

An evaluation of home and health care services, cost-effectiveness, and health-related quality of
life of older adult home care clients

by

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Abstract

Home care services can provide both health interventions and support with daily tasks to assist individuals to remain in the community. Within Canada, home care services are not federally regulated, leading to each province and territory offering a different milieu of support. Alberta's provincial health authority, Alberta Health Services (AHS), provides home care through specialized health care and non-regulated care services based on a client's identified needs. Challenges exist in identifying the optimal types and amounts of services as demand for care grows and home care, like other health care programs, must work within a budget. Current information is inadequate regarding factors affecting the Health-Related Quality of Life (HRQoL) of older home care clients, and cost-effective health interventions for this group. Navigating care provision through the COVID-19 pandemic has made service provision in this area even more complex. The aim of this dissertation was to investigate cost-effective interventions provided within home care and factors that impacted the HRQoL of this population, to thereby support clinical intervention selection and health policy development.

This dissertation includes five studies, starting with two systematic reviews addressing economic reporting of rehabilitation interventions and implementation of alternative home care programs. Three further observational retrospective exploratory evaluations assessed factors related to changes in home care clients' HRQoL, with one evaluation specifically addressing changes during COVID-19. These three studies used regular clinical practice data from AHS, and through a validated mapping process to estimate the Health Utility Index 3 scores, investigated longitudinal changes in client HRQoL outcomes.

This research provides evidence to support decision-making regarding the services of home care clients. Using the Consolidated Health Economic Evaluation Reporting Standards

guidelines, inconsistent reporting was identified in economic evaluations of rehabilitation services. Several interventions comparing new or alternative home care to standard home care were identified, but only a few such as preventative nursing and restorative care or reablement were found to be cost-effective. This research reports on factors associated with decreases in HRQoL for home care clients including additional diagnosis during the study period, being in an older age group, and more care time provided by clinical specialties and non-regulated staff. Larger decreases in the average HRQoL were found during COVID-19, compared to before the pandemic, with greater decreases in ambulation and cognition. Within the Edmonton zone, the majority of older adult home care clients were found to have a decrease in HRQoL irrespective of type of care activity or profession providing care.

Demonstration of the cost-effectiveness of home care services, including rehabilitation, within a budget-constrained environment, is required for the development of these programs. However, as there are low numbers of home care studies within Canada and inconsistent reporting of economic evaluations, additional research is required for the implementation of value-based interventions to support the well-being of home care clients. As large decreases were found in the health attributes of cognition and ambulation clients with decreases in these areas can be an ideal group to target for intervention. Educating health care providers regarding factors associated to decreased HRQoL outcomes such as clients with recent diagnosis, being in an older age group and higher levels of clinical specialty and non-regulated care time may support enhanced client care. Better knowledge from changes in HRQoL can build provider awareness for appropriately tailored interventions based on client need. This research highlights COVID-19 related challenges for the home care population and discusses the importance of healthcare professionals maintaining effective communication.

Further research is suggested for home care populations that are traditionally underrepresented, barriers to full reporting of economic information, and interventions that may be cost-effective for this context. Additional evaluation is also warranted regarding the usefulness of implementing an embedded Outcome Scale for HRQoL within the RAI-HC, to allow for care providers and policymakers to easily monitor client outcomes, subgroups of the home care population, and possibly the impact of moving to a higher level of care.

Preface

This thesis is an original work by Julie Flemming. The research project, of which this thesis is a part, received research ethics approval from the University of Alberta Research Ethics Board, Project Name “Health-Related Quality of Life Changes for Home Care Clients”, No. Pro00108790, July 16, 2021. Operational approval was also received from Alberta Health Services.

Chapter 2 of this thesis has been published as, “Julie Flemming, Dagmara Chojecki, Lisa Tjosvold, Mike Paulden & Susan Armijo-Olivo (2022). Quality of reporting of economic evaluations in rehabilitation research: a systematic review, *Disability and Rehabilitation*, 44:11, 2233-2240, DOI: 10.1080/09638288.2020.1830441.” Professor S. Armijo-Olivo and I completed concept/idea/research design and writing efforts. Professor M. Paulden provided feedback on the concept/idea/research design and feedback on the methodology for extracting data. D. Chojecki and L. Tjosvold performed literature searches. Professor S. Armijo-Olivo and I provided data collection efforts including data screening, data extraction, and assessing the quality of reporting using the CHEERS guidelines. Professor S. Armijo-Olivo completed the data analysis. All authors critically revised the manuscript and provided final approval of the version to be published.

