, Shields N, Holland A, Iles R, Kingsley M, et al. Motivational interviewing to increase physical activity in people with chronic health conditions: a systematic review and meta-analysis. *Clin Rehabil.* 2014; 28(12): pp.1159-71.

(48) Van Camp YP, Van RB, Elseviers MM. Nurse-led interventions to enhance adherence to chronic medication: systematic review and meta-analysis of randomised controlled trials. *Eur J Clin Pharmacol.* 2013; 69(4): pp.761-70.

(49) Chang SJ, Choi S, Kim S-A, Song M. Intervention strategies based on information-motivation-behavioral skills model for health behavior change: A systematic review. *Asian Nursing Research.* 2014; 8(3): pp.172-81.

(50) Foster G, Taylor SJ, Eldridge SE, Ramsay J, Griffiths CJ. Self-management education programmes by lay leaders for people with chronic conditions. *Cochrane Database Syst Rev.* 2007;(4): p.CD005108.

(51) Coulter A, Entwistle VA, Eccles A, Ryan S, Shepperd S, Perera R. Personalised care planning for adults with chronic or long-term health conditions. *Cochrane Database Syst Rev.* 2015; 3 p.CD010523.

(52) Ausili D, Masotto M, Dall'Ora C, Salvini L, Di MS. A literature review on self-care of chronic illness: definition, assessment and related outcomes. *Prof Inferm.* 2014; 67(3): pp.180-9.

(53) Bowles KH, Baugh AC. Applying research evidence to optimize telehomecare. *J Cardiovasc Nurs.* 2007; 22(1): pp.5-15.

(54) Gaikwad R, Warren J. The role of home-based information and communications technology interventions in chronic disease management: a systematic literature review. *Health Informatics J.* 2009; 15(2): pp.122-46.

(55) Ofman JJ, Badamgarav E, Henning JM, Knight K, Gano J, Levan RK, et al. Does disease management improve clinical and economic outcomes in patients with chronic diseases? A systematic review. *Am J Med.* 2004; 117(3): pp.182-92.

(56) Paré G, Jaana M, Sicotte C. Systematic Review of Home Telemonitoring for Chronic Diseases: The Evidence Base. *J Am Med Inform Assoc.* 2007; 14(3): pp.269-77.

(57) Pericas JM, Aibar J, Soler N, Lopez-Soto A, Sanclemente-Anso C, Bosch X. Should alternatives to conventional hospitalisation be promoted in an era of financial constraint? *Eur J Clin Invest.* 2013; 43(6): pp.602-15.

(58) Polisena J, Tran K, Cimon K, Hutton B, McGill S, Palmer K, et al. Home telehealth for chronic obstructive pulmonary disease: a systematic review and meta-analysis. *J Telemed Telecare.* 2010; 16(3): pp.120-7.

(59) Richardson G, Gravelle H, Weatherly H, Ritchie G. Cost-effectiveness of interventions to support self-care: A systematic review. *Int J Technol Assess Health Care.* 2005; 21(4): pp.423-32.

(60) Rojas SV, Gagnon MP. A systematic review of the key indicators for assessing telehomecare cost-effectiveness. *Telemed J E Health.* 2008; 14(9): pp.896-904.

(61) Stellefson M, Chaney B, Barry AE, Chavarria E, Tennant B, Walsh-Childers K, et al. Web 2.0 chronic disease self-management for older adults: a systematic review. *J Med Internet Res.* 2013; 15(2): p.e35.

(62) van den BN, Schumann M, Kraft K, Hoffmann W. Telemedicine and telecare for older patients--a systematic review. *Maturitas.* 2012; 73(2): pp.94-114.

(63) Aanesen M, Lotherington AT, Olsen F. Smarter elder care? A cost-effectiveness analysis of implementing technology in elder care. *Health Informatics J.* 2011; 17(3): pp.161-72.

(64) Ahn S, Basu R, Smith ML, Jiang L, Lorig K, Whitelaw N, et al. The impact of chronic disease self-management programs: healthcare savings through a community-based intervention. *BMC Public Health.* 2013; 13 p.1141.

(65) Battersby M, Harvey P, Mills PD, Kalucy E, Pols RG, Frith PA, et al. SA HealthPlus: a controlled trial of a statewide application of a generic model of chronic illness care. *Milbank Q.* 2007; 85(1): pp.37-67.

(66) Bendixen RM, Levy CE, Olive ES, Kobb RF, Mann WC. Cost effectiveness of a telerehabilitation program to support chronically ill and disabled elders in their homes. *Telemedicine e-Health.* 2009; 15(1): pp.31-8.

(67) Dimmick SL, Mustaleski C, Burgiss SG, Welsh T. A case study of benefits & potential savings in rural home telemedicine. *Home Healthc Nurse.* 2000; 18(2): pp.124-35.

(68) Doolittle GC. A cost measurement study for a home-based telehospice service. *J Telemed Telecare.* 2000; 6 Suppl 1 p.S193-S195.

(69) Elliott RA, Barber N, Clifford S, Horne R, Hartley E. The cost effectiveness of a telephone-based pharmacy advisory service to improve adherence to newly prescribed medicines. *Pharm World Sci.* 2008; 30(1): pp.17-23.

(70) Finkelstein SM, Speedie SM, Potthoff S. Home telehealth improves clinical outcomes at lower cost for home healthcare. *Telemed J E Health.* 2006; 12(2): pp.128-36.

(71) Graves N, Barnett AG, Halton KA, Veerman JL, Winkler E, Owen N, et al. Cost-Effectiveness of a Telephone-Delivered Intervention for Physical Activity and Diet. *PLoS One.* 2009; 4(9): p.e7135.

(72) Griffiths C, Motlib J, Azad A, Ramsay J, Eldridge S, Feder G, et al. Randomised controlled trial of a lay-led self-management programme for Bangladeshi patients with chronic disease. *Br J Gen Pract.* 2005; 55(520): pp.831-7.

(73) Henderson C, Knapp M, Fernandez JL, Beecham J, Hirani SP, Cartwright M, et al. Cost effectiveness of telehealth for patients with long term conditions (Whole Systems Demonstrator telehealth questionnaire study): nested economic evaluation in a pragmatic, cluster randomised controlled trial. *BMJ.* 2013; 346 p.f1035.

(74) Jerant A, Moore-Hill M, Franks P. Home-based, peer-led chronic illness self-management training: findings from a 1-year randomized controlled trial. *Ann Fam Med.* 2009; 7(4): pp.319-27.

(75) Johnston B, Wheeler L, Deuser J, Sousa KH. Outcomes of the Kaiser Permanente Tele-Home Health Research Project. *Arch Fam Med.* 2000; 9(1): pp.40-5.

(76) Katon W, Russo J, Lin EB. Cost-effectiveness of a multicondition collaborative care intervention: A randomized controlled trial. *Archives of General Psychiatry.* 2012; 69(5): pp.506-14.

(77) Lorig KR, Ritter P, Stewart AL, Sobel DS, William Brown BJ, Bandura A, et al. Chronic Disease Self-Management Program: 2-Year Health Status and Health Care Utilization Outcomes. *Med Care.* 2001; 39(11):

(78) Moczygemba LR, Barner JC, Gabrillo ER. Outcomes of a Medicare Part D telephone medication therapy management program. *J Am Pharm Assoc.* 2012; 52(6): p.e144-e152.

(79) Noel HC, Vogel DC. Resource costs and quality of life outcomes for homebound elderly using telemedicine integrated with nurse case management. *Care Management.* 2000; 6(5): pp.22-4.

(80) Noel HC, Vogel DC, Erdos JJ, Cornwall D, Levin F. Home telehealth reduces healthcare costs. *Telemed J E Health.* 2004; 10(2): pp.170-83.

(81) Page TF, Palmer RC. Cost analysis of chronic disease self-management programmes being delivered in South Florida. *Health Education Journal.* 2014; 73(2): pp.228-36.

(82) Paré G, Poba-Nzaou P, Sicotte C. Home telemonitoring for chronic disease management: An economic assessment. *Int J Technol Assess Health Care.* 2013; 29(2): pp.155-61.

(83) Richardson G, Kennedy A, Reeves D, Bower P, Lee V, Middleton E, et al. Cost effectiveness of the Expert Patients Programme (EPP) for patients with chronic conditions. *J Epidemiol Community Health.* 2008; 62(4): pp.361-7.

(84) Schwartz SM, Day B, Wildenhaus K, Silberman A, Wang C, Silberman J. The impact of an online disease management program on medical costs among health plan members. *Am J Health Promot.* 2010; 25(2): pp.126-33.

(85) Scott JC, Conner DA, Venohr I, Gade G, McKenzie M, Kramer AM, et al. Effectiveness of a Group Outpatient Visit Model for Chronically Ill Older Health Maintenance Organization Members: A 2-Year Randomized Trial of the Cooperative Health Care Clinic. *J Am Geriatr Soc.* 2004; 52(9): pp.1463-70.

(86) Steventon A, Tunkel S, Blunt I, Bardsley M. Effect of telephone health coaching (Birmingham OwnHealth) on hospital use and associated costs: cohort study with matched controls. *BMJ.* 2013; 347 p.f4585.

(87) Tousignant M, Boissy P, Corriveau H, Moffet H. In home telerehabilitation for older adults after discharge from an acute hospital or rehabilitation unit: A proof-of-concept study and costs estimation. *Disabil Rehabil Assist Technol.* 2006; 1(4): pp.209-16.

(88) Ryan A, Wallace E, O'Hara P, Smith SM. Multimorbidity and functional decline in community-dwelling adults: a systematic review. *Health Qual Life Outcomes.* 2015; 13(1): p.168.

(89) Holohan J, Manning P, Nolan D. *ICGP: Asthma Control in General Practice Adapted from the GINA Global Strategy for Asthma Management and Prevention*. 2013.

(90) WHO. *Asthma Fact sheet N°307* [Online]. Available from: http://www.who.int/mediacentre/factsheets/fs307/en/.

(91) Health Servie Executive. *National Clinical Programme for Asthma* [Online]. Available from: http://www.hse.ie/eng/about/Who/clinical/natclinprog/asthma/.

(92) DiBello K, Boyar K, Abrenica S, Worral PS. The effectiveness of text messaging programs on adherence to treatment regimens among adults aged 18 to 45 years diagnosed with asthma: A systematic review. *JBI Database Syst Rev Implement Rep.* 2014; 12(4): pp.485-532.

(93) Denford S, Taylor RS, Campbell JL, Greaves CJ. Effective behavior change techniques in asthma self-care interventions: Systematic review and meta-regression. *Health Psychol.* 2014; 33(7): pp.577-87.

(94) Blakemore A, Dickens C, Anderson R, Tomenson B, Woodcock A, Guthrie E. Complex interventions reduce use of urgent healthcare in adults with asthma: Systematic review with meta-regression. *Respir Med.* 2015; 109(2): pp.147-56.

(95) Bailey EJ, Cates CJ, Kruske SG, Morris PS, Brown N, Chang AB. Culture-specific programs for children and adults from minority groups who have asthma. *Cochrane Database of Systematic Reviews.* 2009;

(96) Tran N, Coffman JM, Sumino K, Cabana MD. Patient reminder systems and asthma medication adherence: A systematic review. *J Asthma.* 2014; 51(5): pp.536-43.

(97) Tapp S, Lasserson TJ, Rowe BH. Education interventions for adults who attend the emergency room for acute asthma. *Cochrane Database of Systematic Reviews.* 2007;

(98) Gibson PG, Powell H, Wilson A, Abramson MJ, Haywood P, Bauman A, et al. Self-management education and regular practitioner review for adults with asthma. *Cochrane Database of Systematic Reviews.* 2002;

(99) Powell H, Gibson PG. Options for self-management education for adults with asthma. *Cochrane Database of Systematic Reviews.* 2002;

(100) Gibson PG, Powell H. Written action plans for asthma: an evidence-based review of the key components. *Thorax.* 2004; 59(2): pp.94-9.

(101) Ring N, Malcolm C, Wyke S, MacGillivray S, Dixon D, Hoskins G, et al. Promoting the use of personal asthma action plans: A systematic review. *Prim Care Respir J.* 2007; 16(5): pp.271-83.

(102) Toelle B, Ram-Felix SF. Written individualised management plans for asthma in children and adults. *Cochrane Database of Systematic Reviews.* 2004;

(103) Moullec G, Gour-Provencal G, Bacon SL, Campbell TS, Lavoie KL. Efficacy of interventions to improve adherence to inhaled corticosteroids in adult asthmatics: Impact of using components of the chronic care model. *Respir Med.* 2012; 106(9): pp.1211-25.

(104) Newman S, Steed L, Mulligan K. Self-management interventions for chronic illness. *Lancet.* 2004; 364(9444): pp.1523-37.

(105) OECD. *Purchasing Power Parities (PPP) Statistics* [Online]. Available from: http://stats.oecd.org/Index.aspx?DataSetCode=PPPGDP.

(106) Castro M, Zimmermann NA, Crocker S, Bradley J, Leven C, Schechtman KB. Asthma Intervention Program Prevents Readmissions in High Healthcare Users. *American Journal of Respiratory and Critical Care Medicine.* 2003; 168(9): pp.1095-9.

(107) Corrigan SP, Cecillon DL, Sin DD, Sharpe HM, Andrews EM, Cowie RL, et al. The costs of implementing the 1999 Canadian Asthma Consensus Guidelines recommendation of asthma education and spirometry for the family physician. *Canadian Respiratory Journal.* 2004; 11(5): pp.349-53.

(108) Donald KJ, McBurney H, Teichtahl H, Irving L, Browning C, Rubinfeld A, et al. Telephone based asthma management - financial and individual benefits. *Australian family physician.* 2008; 37(4): pp.272-5.

(109) Gallefoss F, Bakke PS. Cost-effectiveness of self-management in asthmatics: a 1-yr follow-up randomized, controlled trial. *Eur Respir J.* 2001; 17(2): pp.206-13.

(110) Kauppinen R, Sintonen H, Tukiainen H. One-year economic evaluation of intensive vs conventional patient education and supervision for self-management of new asthmatic patients. *Respir Med.* 1998; 92(2): pp.300-7.

(111) Kauppinen R, Sintonen H, Vilkka V, Tukiainen H. Long-term (3-year) economic evaluation of intensive patient education for self-management during the first year in new asthmatics. *Respir Med.* 1999; 93(4): pp.283-9.

(112) Kauppinen R, Vilkka V, Sintonen H, Klaukka T, Tukiainen H. Long-term economic evaluation of intensive patient education during the first treatment year in newly diagnosed adult asthma. *Respir Med.* 2001; 95(1): pp.56-63.

(113) Parry GD, Cooper CL, Moore JM, Yadegarfar G, Campbell MJ, Esmonde L, et al. Cognitive behavioural intervention for adults with anxiety complications of asthma: prospective randomised trial. *Respir Med.* 2012; 106(6): pp.802-10.

(114) Pinnock H, McKenzie L, Price D, Sheikh A. Cost-effectiveness of telephone or surgery asthma reviews: Economic analysis of a randomised controlled trial. *British Journal of General Practice.* 2005; 55(511): pp.119-24.

(115) Shelledy DC, Legrand TS, Gardner DD, Peters JI. A randomized, controlled study to evaluate the role of an in-home asthma disease management program provided by respiratory therapists in improving outcomes and reducing the cost of care. *J Asthma.* 2009; 46(2): pp.194-201.

(116) van der Meer V, van den Hout WB, Bakker MJ, Rabe KF, Sterk PJ, Assendelft WJJ, et al. Cost-effectiveness of internet-based self-management compared with usual care in Asthma. *PLoS ONE.* 2011; 6(11 Article Number):

(117) Willems DC, Joore MA, Hendriks JJ, Wouters EF, Severens JL. Cost-effectiveness of a nurse-led telemonitoring intervention based on peak expiratory flow measurements in asthmatics: results of a randomised controlled trial. *Cost Effectiveness and Resource Allocation.* 2007; 5 p.10.

(118) Health Servie Executive. *Asthma achievements to date* [Online]. Available from: http://www.hse.ie/eng/about/Who/clinical/natclinprog/asthma/achievements/.

(119) Global Initiative for Chrnic Obstructive Lung Disease. *Pocket Guide to COPD diagnosis, management, and prevention. A guide for healthcare professionals* [Online]. Available from: http://www.goldcopd.org/uploads/users/files/GOLD_Pocket_May2512.pdf.

(120) O'Connor M. *Chronic Obstructive Pulmonary Disease (COPD). Faculty of Public Health Medicine Postion Paper* [Online]. Available from: http://www.rcpi.ie/content/docs/000001/2081_5_media.pdf?1410795330.

(121) European Respiratory Society, European Lung Foundation. *European Lung White Book.* [Online]. Available from: www.erswhitebook.org.

(122) Organisation for Economic Co-operation and Development. *Health at a Glance OECD Indicators* [Online]. Available from: http://www.oecd.org/els/health-systems/49105858.pdf.

(123) Irish Thoracic Society, HSE, ICGP. *National Respiratory (COPD) Framework* [Online]. Available from: http://www.irishthoracicsociety.com/images/uploads/file/draft_respframework_oct_000.pdf.

(124) Forde D, McDonnell T. *Clinical Focus. COPD: mapping the road ahead* [Online]. Available from: https://www.icgp.ie/assets/38/9843875F-19B9-E185-83B91B82930A99E1_document/1.COPD_challenges.pdf.

(125) Health Service Executive. *National Clinical Programme for COPD* [Online]. Available from: http://www.hse.ie/eng/about/Who/clinical/natclinprog/copdprogramme/.

(126) Spruit MA, Singh SJ, Garvey C, ZuWallack R, Nici L, Rochester C, et al. An official American Thoracic Society/European Respiratory Society statement: key concepts and advances in pulmonary rehabilitation. *Am J Respir Crit Care Med.* 2013; 188(8): p.e13-e64.

(127) Walters JA, Turnock AC, Walters EH, Wood-Baker R. Action plans with limited patient education only for exacerbations of chronic obstructive pulmonary disease. *Cochrane Database Syst Rev.* 2010;(5): p.CD005074.

(128) Kruis AL, Smidt N, ssendelft-Willem JJ, Gussekloo J, Boland-Melinde RS, Rutten-van MM, et al. Integrated disease management interventions for patients with chronic obstructive pulmonary disease. *Cochrane Database of Systematic Reviews.* 2013;

(129) Dickens C, Katon W, Blakemore A, Khara A, Tomenson B, Woodcock A, et al. Complex interventions that reduce urgent care use in COPD: A systematic review with meta-regression. *Respir Med.* 2014; 108(3): pp.426-37.

(130) Jordan RE, Majothi S, Heneghan NR, Blissett DB, Riley RD, Sitch AJ, et al. Supported self-management for patients with moderate to severe chronic obstructive pulmonary disease (COPD): an evidence synthesis and economic analysis. *Health Technol Assess.* 2015; 19(36): pp.1-516.

(131) Zwerink M, Brusse KM, -van-der-Valk-Paul-DLPM, Zielhuis GA, Monninkhof EM, van-der PJ, et al. Self management for patients with chronic obstructive pulmonary disease. *Cochrane Database of Systematic Reviews.* 2014;

(132) Harrison SL, Janaudis-Ferreira T, Brooks D, Desveaux L, Goldstein RS. Self-management following an acute exacerbation of COPD: a systematic review. *Chest.* 2015; 147(3): pp.646-61.

(133) Cruz J, Brooks D, Marques A. Home telemonitoring effectiveness in COPD: A systematic review. *Int J Clin Pract.* 2014; 68(3): pp.369-78.

(134) Kamei T, Yamamoto Y, Kajii F, Nakayama Y, Kawakami C. Systematic review and meta-analysis of studies involving telehome monitoring-based telenursing for patients with chronic obstructive pulmonary disease. *Jpn J Nurs Sci.* 2013; 10(2): pp.180-92.

(135) Lundell S, Holmner A, Rehn B, Nyberg A, Wadell K. Telehealthcare for patients with COPD, effects on physical activity level, physical capacity and dyspnea: A systematic review and meta-analysis. *Eur Respir J.* 2014; 44

(136) McLean S, Nurmatov U, Liu JL, Pagliari C, Car J, Sheikh A. Telehealthcare for chronic obstructive pulmonary disease. *Cochrane Database Syst Rev.* 2011;(7): p.CD007718.

(137) McCarthy B, Casey D, Devane D, Murphy K, Murphy E, Lacasse Y. Pulmonary rehabilitation for chronic obstructive pulmonary disease. *Cochrane Database Syst Rev.* 2015; 2 p.CD003793.

(138) Bentsen SB, Langeland E, Holm AL. Evaluation of self-management interventions for chronic obstructive pulmonary disease. *J Nurs Manage.* 2012; 20(6): pp.802-13.

(139) Effing TW, Monninkhof EM, Van D, V, Zielhuis GA, Van Herwaarden CLA, Partridge MR, et al. Self-management education for patients with chronic obstructive pulmonary disease. *Cochrane Database of Systematic Reviews.* 2007;(4):

(140) Tan J-Y, Chen J-X, Liu X-L, Zhang Q, Zhang M, Mei L-J, et al. A Meta-Analysis on the Impact of Disease-Specific Education Programs on Health Outcomes for Patients with Chronic Obstructive Pulmonary Disease. *Geriatr Nurs.* 2012; 33(4): pp.280-96.

(141) Turnock AC, Walters EH, Walters JA, Wood-Baker R. Action plans for chronic obstructive pulmonary disease. *Cochrane database of systematic reviews (Online).* 2005;(4): p.CD005074.

(142) Wong CX, Carson KV, Smith BJ. Home care by outreach nursing for chronic obstructive pulmonary disease. *Cochrane Database Syst Rev.* 2012; 4 p.CD000994.

(143) Wong CX, Carson KV, Smith BJ. Home care by outreach nursing for chronic obstructive pulmonary disease. *Cochrane Database Syst Rev.* 2011; 4 p.CD000994.

(144) Bakerly ND, Davies C, Dyer M, Dhillon P. Cost analysis of an integrated care model in the management of acute exacerbations of chronic obstructive pulmonary disease. *Chronic Respiratory Disease.* 2009; 6(4): pp.201-8.

(145) Bourbeau J, Collet JP, Schwartzman K, Ducruet T, Nault D, Bradley C. Economic benefits of self-management education in COPD. *Chest.* 2006; 130(6): pp.1704-11.

(146) Cecins N., Eelhoead E., Enkins S.C. Reduction in hospitalisation following pulmonary rehabilitation in patients with COPD. *Australian Health Review.* 2008; 32 pp. 415-22.

(147) Chandra K, Blackhouse G, Mccurdy BR, Bornstein M, Campbell K, Costa V, et al. Cost-effectiveness of interventions for chronic obstructive pulmonary disease (COPD) using an ontario policy model. *Ontario Health Technology Assessment Series.* 2012; 12(12): pp.1-61.

(148) Chuang C, Levine SH, Rich J. Enhancing cost-effective care with a patient-centric coronary obstructive pulmonary disease program. *Population Health Management.* 2011; 14(3): pp.133-6.

(149) De San MK, Smith J, Lewin G. Telehealth remote monitoring for community-dwelling older adults with chronic obstructive pulmonary disease. *Telemedicine journal and e-health.* 2013; 19(9): pp.652-7.

(150) Dewan NA, Rice KL, Caldwell M, Hilleman DE. Economic Evaluation of a Disease Management Program for Chronic Obstructive Pulmonary Disease. *COPD: Journal of Chronic Obstructive Pulmonary Disease.* 2011; 8(3): pp.153-9.

(151) Farrero E, Escarrabill J, Prats E, Maderal M, Manresa F. Impact of a hospital-based home-care program on the management of COPD patients receiving long-term oxygen therapy. *Chest.* 2001; 119(2): pp.364-9.

(152) Gallefoss F. The effects of patient education in COPD in a 1-year follow-up randomised, controlled trial. *Patient Education and Counseling.* 2004; 52(3): pp.259-66.

(153) Gillespie P, O'Shea E, Casey D, Murphy K, Devane D, Cooney A, et al. The cost-effectiveness of a structured education pulmonary rehabilitation programme for chronic obstructive pulmonary disease in primary care: The. *BMJ Open.* 2013; 3(11 Article Number):

(154) Golmohammadi K, Jacobs P, Sin DD. Economic evaluation of a community-based pulmonary rehabilitation program for chronic obstructive pulmonary disease. *Lung.* 2004; 182(3): pp.187-96.

(155) Griffiths TL, Phillips CJ, Davies S, Burr ML, Campbell IA. Cost effectiveness of an outpatient multidisciplinary pulmonary rehabilitation programme. *Thorax.* 2001; 56(10): pp.779-84.

(156) Haesum LK, Soerensen N, Dinesen B, Nielsen C, Grann O, Hejlesen O, et al. Cost-utility analysis of a telerehabilitation program: a case study of COPD patients. *Telemed J E Health.* 2012; 18(9): pp.688-92.

(157) Hernandez C, Casas A, Escarrabill J, Alonso J, Puig-Junoy J, Farrero E, et al. Home hospitalisation of exacerbated chronic obstructive pulmonary disease patients. *Eur Respir J.* 2003; 21(1): pp.58-67.

(158) Hoogendoorn M, Van Wetering CR, Schols AM, Rutten-Van Molken MPMH. Is INTERdisciplinary COMmunity-based COPD management (INTERCOM) cost-effective? *Eur Respir J.* 2010; 35(1): pp.79-87.

(159) Jodar-Sanchez F, Ortega F, Parra C, Gomez-Suarez C, Bonachela P, Leal S, et al. Cost-utility analysis of a telehealth programme for patients with severe chronic obstructive pulmonary disease treated with long-term oxygen therapy. *J Telemed Telecare.* 2014; 20(6): pp.307-16.

(160) Khdour MR, Agus AM, Kidney JC, Smyth BM, Elnay JC, Crealey GE. Cost-utility analysis of a pharmacy-led self-management programme for patients with COPD. *International Journal of Clinical Pharmacy.* 2011; 33(4): pp.665-73.

(161) Liu SX, Lee MC, Atakhorrami M, Tatousek J, McCormack M, Yung R, et al. Economic assessment of home-based COPD management programs. *COPD.* 2013; 10(6): pp.640-9.

(162) Monninkhof E, Van D, V, Schermer T, van der Palen J, van HC, Zielhuis G. Economic evaluation of a comprehensive self-management programme in patients with moderate to severe chronic obstructive pulmonary disease. *Chronic Respiratory Disease.* 2004; 1(1): pp.7-16.

(163) Pare G, Poba-Nzaou P, Sicotte C, Beaupre A, Lefrancois E, Nault D, et al. Comparing the costs of home telemonitoring and usual care of chronic obstructive pulmonary disease patients: A randomized controlled trial. *European Research in Telemedicine.* 2013; 2(2): pp.35-47.

(164) Stoddart A, van der Pol M, Pinnock H, Hanley J, McCloughan L, Todd A, et al. Telemonitoring for chronic obstructive pulmonary disease: a cost and cost-utility analysis of a randomised controlled trial. *J Telemed Telecare.* 2015; 21(2): pp.108-18.

(165) Taylor SJ, Sohanpal R, Bremner SA, Devine A, McDaid D, Fernandez JL, et al. Self-management support for moderate-to-severe chronic obstructive pulmonary disease: a pilot randomised controlled trial. *Br J Gen Pract.* 2012; 62(603): p.e687-e695.

(166) Tinkelman D, Corsello P, McClure D, Yin M. One-year outcomes from a disease management program for chronic obstructive pulmonary disease (Structured abstract). *Disease Management and Health Outcomes.* 2003; 11 pp.49-59.

(167) Van Boven JF, Tommelein E, Boussery K, Mehuys E, Vegter S, Brusselle GG, et al. Cost-effectiveness analysis of a pharmacist-led intervention on improving inhaler adherence in patients with chronic obstructive pulmonary disease. *Value in Health.* 2014; 17(3): p.A136.

(168) Vitacca M, Bianchi L, Guerra A, Fracchia C, Spanevello A, Balbi B, et al. Tele-assistance in chronic respiratory failure patients: a randomised clinical trial. *Eur Respir J.* 2009; 33(2): pp.411-8.

(169) Health Service Executive. *Annual Report and Financial Statements 2013* [Online]. Available from: http://www.hse.ie/HSE-AnnualReport-2013/files/assets/basic-html/page1.html.

(170) WHO. *Diabetes Fact sheet N°312* [Online]. Available from: http://www.who.int/mediacentre/factsheets/fs312/en/.

(171) Malanda UL, Welschen LM, Riphagen II, Dekker JM, Nijpels G, Bot SD. Self-monitoring of blood glucose in patients with type 2 diabetes mellitus who are not using insulin. *Cochrane Database Syst Rev.* 2012; 1 p.CD005060.

(172) National Institute for Health and Care Excellence (NICE). *Type 2 Diabetes-Newer Agents (Partial Update of CG66).* London: NICE; 2009.

(173) Forde R, Dinneen S, Humphreys M, Carmody M, Clarke A, O'Leary K, et al. *Review of Diabetes Structured Education* [Online]. Available from: http://www.hse.ie/eng/services/Publications/topics/Diabetes/diabetesstructureded.pdf.

(174) Winkley K, Ismail K, Landau S, Eisler I. Psychological interventions to improve glycaemic control in patients with type 1 diabetes: systematic review and meta-analysis of randomised controlled trials. *BMJ.* 2006; 333(7558): p.65.

(175) NICE. *Type 1 diabetes in adults: diagnosis and management* [Online]. Available from: http://www.nice.org.uk/guidance/ng17/resources/type-1-diabetes-in-adults-diagnosis-and-management-1837276469701.

(176) Bolen SD, Chandar A, Falck-Ytter C, Tyler C, Perzynski AT, Gertz AM, et al. Effectiveness and safety of patient activation interventions for adults with type 2 diabetes: systematic review, meta-analysis, and meta-regression. *J Gen Intern Med.* 2014; 29(8): pp.1166-76.

(177) Cotter AP, Durant N, Agne AA, Cherrington AL. Internet interventions to support lifestyle modification for diabetes management: a systematic review of the evidence. *J Diabetes Complications.* 2014; 28(2): pp.243-51.

(178) Huang Z, Tao H, Meng Q, Jing L. Management of endocrine disease. Effects of telecare intervention on glycemic control in type 2 diabetes: a systematic review and meta-analysis of randomized controlled trials. *Eur J Endocrinol.* 2015; 172(3): pp.R93-101.

(179) Pal K, Eastwood S, V, Michie S, Farmer AJ, Barnard ML, Peacock R, et al. Computer-based diabetes self-management interventions for adults with type 2 diabetes mellitus. *Cochrane Database of Systematic Reviews.* 2013;

(180) Saffari M, Ghanizadeh G, Koenig HG. Health education via mobile text messaging for glycemic control in adults with type 2 diabetes: a systematic review and meta-analysis. *Prim Care Diabetes.* 2014; 8(4): pp.275-85.

(181) Zhai YK, Zhu WJ, Cai YL, Sun DX, Zhao J. Clinical- and cost-effectiveness of telemedicine in type 2 diabetes mellitus: a systematic review and meta-analysis. *Medicine (Baltimore).* 2014; 93(28): p.e312.

(182) Song D, Xu T-Z, Sun Q-H. Effect of motivational interviewing on selfmanagement in patients with type 2 diabetes mellitus: A meta-analysis. *Int J Nurs Sci.* 2014; 1(3): pp.291-7.

(183) Antoine SL, Pieper D, Mathes T, Eikermann M. Improving the adherence of type 2 diabetes mellitus patients with pharmacy care: a systematic review of randomized controlled trials. *BMC Endocr Disord.* 2014; 14 p.53.

(184) Schellenberg ES, Dryden DM, Vandermeer B, Ha C, Korownyk C. Lifestyle interventions for patients with and at risk for type 2 diabetes: a systematic review and meta-analysis. *Ann Intern Med.* 2013; 159(8): pp.543-51.

(185) Attridge M, Creamer J, Ramsden M, Cannings JR, Hawthorne K. Culturally appropriate health education for people in ethnic minority groups with type 2 diabetes mellitus. *Cochrane Database of Systematic Reviews.* 2014;

(186) Li T, Wu HM, Wang F, Huang CQ, Yang M, Dong BR, et al. Education programmes for people with diabetic kidney disease. *Cochrane Database Syst Rev.* 2011;(6): p.CD007374.

(187) Chodosh J, Morton SC, Mojica W, Maglione M, Suttorp MJ, Hilton L, et al. Meta-analysis: chronic disease self-management programs for older adults. *Ann Intern Med.* 2005; 143(6): pp.427-38.

(188) Dorresteijn JA, Kriegsman DM, Assendelft WJ, Valk GD. Patient education for preventing diabetic foot ulceration. *Cochrane Database Syst Rev.* 2014; 12 p.CD001488.

(189) Duke SA, Colagiuri S, Colagiuri R. Individual patient education for people with type 2 diabetes mellitus. *Cochrane Database Syst Rev.* 2009;(1): p.CD005268.

(190) Minet L, Moller S, Vach W, Wagner L, Henriksen JE. Mediating the effect of self-care management intervention in type 2 diabetes: a meta-analysis of 47 randomised controlled trials. *Patient Educ Couns.* 2010; 80(1): pp.29-41.

(191) Norris SL, Engelgau MM, Narayan KM. Effectiveness of self-management training in type 2 diabetes: a systematic review of randomized controlled trials. *Diabetes Care.* 2001; 24(3): pp.561-87.

(192) Norris SL, Lau J, Smith SJ, Schmid CH, Engelgau MM. Self-management education for adults with type 2 diabetes: a meta-analysis of the effect on glycemic control. *Diabetes Care.* 2002; 25(7): pp.1159-71.

(193) Sigurdardottir AK, Jonsdottir H, Benediktsson R. Outcomes of educational interventions in type 2 diabetes: WEKA data-mining analysis. *Patient Educ Couns.* 2007; 67(1-2): pp.21-31.

(194) Steinsbekk A, Rygg LO, Lisulo M, Rise MB, Fretheim A. Group based diabetes self-management education compared to routine treatment for people with type 2 diabetes mellitus. A systematic review with meta-analysis. *BMC Health Serv Res.* 2012; 12 p.213.

(195) Hawthorne K, Robles Y, Cannings-John R, Edwards AG. Culturally appropriate health education for type 2 diabetes mellitus in ethnic minority groups. *Cochrane Database Syst Rev.* 2008;(3): p.CD006424.

(196) Khunti K, Camosso-Stefinovic J, Carey M, Davies MJ, Stone MA. *Educational Interventions for Migrant South Asians with Type 2 Diabetes: A Systematic Review.* Leicester: Department of Health Sciences, University of Leicester; 2008.

(197) Nam S, Janson SL, Stotts NA, Chesla C, Kroon L. Effect of culturally tailored diabetes education in ethnic minorities with type 2 diabetes: a meta-analysis. *J Cardiovasc Nurs.* 2012; 27(6): pp.505-18.

(198) Perez-Escamilla R, Hromi-Fiedler A, Vega-Lopez S, Bermudez-Millan A, Segura-Perez S. Impact of peer nutrition education on dietary behaviors and health outcomes among Latinos: a systematic literature review. *J Nutr Educ Behav.* 2008; 40(4): pp.208-25.

(199) Gary TL, Genkinger JM, Guallar E, Peyrot M, Brancati FL. Meta-analysis of randomized educational and behavioral interventions in type 2 diabetes. *Diabetes Educ.* 2003; 29(3): pp.488-501.

(200) Heinrich E, Schaper NC, de Vries NK. Self-management interventions for type 2 diabetes: a systematic review. *Eur Diabet Nurs.* 2010; 7 pp.71-7.

(201) Newman S, Steed L, Mulligan K. Self-management interventions for chronic illness. *Lancet.* 2004; 364(9444): pp.1523-37.

(202) van Dam HA, van der Horst FG, Knoops L, Ryckman RM, Crebolder HF, van den Borne BH. Social support in diabetes: a systematic review of controlled intervention studies. *Patient Educ Couns.* 2005; 59(1): pp.1-12.

(203) Albisser AM, Harris RI, Albisser JB, Sperlich M. The impact of initiatives in education, self-management training, and computer-assisted self-care on outcomes in diabetes disease management. *Diabetes Technol Ther.* 2001; 3(4): pp.571-9.

(204) Banister NA, Jastrow ST, Hodges V, Loop R, Gillham MB. Diabetes self-management training program in a community clinic improves patient outcomes at modest cost. *J Am Diet Assoc.* 2004; 104(5): pp.807-10.

(205) Barnett TE, Chumbler NR, Vogel WB, Beyth RJ, Ryan P, Figueroa S. The cost-utility of a care coordination/home telehealth programme for veterans with diabetes. *Journal of Telemedicine and Telecare.* 2007; 13(6): pp.318-21.

(206) Biermann E, Dietrich W, Rihl J, Standl E. Are there time and cost savings by using telemanagement for patients on intensified insulin therapy? A randomised, controlled trial. *Comput Methods Programs Biomed.* 2002; 69(2): pp.137-46.

(207) Brown 3rd.H.S., Wilson KJ, Pagan JA, Arcari CM, Martinez M, Smith K, et al. Cost-effectiveness analysis of a community health worker intervention for low-income Hispanic adults with diabetes. *Preventing chronic disease.* 2012; 9 p.E140.

(208) Brownson CA, Hoerger TJ, Fisher EB, Kilpatrick KE. Cost-effectiveness of diabetes self-management programs in community primary care settings. *Diabetes Educator.* 2009; 35(5): pp.761-9.

(209) Dall TM, Roary M, Yang W, Zhang S, Chen YJ, Arday DR, et al. Health care use and costs for participants in a diabetes disease management program, United States, 2007-2008. *Preventing chronic disease.* 2011; 8(3): p.A53.

(210) Farmer AJ, Wade AN, French DP, Simon J, Yudkin P, Gray A, et al. Blood glucose self-monitoring in type 2 diabetes: a randomised controlled trial. *Health Technol Assess.* 2009; 13(15): pp.iii-xi, 1.

(211) Fedder DO, Chang RJ, Curry S, Nichols G. The effectiveness of a community health worker outreach program on healthcare utilization of West Baltimore City medicaid patients with diabetes, with or without hypertension. *Ethnicity and Disease.* 2003; 13(1): pp.22-7.

(212) Fera T, Bluml BM, Ellis WM. Diabetes Ten City Challenge: final economic and clinical results. *J Am Pharm Assoc (2003).* 2009; 49(3): pp.383-91.

(213) Fischer HH, Eisert SL, Everhart RM, Durfee MJ, Moore SL, Soria S, et al. Nurse-run, telephone-based outreach to improve lipids in people with diabetes. *American Journal of Managed Care.* 2012; 18(2): pp.77-84.

(214) Garrett DG, Bluml BM. Patient self-management program for diabetes: first-year clinical, humanistic, and economic outcomes. *J Am Pharm Assoc (2003).* 2005; 45(2): pp.130-7.

(215) Gillespie P, O'Shea E, Paul G, O'Dowd T, Smith SM. Cost effectiveness of peer support for type 2 diabetes. *International Journal of Technology Assessment in Health Care.* 2012; 28(1): pp.3-11.

(216) Gillespie P, O'Shea E, O'Hara MC, Dinneen SF. Cost effectiveness of group follow-up after structured education for type 1 diabetes: a cluster randomised controlled trial. *Trials.* 2014; 15 p.227.

(217) Gillett M, Dallosso HM, Dixon S, Brennan A, Carey ME, Campbell MJ, et al. Delivering the diabetes education and self management for ongoing and newly diagnosed (DESMOND) programme for people with newly diagnosed type 2 diabetes: cost effectiveness analysis. *BMJ.* 2010; 341 p.c4093.

(218) Gilmer TP, Philis-Tsimikas A, Walker C. Outcomes of project dulce: A culturally specific diabetes management program. *Annals of Pharmacotherapy.* 2005; 39(5): pp.817-22.

(219) Gilmer TP, Roze S, Valentine WJ, Emy-Albrecht K, Ray JA, Cobden D, et al. Cost-effectiveness of diabetes case management for low-income populations. *Health Serv Res.* 2007; 42(5): pp.1943-59.

(220) Gordon LG, Bird D, Oldenburg B, Friedman RH, Russell AW, Scuffham PA. A cost-effectiveness analysis of a telephone-linked care intervention for individuals with Type 2 diabetes. *Diabetes Res Clin Pract.* 2014; 104(1): pp.103-11.

(221) Handley MA, Shumway M, Schillinger D. Cost-effectiveness of automated telephone self-management support with nurse care management among patients with diabetes. *Annals of Family Medicine.* 2008; 6(6): pp.512-8.

(222) Ismail K, Maissi E, Thomas S, Chalder T, Schmidt U, Bartlett J, et al. A randomised controlled trial of cognitive behaviour therapy and motivational interviewing for people with Type 1 diabetes mellitus with persistent sub-optimal glycaemic control: a Diabetes and Psychological Therapies (ADaPT) study. *Health Technol Assess.* 2010; 14(22): p.1-iv.

(223) Jacobs-van der Bruggen MA, van Baal PH, Hoogenveen RT, Feenstra TL, Briggs AH, Lawson K, et al. Cost-effectiveness of lifestyle modification in diabetic patients. *Diabetes Care.* 2009; 32(8): pp.1453-8.

(224) Kesavadev J, Shankar A, Pillai PBS, Krishnan G, Jothydev S. Cost-effective use of telemedicine and self-monitoring of blood glucose via Diabetes Tele Management System (DTMS) to achieve target glycosylated hemoglobin values without serious symptomatic hypoglycemia in 1,000 subjects with type 2 diabetes mellitus - A retrospective study. *Diabetes Technology and Therapeutics.* 2012; 14(9): pp.772-6.

(225) Kruger J, Brennan A, Thokala P, Basarir H, Jacques R, Elliott J, et al. The cost-effectiveness of the Dose Adjustment for Normal Eating (DAFNE) structured education programme: an update using the Sheffield Type 1 Diabetes Policy Model. *Diabet Med.* 2013; 30(10): pp.1236-44.

(226) Kuo SS, Bryce CL, Zgibor JC, Wolf DL, Roberts MS, Smith KJ. Cost-effectiveness of implementing the chronic care model for diabetes care in a military population. *Journal of Diabetes Science and Technology.* 2011; 5(3): pp.501-13.

(227) Letassy NA, Armor BL, Britton M, Farmer K. Pharmacist-managed diabetes service in a family medicine practice improves patient outcomes. *Drug Benefit Trends.* 2003; 15(SUPPL. H): pp.21-32.

(228) Mason JM, Young RJ, New JP, Gibson JM, Long AF, Gambling T, et al. Economic analysis of a telemedicine intervention to improve glycemic control in patients with diabetes mellitus: Illustration of a novel analytic method. *Disease Management and Health Outcomes.* 2006; 14(6): pp.377-85.

(229) Molsted S, Tribler J, Poulsen PB, Snorgaard O. The effects and costs of a group-based education programme for self-management of patients with Type 2 diabetes. A community-based study. *Health education research.* 2012; 27(5): pp.804-13.

(230) Moreno L, Dale SB, Chen AY, Magee CA. Costs to Medicare of the Informatics for Diabetes Education and Telemedicine (IDEATel) home telemedicine demonstration: findings from an independent evaluation. *Diabetes Care.* 2009; 32(7): pp.1202-4.

(231) O'Reilly D, Hopkins R, Blackhouse G, Clarke P, Hux J, Tarride J-E, et al. Long-term cost-utility analysis of a multidisciplinary primary care diabetes management program in Ontario. *Canadian Journal of Diabetes.* 2007; 31(3): pp.205-14.

(232) Palmas W, Shea S, Starren J, Teresi JA, Ganz ML, Burton TM, et al. Medicare payments, healthcare service use, and telemedicine implementation costs in a randomized trial comparing telemedicine case management with usual care in medically underserved participants with diabetes mellitus (IDEATel). *J Am Med Inform Assoc.* 2010; 17(2): pp.196-202.

(233) Petkova VB, Petrova GI. Pilot project for education of patients with type 2 diabetes by pharmacists. *Acta Diabetologica.* 2006; 43(2): pp.37-42.

(234) Ritzwoller DP, Sukhanova AS, Glasgow RE, Strycker LA, King DK, Gaglio B, et al. Intervention costs and cost-effectiveness for a multiple-risk-factor diabetes self-management trial for Latinas: economic analysis of inverted exclamation markViva Bien! *Transl Behav Med.* 2011; 1(3): pp.427-35.

(235)   Salzsieder E, Augstein P. The Karlsburg Diabetes Management System: Translation from research to eHealth application. *Journal of Diabetes Science and Technology.* 2011; 5(1): pp.13-22.

(236)   Schechter CB, Cohen HW, Shmukler C, Walker EA. Intervention costs and cost-effectiveness of a successful telephonic intervention to promote diabetes control. *Diabetes Care.* 2012; 35(11): pp.2156-60.

(237)   Shearer A, Bagust A, Sanderson D, Heller S, Roberts S. Cost-effectiveness of flexible intensive insulin management to enable dietary freedom in people with Type 1 diabetes in the UK. *Diabet Med.* 2004; 21(5): pp.460-7.

(238)   Stock S, Drabik A, Buscher G, Graf C, Ullrich W, Gerber A, et al. German diabetes management programs improve quality of care and curb costs. *Health Aff (Millwood).* 2010; 29(12): pp.2197-205.

(239)   Trento M, Passera P, Bajardi M, Tomalino M, Grassi G, Borgo E, et al. Lifestyle intervention by group care prevents deterioration of Type II diabetes: a 4-year randomized controlled clinical trial. *Diabetologia.* 2002; 45(9): pp.1231-9.

(240)   Wiegand PN, Wertheimer AI. An economic evaluation of anticipated costs and savings of a behavior change intervention to enhance medication adherence. *Pharmacy Practice.* 2008; 6(2): pp.68-73.

(241)   Emdin CA, Rahimi K, Neal B, Callender T, Perkovic V, Patel A. Blood pressure lowering in type 2 diabetes: a systematic review and meta-analysis. *JAMA.* 2015; 313(6): pp.603-15.

(242)   NICE. *Type 2 diabetes. The management of type 2 diabetes* [Online]. Available from: https://www.nice.org.uk/guidance/cg87/resources/guidance-type-2-diabetes-pdf.

(243)   HSE. *National Clinical Programme for Diabetes* [Online]. Available from: http://www.hse.ie/diabetesprogramme/.

(244)   World Health Organisation (WHO). *Health Topics: Stroke, Cerebrovascular accident* [Online]. Available from: http://www.who.int/topics/cerebrovascular_accident/en/.

(245)   Health Service Executive. *Stroke* [Online]. Available from: http://www.hse.ie/portal/eng/health/az/S/Stroke/.

(246)   Wren MA, Gillespie P, Smith S, Kearns K, Parkins D, Crichton S, et al. *Towards Earlier Discharge, Better Outcomes, Lower Cost: Stroke Rehabilitation in Ireland. Report prepared for the Irish Heart Foundation by the ESRI and RCSI* [Online]. Available from: http://www.nai.ie/assets/79/7E2793B6-B3E9-3A2F-49CD5A03FEFAC2EC_document/BKMNEXT275.pdf.

(247)   Smith S, Horgan F, Sexton E, Wiley M. *Cost of Stroke in Ireland. Estimating the annual economic cost of stroke and transient ischaemic attack (TIA)* [Online]. Available from: https://www.irishheart.ie/media/pub/strokereports/cosi.pdf.

(248)   Layte R, Barry M, BEnnett K, Brick A, Morgenroth E, Normand C, et al. *Projecting the Impact of Demographic Change on the Demand for and Delivery of Healthcare in Ireland. ESRI.* Dublin: Economic and Social Research Institute; Report No.: 13. 2009.

(249) Lennon S, McKenna S, Jones F. Self-management programmes for people post stroke: a systematic review. *Clin Rehabil.* 2013; 27(10): pp.867-78.

(250) Zhang WW, Speare S, Churilov L, Thuy M, Donnan G, Bernhardt J. Stroke rehabilitation in China: a systematic review and meta-analysis. *Int J Stroke.* 2014; 9(4): pp.494-502.

(251) Laver KE, Schoene D, Crotty M, George S, Lannin NA, Sherrington C. Telerehabilitation services for stroke. *Cochrane Database Syst Rev.* 2013; 12 p.CD010255.

(252) Imam B, Jarus T. Virtual reality rehabilitation from social cognitive and motor learning theoretical perspectives in stroke population. *Rehabil Res Pract.* 2014; 2014 p.594540.

(253) Laver KE, George S, Thomas S, Deutsch JE, Crotty M. Virtual reality for stroke rehabilitation. *Cochrane Database Syst Rev.* 2015; 2 p.CD008349.

(254) Lohse KR, Hilderman CGE, Cheung KL, Tatla S, Van der Loos HFM. Virtual Reality Therapy for Adults Post-Stroke: A Systematic Review and Meta-Analysis Exploring Virtual Environments and Commercial Games in Therapy. *PLoS ONE.* 2014; 3(1): p.13.

(255) Rodrigues-Baroni JM, Nascimento LR, Ada L, Teixeira-Salmela LF. Walking training associated with virtual reality-based training increases walking speed of individuals with chronic stroke: systematic review with meta-analysis. *Braz J Phys Ther.* 2014; 18(6): pp.502-12.

(256) Lo SHS, Chang AM, Chau JPC, Gardner GE. Theory-based self-management programs for promoting recovery in community-dwelling stroke survivors: a systematic review. *JBI Database of Systematic Reviews & Implementation Reports.* 2013; 11(12): pp.157-215.

(257) Warner G, Packer T, Villeneuve M, Audulv A, Versnel J. A systematic review of the effectiveness of stroke self-management programs for improving function and participation outcomes: self-management programs for stroke survivors. *Disabil Rehabil.* 2015; pp.1-23.

(258) Forster A, Brown L, Smith J, House A, Knapp P, Wright JJ, et al. Information provision for stroke patients and their caregivers. *Cochrane Database Syst Rev.* 2012; 11 p.CD001919.

(259) Cheng HY, Chair SY, Chau JPC. The effectiveness of psychosocial interventions for stroke family caregivers and stroke survivors: A systematic review and meta-analysis. *Patient Education and Counseling.* 2014; 95(1): pp.30-44.

(260) Lennon O, Galvin R, Smith K, Doody C, Blake C. Lifestyle interventions for secondary disease prevention in stroke and transient ischaemic attack: a systematic review. *Eur J Prev Cardiol.* 2014; 21(8): pp.1026-39.

(261) Vallury KD, Jones M, Gray R. Do family-oriented interventions reduce poststroke depression? A systematic review and recommendations for practice. *Top Stroke Rehabil.* 2015; p.1074935715Z00000000061.

(262) Cheng D, Qu Z, Huang J, Xiao Y, Luo H, Wang J. Motivational interviewing for improving recovery after stroke. *Cochrane Database Syst Rev.* 2015; 6 p.CD011398.

(263) Dorstyn D, Roberts R, Kneebone I, Kennedy P, Lieu C. Systematic review of leisure therapy and its effectiveness in managing functional outcomes in stroke rehabilitation. *Top Stroke Rehabil.* 2014; 21(1): pp.40-51.

(264) Fens M, Vluggen T, van Haastregt JC, Verbunt JA, Beusmans GH, Van Heugten CM. Multidisciplinary care for stroke patients living in the community: a systematic review. *J Rehabil Med.* 2013; 45(4): pp.321-30.

(265) Aziz NA, Leonardi-Bee J, Phillips M, Gladman JR, Legg L, Walker MF. Therapy-based rehabilitation services for patients living at home more than one year after stroke. *Cochrane Database Syst Rev.* 2008;(2): p.CD005952.

(266) Hoffmann T, Bennett S, Koh CL, McKenna KT. Occupational therapy for cognitive impairment in stroke patients. *Cochrane Database Syst Rev.* 2010;(9): p.CD006430.

(267) Legg LA, Drummond AE, Langhorne P. Occupational therapy for patients with problems in activities of daily living after stroke. *Cochrane Database Syst Rev.* 2006;(4): p.CD003585.

(268) Outpatient Service Trialists. Therapy-based rehabilitation services for stroke patients at home. *Cochrane Database Syst Rev.* 2003;(1): p.CD002925.

(269) Poulin V, Korner-Bitensky N, Dawson DR, Bherer L. Efficacy of executive function interventions after stroke: a systematic review. *Top Stroke Rehabil.* 2012; 19(2): pp.158-71.

(270) Steultjens EM, Dekker J, Bouter LM, van de Nes JC, Cup EH, van den Ende CH. Occupational therapy for stroke patients: a systematic review. *Stroke.* 2003; 34(3): pp.676-87.

(271) Walker MF, Leonardi-Bee J, Bath P, Langhorne P, Dewey M, Corr S, et al. Individual patient data meta-analysis of randomized controlled trials of community occupational therapy for stroke patients. *Stroke.* 2004; 35(9): pp.2226-32.

(272) Korpershoek C, van der BJ, Hafsteinsdottir TB. Self-efficacy and its influence on recovery of patients with stroke: a systematic review. *J Adv Nurs.* 2011; 67(9): pp.1876-94.

(273) Smith J, Forster A, House A, Knapp P, Wright J, Young J. Information provision for stroke patients and their caregivers. *Cochrane Database Syst Rev.* 2008;(2): p.CD001919.

(274) Ellis G, Mant J, Langhorne P, Dennis M, Winner S. Stroke liaison workers for stroke patients and carers: an individual patient data meta-analysis. *Cochrane Database Syst Rev.* 2010;(5): p.CD005066.

(275) Lui MH, Ross FM, Thompson DR. Supporting family caregivers in stroke care: a review of the evidence for problem solving. *Stroke.* 2005; 36(11): pp.2514-22.

(276) Huijbregts MP, Myers AM, Streiner D, Teasell R. Implementation, process, and preliminary outcome evaluation of two community programs for persons with stroke and their care partners (Provisional abstract). *Topics in stroke rehabilitation.* 2008; 15 pp.503-20.

(277) Harrington R, Taylor G, Hollinghurst S, Reed M, Kay H, Wood VA. A community-based exercise and education scheme for stroke survivors: a randomized controlled trial and economic evaluation. *Clin Rehabil.* 2010; 24(1): pp.3-15.

(278) Latimer NR, Dixon S, Palmer R. Cost-utility of self-managed computer therapy for people with aphasia. *Int J Technol Assess Health Care.* 2013; 29(4): pp.402-9.

(279) Llorens R, Noe E, Colomer C, Alcaniz M. Effectiveness, usability, and cost-benefit of a virtual reality-based telerehabilitation program for balance recovery after stroke: a randomized controlled trial (Provisional abstract). *Archives of Physical Medicine and Rehabilitation.* 2014; p.epub.

(280) Palmer R, Enderby P, Cooper C, Latimer N, Julious S, Paterson G, et al. Computer therapy compared with usual care for people with long-standing aphasia poststroke: a pilot randomized controlled trial. *Stroke.* 2012; 43(7): pp.1904-11.

(281) Fearon P, Langhorne P. Services for reducing duration of hospital care for acute stroke patients. *Cochrane Database Syst Rev.* 2012; 9 p.CD000443.

(282) Hackett ML, Pickles K. Part I: frequency of depression after stroke: an updated systematic review and meta-analysis of observational studies. *Int J Stroke.* 2014; 9(8): pp.1017-25.

(283) Ringelstein EB, Chamorro A, Kaste M, Langhorne P, Leys D, Lyrer P, et al. European Stroke Organisation recommendations to establish a stroke unit and stroke center. *Stroke.* 2013; 44(3): pp.828-40.

(284) Health Service Executive. *Draft Clinical Strategy and Programmes Division Rehabilitation Medicine Programme Model of Care For the Provision of Specialist Rehabilitation Services in Ireland* [Online]. Available from: http://www.hse.ie/eng/about/Who/clinical/natclinprog/rehabilitationmedicineprogramme/docsforconsultation/modelofcare.pdf.

(285) Department of Health. *National Policy and Strategy for the Provision of Neuro-Rehabilitation Services in Ireland 2011-2015* [Online]. Available from: http://health.gov.ie/wp-content/uploads/2014/03/NeuroRehab_Services1.pdf.

(286) Department of Health. *Changing Cardiovascular Health: National Cardiovascular Health Policy 2010 - 2019*. Dublin, Ireland: Department of Health (Ireland); 2010.

(287) Higgins JPT, Lane PW, Anagnostelis B, nzures-Cabrera J, Baker NF, Cappelleri JC, et al. A tool to assess the quality of a meta-analysis. *Res Syn Meth.* 2013; 4(4): pp.351-66.

(288) Dalal HM, Doherty P, Taylor RS. Cardiac rehabilitation. *BMJ.* 2015; 351

(289) BACPR. *The BACPR Standards and Core Components for Cardiovascular Disease Prevention and Rehabilitation, 2nd edition*. UK: The British Association for Cardiovascular Prevention and Rehabilitation; 2012.

(290) Ghisi GL, Abdallah F, Grace SL, Thomas S, Oh P. A systematic review of patient education in cardiac patients: do they increase knowledge and promote health behavior change? *Patient Educ Couns.* 2014; 95(2): pp.160-74.

(291) Brown JP, Clark AM, Dalal H, Welch K, Taylor RS. Effect of patient education in the management of coronary heart disease: a systematic review and meta-analysis of randomized controlled trials. *Eur J Prev Cardiol.* 2013; 20(4): pp.701-14.

(292) Brown JP, Clark AM, Dalal H, Welch K, Taylor RS. Patient education in the management of coronary heart disease. *Cochrane Database Syst Rev.* 2011;(12): p.CD008895.

(293) Barth J, Jacob T, Daha I, Critchley JA. Psychosocial interventions for smoking cessation in patients with coronary heart disease. *Cochrane Database Syst Rev.* 2015; 7 p.CD006886.

(294) McGillion M, O'Keefe-McCarthy S, Carroll SL, Victor JC, Cosman T, Cook A, et al. Impact of self-management interventions on stable angina symptoms and health-related quality of life: a meta-analysis. *BMC Cardiovasc Disord.* 2014; 14 p.14.

(295) Whalley B, Thompson DR, Taylor RS. Psychological interventions for coronary heart disease: cochrane systematic review and meta-analysis. *Int J Behav Med.* 2014; 21(1): pp.109-21.

(296) Heran BS, Chen JM, Ebrahim S, Moxham T, Oldridge N, Rees K, et al. Exercise-based cardiac rehabilitation for coronary heart disease. *Cochrane Database Syst Rev.* 2011;(7): p.CD001800.

(297) Lawler PR, Filion KB, Eisenberg MJ. Efficacy of exercise-based cardiac rehabilitation post-myocardial infarction: A systematic review and meta-analysis of randomized controlled trials. *Am Heart J.* 2011; 162(4): pp.571-84.

(298) Clark AM, Haykowsky M, Kryworuchko J, MacClure T, Scott J, DesMeules M, et al. A meta-analysis of randomized control trials of home-based secondary prevention programs for coronary artery disease. *Eur J Cardiovasc Prev Rehabil.* 2010; 17(3): pp.261-70.

(299) Taylor RS, Dalal H, Jolly K, Moxham T, Zawada A. Home-based versus centre-based cardiac rehabilitation. *Cochrane Database Syst Rev.* 2010;(1): p.CD007130.

(300) Huang K, Liu W, He D, Huang B, Xiao D, Peng Y, et al. Telehealth interventions versus center-based cardiac rehabilitation of coronary artery disease: A systematic review and meta-analysis. *Eur J Prev Cardiol.* 2015; 22(8): pp.959-71.

(301) Kotb A, Hsieh S, Wells GA. The effect of telephone support interventions on coronary artery disease (CAD) patient outcomes during cardiac rehabilitation: a systematic review and meta-analysis. *PLoS One.* 2014; 9(5): p.e96581.

(302) Neubeck L, Redfern J, Fernandez R, Briffa T, Bauman A, Freedman SB. Telehealth interventions for the secondary prevention of coronary heart disease: a systematic review. *Eur J Cardiovasc Prev Rehabil.* 2009; 16(3): pp.281-9.

(303) Cole JA, Smith SM, Hart N, Cupples ME. Systematic review of the effect of diet and exercise lifestyle interventions in the secondary prevention of coronary heart disease. *Cardiol Res Pract.* 2011; 1(1):

(304) Ballegaard S, Borg E, Karpatschof B, Nyboe J, Johannessen A. Long-term effects of integrated rehabilitation in patients with advanced angina pectoris: a nonrandomized comparative study. *J Altern Complement Med.* 2004; 10(5): pp.777-83.

(305) Barley EA, Walters P, Haddad M, Phillips R, Achilla E, McCrone P, et al. The UPBEAT nurse-delivered personalized care intervention for people with coronary heart disease who report current chest pain and depression: A randomised controlled pilot study. *PLoS One.* 2014; 9(6 Article Number):

(306) Berndt N, Bolman C, Lechner L, Max W, Mudde A, de VH, et al. Economic evaluation of a telephone- and face-to-face-delivered counseling intervention for smoking cessation in patients with coronary heart disease. *European Journal of Health Economics.* 2015; . Date of Publication(22 Mar 2015):

(307) Briffa TG, Eckermann SD, Griffiths AD, Harris PJ, Heath MR, Freedman SB, et al. Cost-effectiveness of rehabilitation after an acute coronary event: a randomised controlled trial. *Med J Aust.* 2005; 183(9): pp.450-5.

(308) Dendale P, Hansen D, Berger J, Lamotte M. Long-term cost-benefit ratio of cardiac rehabilitation after percutaneous coronary intervention. *Acta Cardiologica.* 2008; 63(4): pp.451-6.

(309) Furze G, Cox H, Morton V, Chuang LH, Lewin RJ, Nelson P, et al. Randomized controlled trial of a lay-facilitated angina management programme. *J Adv Nurs.* 2012; 68(10): pp.2267-79.

(310) Ito K, Shrank WH, Avorn J, Patrick AR, Brennan TA, Antman EM, et al. Comparative cost-effectiveness of interventions to improve medication adherence after myocardial infarction. *Health Serv Res.* 2012; 47(6): pp.2097-117.

(311) Jolly K, Taylor R, Lip GYH, Greenfield S, Raftery J, Mant J, et al. The Birmingham Rehabilitation Uptake Maximisation Study (BRUM). Home-based compared with hospital-based cardiac rehabilitation in a multi-ethnic population: Cost-effectiveness and patient adherence. *Health Technology Assessment.* 2007; 11(35): p.iii-93.

(312) Ladapo JA, Jaffer FA, Weinstein MC, Froelicher ES. Projected cost-effectiveness of smoking cessation interventions in patients hospitalized with myocardial infarction. *Archives of Internal Medicine.* 2011; 171(1): pp.39-45.

(313) Reid RD, Dafoe WA, Morrin L, Mayhew A, Papadakis S, Beaton L, et al. Impact of program duration and contact frequency on efficacy and cost of cardiac rehabilitation: results of a randomized trial. *Am Heart J.* 2005; 149(5): pp.862-8.

(314) Seidl H, Hunger M, Leidl R, Meisinger C, Wende R, Kuch B, et al. Cost-effectiveness of nurse-based case management versus usual care for elderly patients with myocardial infarction: results from the KORINNA study. *The European Journal of Health Economics.* 2014; . Date of Publication(10 Aug 2014):

(315) Taylor RS, Watt A, Dalal HM, Evans PH, Campbell JL, Read KL, et al. Home-based cardiac rehabilitation versus hospital-based rehabilitation: a cost effectiveness analysis. *Int J Cardiol.* 2007; 119(2): pp.196-201.

(316) Turkstra E, Hawkes AL, Oldenburg B, Scuffham PA. Cost-effectiveness of a coronary heart disease secondary prevention program in patients with myocardial infarction: Results from a randomised controlled trial (ProActive Heart). *BMC Cardiovascular Disorders.* 2013; 13 Article Number(33. Date of Publication):

(317) Raftery JP, Yao GL, Murchie P, Campbell NC, Ritchie LD. Cost effectiveness of nurse led secondary prevention clinics for coronary heart disease in primary care: follow up of a randomised controlled trial. *BMJ.* 2005; 330(7493): p.707.

(318) Buckley BS, Byrne MC, Smith SM. Service organisation for the secondary prevention of ischaemic heart disease in primary care. *Cochrane Database Syst Rev.* 2010;(3): p.CD006772.

(319) Anderson L, Taylor RS. Cardiac rehabilitation for people with heart disease: an overview of Cochrane systematic reviews. *Cochrane Database Syst Rev.* 2014; 12 p.CD011273.

(320) HSE, RCPI. *Acute Coronary Syndromes Programme Model of Care*. Dublin: Health Services Executive (HSE), Royal College of Physicians in Ireland (RCPI); 2012.

(321) IACR, IHF. *IACR and IHF Survey of Cardiac Rehabilitation Services*. Dublin: Irish Association of Cardiac Rehabilitation, Irish Heart Foundation; 2013.

(322) World Health Organisation (WHO). *High Blood Pressure Fact Sheet* [Online]. Available from: http://www.euro.who.int/__data/assets/pdf_file/0004/185917/Fact-sheet-World-Health-Day-2013-Eng-final.pdf?ua=1.

(323) Murphy CM, Kearney PM, Shelley EB, Fahey T, Dooley C, Kenny RA. Hypertension prevalence, awareness, treatment and control in the over 50s in Ireland: evidence from The Irish Longitudinal Study on Ageing. *J Public Health (Oxf).* 2015;

(324) Institute of Public Health. *Chronic conditions hub: Hypertension briefing* [Online]. Available from: http://www.publichealth.ie/sites/default/files/Hypertension%20Briefing%2015%20May%202012%20FINAL.pdf.

(325) Department of Health. *Changing Cardiovascular Health. National Cardiovascular Health Policy 2010-2019* [Online]. Available from: http://epubs.rcsi.ie/psycholrep/32/.

(326) NICE. *Hypertension. Clinical management of primary hypertension in adults. Clinical guideline 127*. UK: NICE; 2011.

(327) Mancia G, Fagard R, Narkiewicz K, Redon J, Zanchetti A, Bohm M, et al. 2013 ESH/ESC Practice Guidelines for the Management of Arterial Hypertension. *Blood Press.* 2014; 23(1): pp.3-16.

(328) HSE. *Stroke* [Online]. Available from: http://www.hse.ie/portal/eng/health/az/S/Stroke/.

(329) Kjeldsen SE, Aksnes TA, Ruilope LM. Clinical implications of the 2013 ESH/ESC hypertension guidelines: targets, choice of therapy, and blood pressure monitoring. *Drugs R D.* 2014; 14(2): pp.31-43.

(330) Gwadry-Sridhar FH, Manias E, Lal L, Salas M, Hughes DA, Ratzki-Leewing A, et al. Impact of interventions on medication adherence and blood pressure control in patients with essential hypertension: a systematic review by the ISPOR medication adherence and persistence special interest group. *Value Health.* 2013; 16(5): pp.863-71.

(331) Mennini FS, Marcellusi A, von der Schulenburg JM, Gray A, Levy P, Sciattella P, et al. Cost of poor adherence to anti-hypertensive therapy in five European countries. *Eur J Health Econ.* 2015; 16(1): pp.65-72.

(332) O'Brien E. *Single-pill combinations to improve blood pressure control. Irish Medical Times* [Online]. Available from: http://www.imt.ie/clinical/2014/08/single-pill-combinations-to-improve-blood-pressure-control.html.

(333) Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL, Jr., et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. *JAMA.* 2003; 289(19): pp.2560-72.

(334) Omboni S, Gazzola T, Carabelli G, Parati G. Clinical usefulness and cost effectiveness of home blood pressure telemonitoring: meta-analysis of randomized controlled studies. *J Hypertens.* 2013; 31(3): pp.455-67.

(335) Pickering TG, Miller NH, Ogedegbe G, Krakoff LR, Artinian NT, Goff D. Call to action on use and reimbursement for home blood pressure monitoring: Executive Summary. A joint scientific statement from the American Heart Association, American Society of Hypertension, and Preventive Cardiovascular Nurses Association. *J Clin Hypertens (Greenwich).* 2008; 10(6): pp.467-76.

(336) Saksena A. Computer-based education for patients with hypertension: a systematic review. *Health Educ J.* 2010; 69(236):

(337) Glynn LG, Murphy AW, Smith SM, Schroeder K, Fahey T. Interventions used to improve control of blood pressure in patients with hypertension. *Cochrane Database Syst Rev.* 2010;(3): p.CD005182.

(338) Fletcher BR, Hartmann-Boyce J, Hinton L, McManus RJ. The Effect of Self-Monitoring of Blood Pressure on Medication Adherence and Lifestyle Factors: A Systematic Review and Meta-Analysis. *Am J Hypertens.* 2015;

(339) Uhlig K, Patel K, Ip S, Kitsios GD, Balk EM. Self-measured blood pressure monitoring in the management of hypertension: a systematic review and meta-analysis. *Ann Intern Med.* 2013; 159(3): pp.185-94.

(340) Cheema E, Sutcliffe P, Singer DR. The impact of interventions by pharmacists in community pharmacies on control of hypertension: a systematic review and meta-analysis of randomized controlled trials. *Br J Clin Pharmacol.* 2014; 78(6): pp.1238-47.

(341) Xu LJ, Meng Q, He SW, Yin XL, Tang ZL, Bo HY, et al. The effects of health education on patients with hypertension in China: a meta-analysis. *Health Education Journal.* 2014; 73 pp.137-49.

(342) Chandak A, Joshi A. Self-management of hypertension using technology enabled interventions in primary care settings. *Technol Health Care.* 2015; 23(2): pp.119-28.

(343) Ebrahim S. Detection, adherence and control of hypertension for the prevention of stroke: a systematic review. *Health Technol Assess.* 1998; 2(11): p.i-78.

(344) Ogedegbe G, Schoenthaler A. A systematic review of the effects of home blood pressure monitoring on medication adherence. *J Clin Hypertens (Greenwich).* 2006; 8(3): pp.174-80.

(345) Verberk WJ, Kessels AG, Thien T. Telecare is a valuable tool for hypertension management, a systematic review and meta-analysis. *Blood Press Monit.* 2011; 16(3): pp.149-55.

(346) Bosch-Capblanch X, Abba K, Prictor M, Garner P. Contracts between patients and healthcare practitioners for improving patients' adherence to treatment, prevention and health promotion activities. *Cochrane Database Syst Rev.* 2007;(2): p.CD004808.

(347) Dickinson HO, Mason JM, Nicolson DJ, Campbell F, Beyer FR, Cook JV, et al. Lifestyle interventions to reduce raised blood pressure: a systematic review of randomized controlled trials. *J Hypertens.* 2006; 24(2): pp.215-33.

(348) Schroeder K, Fahey T, Ebrahim S. Interventions for improving adherence to treatment in patients with high blood pressure in ambulatory settings. *Cochrane Database Syst Rev.* 2004;(2): p.CD004804.

(349) Takiya LN, Peterson AM, Finley RS. Meta-analysis of interventions for medication adherence to antihypertensives. *Ann Pharmacother.* 2004; 38(10): pp.1617-24.

(350) European Medicines Agency. *Guideline on clinical investigation of medicinal products in the treatment of hypertension*. London: 2010.

(351) Calvo-Vargas C, Padilla R, V, Troyo-Sanroman R, Grover-Paez F. Reproducibility and cost of blood pressure self-measurement using the 'Loaned Self-measurement Equipment Model'. *Blood Press Monit.* 2001; 6(5): pp.225-32.

(352) Moore JO, Marshall MA, Judge DC, Moss FH, Gilroy SJ, Crocker JB, et al. Technology-supported apprenticeship in the management of hypertension: A randomized controlled trial. *Journal of Clinical Outcomes Management.* 2014; 21(3): pp.110-2.

(353) Arrieta A, Woods JR, Qiao N, Jay SJ. CostⒸôBenefit Analysis of Home Blood Pressure Monitoring in Hypertension Diagnosis and Treatment: An Insurer Perspective. *Hypertension.* 2014;

(354) Datta SK, Oddone EZ, Olsen MK, Orr M, McCant F, Gentry P, et al. Economic analysis of a tailored behavioral intervention to improve blood pressure control for primary care patients. *Am Heart J.* 2010; 160(2): pp.257-63.

(355) Fishman PA, Cook AJ, Anderson ML, Ralston JD, Catz SL, Carrell D, et al. Improving BP control through electronic communications: an economic evaluation (Provisional abstract). *American Journal of Managed Care.* 2013; 19 pp.709-16.

(356) Kaambwa B, Bryan S, Jowett S, Mant J, Bray EP, Hobbs FD, et al. Telemonitoring and self-management in the control of hypertension (TASMINH2): a cost-effectiveness analysis. *Eur J Prev Cardiol.* 2014; 21(12): pp.1517-30.

(357) Maciejewski ML, Bosworth HB, Olsen MK, Smith VA, Edelman D, Powers BJ, et al. Do the Benefits of Participation in a Hypertension Self-Management Trial Persist after Patients Resume Usual Care? *Circulation.* 2014; 7(2): pp.269-75.

(358) Madsen LB, Christiansen T, Kirkegaard P, Pedersen EB. Economic evaluation of home blood pressure telemonitoring: A randomized controlled trial. *Blood Pressure.* 2011; 20(2): pp.117-25.

(359) McManus RJ, Mant J, Roalfe A, Oakes RA, Bryan S, Pattison HM, et al. Targets and self monitoring in hypertension: randomised controlled trial and cost effectiveness analysis. *BMJ.* 2005; 331(7515): p.493.

(360) Parati G, Omboni S, Albini F, Piantoni L, Giuliano A, Revera M, et al. Home blood pressure telemonitoring improves hypertension control in general practice. the TeleBPCare study. *Journal of Hypertension.* 2009; 27(1): pp.198-203.

(361) Perman G, Rossi E, Waisman GD, Aguero C, Gonzalez CD, Pallordet CL, et al. Cost-effectiveness of a hypertension management programme in an elderly population: a Markov model (Structured abstract). *Cost Effectiveness and Resource Allocation.* 2011; 9:4

(362) Reed SD, Li Y, Oddone EZ, Neary AM, Orr MM, Grubber JM, et al. Economic evaluation of home blood pressure monitoring with or without telephonic behavioral self-management in patients with hypertension. *American Journal of Hypertension.* 2010; 23(2): pp.142-8.

(363) Staessen JA, Hond E, Celis H, Fagard R, Keary L, Vandenhoven G, et al. Antihypertensive treatment based on blood pressure measurement at home or in the physician's office: a randomized controlled trial (Structured abstract). *JAMA.* 2004; 291 pp.955-64.

(364) Stoddart A, Hanley J, Wild S, Pagliari C, Paterson M, Lewis S, et al. Telemonitoring-based service redesign for the management of uncontrolled hypertension (HITS): cost and cost-effectiveness analysis of a randomised controlled trial. *BMJ Open.* 2013; 3(5):

(365) Trogdon JG, Larsen B, Larsen D, Salas W, Snell M. Cost-effectiveness evaluation of a collaborative patient education hypertension intervention in Utah. *J Clin Hypertens (Greenwich).* 2012; 14(11): pp.760-6.

(366) Verberk WJ, Kroon AA, Lenders JW, Kessels AG, Montfrans GA, Smit AJ, et al. Self-measurement of blood pressure at home reduces the need for antihypertensive drugs: a randomized, controlled trial (Provisional abstract). *Hypertension.* 2007; 50 pp.1019-25.

(367) Barron S, Balanda K, Hughes J, Fahy L. National and subnational hypertension prevalence estimates for the Republic of Ireland: better outcome and risk factor data are needed to produce better prevalence estimates. *BMC Public Health.* 2014; 14 p.24.

(368) Murphy CM, Kearney PM, Shelley EB, Fahey T, Dooley C, Kenny RA. Hypertension prevalence, awareness, treatment and control in the over 50s in Ireland: evidence from The Irish Longitudinal Study on Ageing. *J Public Health (Oxf).* 2015;

(369) Dasgupta K, Quinn RR, Zarnke KB, Rabi DM, Ravani P, Daskalopoulou SS, et al. The 2014 Canadian Hypertension Education Program recommendations for blood pressure measurement, diagnosis, assessment of risk, prevention, and treatment of hypertension. *Can J Cardiol.* 2014; 30(5): pp.485-501.

(370) Milot JP, Birnbaum L, Larochelle P, Wistaff R, Laskine M, Van NP, et al. Unreliability of home blood pressure measurement and the effect of a patient-oriented intervention. *Can J Cardiol.* 2015; 31(5): pp.658-63.

(371) Cowie MR, Zaphiriou A. Management of chronic heart failure. *BMJ.* 2002; 325(7361): pp.422-5.

(372) Barrett A, Savva G, Timonen V, Kenny RA, (editors). *Fifty Plus in Ireland 2011: First results from the Irish Longitudinal Study on Ageing (TILDA)*. Dublin: TILDA; 2015.

(373) James S, Barton D, O'Connell E, Voon V, Murtagh G, Watson C, et al. Life expectancy for community-based patients with heart failure from time of diagnosis. *International Journal of Cardiology.* 178 pp.268-74.

(374) Feltner C, Jones CD, Cene CW, Zheng ZJ, Sueta CA, Coker-Schwimmer EJ, et al. Transitional care interventions to prevent readmissions for persons with heart failure: a systematic review and meta-analysis. *Ann Intern Med.* 2014; 160(11): pp.774-84.

(375) Wakefield BJ, Boren SA, Groves PS, Conn VS. Heart failure care management programs: a review of study interventions and meta-analysis of outcomes. *J Cardiovasc Nurs.* 2013; 28(1): pp.8-19.

(376) Boyde M, Turner C, Thompson DR, Stewart S. Educational interventions for patients with heart failure: a systematic review of randomized controlled trials. *J Cardiovasc Nurs.* 2011; 26(4): p.E27-E35.

(377) Ditewig JB, Blok H, Havers J, van VH. Effectiveness of self-management interventions on mortality, hospital readmissions, chronic heart failure hospitalization rate and quality of life in patients with chronic heart failure: a systematic review. *Patient Educ Couns.* 2010; 78(3): pp.297-315.

(378) Boren SA, Wakefield BJ, Gunlock TL, Wakefield DS. Heart failure self-management education: a systematic review of the evidence. *Int J Evid Based Healthc.* 2009; 7(3): pp.159-68.

(379) Samartzis L, Dimopoulos S, Tziongourou M, Nanas S. Effect of psychosocial interventions on quality of life in patients with chronic heart failure: a meta-analysis of randomized controlled trials. *J Card Fail.* 2013; 19(2): pp.125-34.

(380) Barnason S, Zimmerman L, Young L. An integrative review of interventions promoting self-care of patients with heart failure. *J Clin Nurs.* 2012; 21(3-4): pp.448-75.

(381) Rajati F, Sadeghi M, Feizi A, Sharifirad G, Hasandokht T, Mostafavi F. Self-efficacy strategies to improve exercise in patients with heart failure: A systematic review. *ARYA Atheroscler.* 2014; 10(6): pp.319-33.

(382) Taylor RS, Sagar VA, Davies EJ, Briscoe S, Coats AJ, Dalal H, et al. Exercise-based rehabilitation for heart failure. *Cochrane Database Syst Rev.* 2014; 4 p.CD003331.

(383) Tierney S, Mamas M, Woods S, Rutter MK, Gibson M, Neyses L, et al. What strategies are effective for exercise adherence in heart failure? A systematic review of controlled studies. *Heart Fail Rev.* 2012; 17(1): pp.107-15.

(384) Hwang R, Marwick T. Efficacy of home-based exercise programmes for people with chronic heart failure: a meta-analysis. *Eur J Cardiovasc Prev Rehabil.* 2009; 16(5): pp.527-35.

(385) Gorthi J, Hunter CB, Mooss AN, Alla VM, Hilleman DE. Reducing heart failure hospital readmissions: A systematic review of disease management programs. *Cardiol Res.* 2014; 5(5): pp.126-38.

(386)   Kotb A, Cameron C, Hsieh S, Wells G. Comparative effectiveness of different forms of telemedicine for individuals with heart failure (HF): a systematic review and network meta-analysis. *PLoS One.* 2015; 10(2): p.e0118681.

(387)   Conway A, Inglis SC, Clark RA. Effective technologies for noninvasive remote monitoring in heart failure. *Telemed J E Health.* 2014; 20(6): pp.531-8.

(388)   Nakamura N, Koga T, Iseki H. A meta-analysis of remote patient monitoring for chronic heart failure patients. *Journal of Telemedicine and Telecare.* 2013;

(389)   Pandor A, Thokala P, Gomersall T, Baalbaki H, Stevens JW, Wang J, et al. Home telemonitoring or structured telephone support programmes after recent discharge in patients with heart failure: systematic review and economic evaluation. *Health Technol Assess.* 2013; 17(32): p.1-vi.

(390)   Giamouzis G, Mastrogiannis D, Koutrakis K, Karayannis G, Parisis C, Rountas C, et al. Telemonitoring in chronic heart failure: a systematic review. *Cardiol Res Pract.* 2012; 2012 p.410820.

(391)   Clarke M, Shah A, Sharma U. Systematic review of studies on telemonitoring of patients with congestive heart failure: a meta-analysis. *Journal of Telemedicine and Telecare.* 2011; 17(1): pp.7-14.

(392)   Inglis SC, Clark RA, McAlister FA, Ball J, Lewinter C, Cullington D, et al. Structured telephone support or telemonitoring programmes for patients with chronic heart failure. *Cochrane Database Syst Rev.* 2010;(8): p.CD007228.

(393)   Pare G, Moqadem K, Pineau G, St-Hilaire C. Clinical effects of home telemonitoring in the context of diabetes, asthma, heart failure and hypertension: a systematic review. *J Med Internet Res.* 2010; 12(2): p.e21.

(394)   Willey RM. Managing heart failure: a critical appraisal of the literature. *J Cardiovasc Nurs.* 2012; 27(5): pp.403-17.

(395)   Kitsiou S, Pare G, Jaana M. Effects of home telemonitoring interventions on patients with chronic heart failure: an overview of systematic reviews. *J Med Internet Res.* 2015; 17(3): p.e63.

(396)   Sousa C, Leite S, Lagido R, Ferreira L, Silva-Cardoso J, Maciel MJ. Telemonitoring in heart failure: a state-of-the-art review. *Rev Port Cardiol.* 2014; 33(4): pp.229-39.

(397)   Purcell R, McInnes S, Halcomb E. Telemonitoring can assist in managing cardiovascular disease in primary care: a systematic review of systematic reviews. *BMC Family Practice.* 2014; 15(1): p.43.

(398)   Gurne O, Conraads V, Missault L, Mullens W, Vachierys JL, Van MW, et al. A critical review on telemonitoring in heart failure. *Acta Cardiol.* 2012; 67(4): pp.439-44.

(399)   National Heart Failure Clinical Care Programme. *Heart Failure Model of Care*. Dublin: Clinical Strategy and Programmes Directorate, HSE; 2012.

(400)   IACR, IHF. *IACR and IHF Survey of Cardiac Rehabilitation Services 4290*. Dublin: Irish Association of Cardiac Rehabilitation, Irish Heart Foundation; 2013.

(401)   Schadewaldt V, Schultz T. Nurse-led clinics as an effective service for cardiac patients: results from a systematic review. *Int J Evid Based Healthc.* 2011; 9(3): pp.199-214.

(402)   Marchionni N, Fattirolli F, Fumagalli S, Oldridge N, Del Lungo F, Morosi L, et al. Improved Exercise Tolerance and Quality of Life With Cardiac Rehabilitation of Older Patients After Myocardial Infarction: Results of a Randomized, Controlled Trial. *Circulation.* 2003; 107(17): pp.2201-6.

(403)   Agren S, Evangelista LS, Davidson T, Stromberg A. Cost-effectiveness of a nurse-led education and psychosocial programme for patients with chronic heart failure and their partners. *Journal of Clinical Nursing.* 2013; 22(15-16): pp.2347-53.

(404)   Aguado O, Morcillo C, Delas J, Rennie M, Bechich S, Schembari A, et al. Long-term implications of a single home-based educational intervention in patients with heart failure. *Heart Lung.* 2010; 39(6 Suppl): p.S14-S22.

(405)   Koelling TM, Johnson ML, Cody RJ, Aaronson KD. Discharge education improves clinical outcomes in patients with chronic heart failure. *Circulation.* 2005; 111(2): pp.179-85.

(406)   Krumholz HM, Amatruda J, Smith GL, Mattera JA, Roumanis SA, Radford MJ, et al. Randomized trial of an education and support intervention to prevent readmission of patients with heart failure
1953. *J Am Coll Cardiol.* 2002; 39(1): pp.83-9.

(407)   Lopez CC, Falces SC, Cubi QD, Arnau BA, Ylla BM, Muro PN, et al. Randomized clinical trial of a postdischarge pharmaceutical care program vs regular follow-up in patients with heart failure
1296. *Farm Hosp.* 2006; 30(6): pp.328-42.

(408)   Morcillo C, Valderas JM, Aguado O, Delas J, Sort D, Pujadas R, et al. Evaluation of a home-based intervention in heart failure patients. Results of a randomized study. *Rev Esp Cardiol.* 2005; 58(6): pp.618-25.

(409)   Riegel B, Carlson B. Is individual peer support a promising intervention for persons with heart failure? *J Cardiovasc Nurs.* 2004; 19(3): pp.174-83.

(410)   Berg GD, Wadhwa S, Johnson AE. A matched-cohort study of health services utilization and financial outcomes for a heart failure disease-management program in elderly patients
7957. *Journal of the American Geriatrics Society.* 2004; 52(10): pp.1655-61.

(411)   Boyne J, Van Asselt ADI, Gorgels APM, Steuten LMG, Kragten J, De Weerd GJ, et al. Cost-effectiveness analysis of telemonitoring versus usual care in patients with heart failure (the TEHAF-study)
3736. *European Heart Journal.* 2013; 34 SUPPL. 1 p.626.

(412)   Cui Y, Doupe M, Katz A, Nyhof P, Forget EL. Economic evaluation of Manitoba Health Lines in the management of congestive heart failure
137. *Healthc Policy.* 2013; 9(2): pp.36-50.

(413)   Dar O, Riley J, Chapman C, Dubrey SW, Morris S, Rosen SD, et al. A randomized trial of home telemonitoring in a typical elderly heart failure population in North West London: Results of the Home-HF study
6352. *European Journal of Heart Failure.* 2009; 11(3): pp.319-25.

(414) Dunagan WC, Littenberg B, Ewald GA, Jones CA, Emery VB, Waterman BM, et al. Randomized trial of a nurse-administered, telephone-based disease management program for patients with heart failure 1534. *J Card Fail.* 2005; 11(5): pp.358-65.

(415) Giordano A, Scalvini S, Zanelli E, Corra U, G.L.L., Ricci VA, et al. Multicenter randomised trial on home-based telemanagement to prevent hospital readmission of patients with chronic heart failure 6401. *International Journal of Cardiology.* 2009; 131(2): pp.192-9.

(416) Jerant AF, Azari R, Nesbitt TS. Reducing the cost of frequent hospital admissions for congestive heart failure: a randomized trial of a home telecare intervention 8783. *Medical Care.* 2001; 39(11): pp.1234-45.

(417) Klersy C, De SA, Gabutti G, Raisaro A, Curti M, Regoli F, et al. Economic impact of remote patient monitoring: An integrated economic model derived from a meta-analysis of randomized controlled trials in heart failure 5265. *European Journal of Heart Failure.* 2011; 13(4): pp.450-9.

(418) Riegel B, Carlson B, Kopp Z, LePetri B, Glaser D, Unger A. Effect of a standardized nurse case-management telephone intervention on resource use in patients with chronic heart failure 8684. *Archives of Internal Medicine.* 2002; 162(6): pp.705-12.

(419) Scalvini S, Capomolla S, Zanelli E, Benigno M, Domenighini D, Paletta L, et al. Effect of home-based telecardiology on chronic heart failure: Costs and outcomes 7536. *Journal of Telemedicine and Telecare.* 2005; 11(SUPPL. 1): pp.16-8.

(420) Sohn S, Helms TM, Pelleter JT, Muller A, Krottinger AI, Schoffski O. Costs and benefits of personalized healthcare for patients with chronic heart failure in the care and education program "Telemedicine for the Heart" 4661. *Telemedicine journal and e-health.* 2012; 18(3): pp.198-204.

(421) Soran OZ, Feldman AM, Pina IL, Lamas GA, Kelsey SF, Selzer F, et al. Cost of medical services in older patients with heart failure: Those receiving enhanced monitoring using a computer-based telephonic monitoring system compared with those in usual care: The heart failure home care trial 5517. *Journal of Cardiac Failure.* 2010; 16(11): pp.859-66.

(422) Wootton R, Gramotnev H, Hailey D. A randomized controlled trial of telephone-supported care coordination in patients with congestive heart failure 6244. *Journal of Telemedicine and Telecare.* 2009; 15(4): pp.182-6.

(423) Ledwidge M, Barry M, Cahill J, Ryan E, Maurer B, Ryder M, et al. Is multidisciplinary care of heart failure cost-beneficial when combined with optimal medical care? 8295. *European Journal of Heart Failure.* 2003; 5(3): pp.381-9.

(424) Kasper EK, Gerstenblith G, Hefter G, Van AE, Brinker JA, Thiemann DR, et al. A randomized trial of the efficacy of multidisciplinary care in heart failure outpatients at high risk of hospital readmission. *Journal of the American College of Cardiology.* 2002; 39(3): pp.471-80.

(425) Stewart S, Horowitz JD. Home-based intervention in congestive heart failure: long-term implications on readmission and survival. *Circulation.* 2002; 105(24): pp.2861-6.

(426) Chen Y-H, Ho Y-L, Huang H-C, Wu H-W, Lee C-Y, Hsu T-P, et al. Assessment of the clinical outcomes and cost-effectiveness of the management of systolic heart failure in Chinese patients using a home-based intervention 5824. *Journal of International Medical Research.* 2010; 38(1): pp.242-52.

(427) Discher CL, Klein D, Pierce L, Levine AB, Levine TB. Heart failure disease management: Impact on hospital care, length of stay, and reimbursement 8445. *Congestive Heart Failure.* 2003; 9(2): pp.77-83.

(428) Gregory D, Kimmelstiel C, Perry K, Parikh A, Konstam V, Konstam MA. Hospital cost effect of a heart failure disease management program: the Specialized Primary and Networked Care in Heart Failure (SPAN-CHF) trial 1385. *Am Heart J.* 2006; 151(5): pp.1013-8.

(429) Hebert PL, Sisk JE, Wang JJ, Tuzzio L, Casabianca JM, Chassin MR, et al. Cost-effectiveness of nurse-led disease management for heart failure in an ethnically diverse urban community 6509. *Annals of Internal Medicine.* 2008; 149(8): pp.540-8.

(430) Hendricks V, Schmidt S, Vogt A, Gysan D, Latz V, Schwang I, et al. Case management program for patients with chronic heart failure: effectiveness in terms of mortality, hospital admissions and costs. *Dtsch Arztebl Int.* 2014; 111(15): pp.264-70.

(431) Kwok T, Lee J, Woo J, Lee DT, Griffith S. A randomized controlled trial of a community nurse-supported hospital discharge programme in older patients with chronic heart failure. *J Clin Nurs.* 2008; 17(1): pp.109-17.

(432) Laramee AS, Levinsky SK, Sargent J, Ross R, Callas P. Case management in a heterogeneous congestive heart failure population: a randomized controlled trial. *Arch Intern Med.* 2003; 163(7): pp.809-17.

(433) Miller G, Randolph S, Forkner E, Smith B, Galbreath AD. Long-term cost-effectiveness of disease management in systolic heart failure. *Med Decis Making.* 2009; 29(3): pp.325-33.

(434) Naylor MD, Brooten DA, Campbell RL, Maislin G, McCauley KM, Schwartz JS. Transitional care of older adults hospitalized with heart failure: a randomized, controlled trial. *J Am Geriatr Soc.* 2004; 52(5): pp.675-84.

(435) Piepoli MF, Villani GQ, Aschieri D, Bennati S, Groppi F, Pisati MS, et al. Multidisciplinary and multisetting team management programme in heart failure patients affects hospitalisation and costing 1476. *Int J Cardiol.* 2006; 111(3): pp.377-85.

(436) Postmus D, Abdul Pari AA, Jaarsma T, Luttik ML, van Veldhuisen DJ, Hillege HL, et al. A trial-based economic evaluation of 2 nurse-led disease management programs in heart failure. *American Heart Journal.* 2011; 162(6): pp.1096-104.

(437) Roig E, Perez-Villa F, Cuppoletti A, Castillo M, Hernandez N, Morales M, et al. Specialized care program for end-stage heart failure patients. Initial experience in a heart failure unit. *Revista Espanola de Cardiologia.* 2006; 59(2): pp.109-16.

(438) Smith B, Hughes-Cromwick PF, Forkner E, Galbreath AD. Cost-effectiveness of telephonic disease management in heart failure. *American Journal of Managed Care.* 2008; 14(2): pp.106-15.

(439) Tsuyuki RT, Fradette M, Johnson JA, Bungard TJ, Eurich DT, Ashton T, et al. A multicenter disease management program for hospitalized patients with heart failure. *Journal of Cardiac Failure.* 2004; 10(6 SUPPL.): pp.473-80.

(440) Bruggink-Andre De La Porte, Lok DJA, van Veldhuisen DJ, Van WJ, Cornel JH, Zuirhoff NPA, et al. Added value of a physician-and-nurse-directed heart failure clinic: Results from the Deventer-Alkmaar heart failure study. *Heart.* 2007; 93(7): pp.819-25.

(441) Mejia A, Richardson G, Pattenden J, Cockayne S, Lewin R. Cost-effectiveness of a nurse facilitated, cognitive behavioural self-management programme compared with usual care using a CBT manual alone for patients with heart failure: secondary analysis of data from the SEMAPHFOR trial. *Int J Nurs Stud.* 2014; 51(9): pp.1214-20.

(442) Murray MD, Young J, Hoke S, Tu W, Weiner M, Morrow D, et al. Pharmacist intervention to improve medication adherence in heart failure: a randomized trial. *Ann Intern Med.* 2007; 146(10): pp.714-25.

(443) Stauffer BD, Fullerton C, Fleming N, Ogola G, Herrin J, Stafford PM, et al. Effectiveness and cost of a transitional care program for heart failure: a prospective study with concurrent controls. *Arch Intern Med.* 2011; 171(14): pp.1238-43.