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literature searches. P. Lapointe, D. Robertson, J. Wang, and I completed data collection including data screening. I completed data extraction and assessed the quality of reporting. Professor S. Armijo-Olivo and I completed the data analysis. All authors critically revised the manuscript and provided final approval of the version to be published.

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Glossary of Terms

ADL	Activities of Daily Living
AH	Alberta Health
AHS	Alberta Health Services
AHS	Alberta Health Services
ALC	Alternative Level of Care
ANCOVA	Analysis of Covariance
AQoL	Assessment of Quality of Life
CAD	Canadian Dollar
CHEERS	Consolidated Health Economic Evaluation Reporting Standards
CHEC	Consensus on Health Economic Criteria
CI	Comorbidity Index
CM	Case Manager
CONSORT	Consolidated Standards of Reporting Trials
COPD	Chronic Obstructive Pulmonary Disease
COPM- P	Canadian Occupational Performance Measure – Performance
COPM- S	Canadian Occupational Performance Measure – Satisfaction
COVID-19	Coronavirus disease
DE	Data Extraction
EPHPP	Effective Public Health Practice Project
EQ-5D	EuroQol-5 Dimensions
EQ-5D-3L	EuroQol-5 Dimensions 3 Levels
EQ-VAS	EuroQol-Visual Analogue Scale
ER	Emergency Room
HAQ	Health Assessment Questionnaire

HC	Home Care
HCA	Health Care Aid
HRQoL	Health-Related Quality of Life
HUI	Health Utility Index
HUI2	Health Utility Index Mark 2
HUI3	Health Utility Index Mark 3
IADL	Instrumental Activities of Daily Living
ICER	Incremental Cost-Effectiveness Ratio
ICUR	Incremental Cost-Utility Ratio
ISPOR	International Society for Pharmacoeconomics and Outcomes Research
LPN	Licensed Practical Nurse
LTC	Long-Term Care
LTCF	Long-Term Care Facility
NHP	Nottingham Health Profile
OT	Occupational Therapy
PDI	Pampalon Deprivation Index
POW	Production of Welfare
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PROSPERO	Prospective Register of Systematic Reviews
PT	Physical Therapy
QALY	Quality Adjusted Life Year
QHES	Quality of Health Economic Studies
RAI-HC	Resident Assessment Instrument – Home Care
RCT	Randomized Controlled Trials
RD	Registered Dietitian

RN	Registered Nurse
RoB	Risk of Bias
RPN	Registered Psychiatric Nurse
RRT	Registered Respiratory Therapist
SD	Standard Deviation
SF-36	36-Item Short Form Survey
SW	Social Work
USA	United States of America
US\$	United States Dollar
WHO	World Health Organization
€	Euro

Chapter 1: Introduction

Home Care (HC) is essential in supporting the health and well-being of individuals in the community. It provides support for individuals in the home or community setting which includes services such as health promotion, curative support, end-of-life care, maintenance, rehabilitation, and support for family caregivers [1]. Formal HC services may be provided through public or private funding to bolster existing informal care given by friends, family, and neighbors [2]. Although HC provides care to individuals of all ages [3], the client profile indicates that many clients receiving these services are older adults [4]. The health-related quality of life (HRQoL) of HC clients, including older adults, is affected by a continuously changing community-care milieu. One aspect of this is the expected shift in population demographics. Individuals aged 60 years and older are estimated to double to 2.1 billion by 2050 with all countries facing challenges in ensuring their health system is ready [5]. Further information is required to develop HC services for older adults in ways that can support their HRQoL.

To better understand how various factors impact the well-being of older adults accepting HC, the Production of Welfare (POW) framework has been used. The POW framework proposes intercorrelated resource and non-resource inputs, create intermediate outputs (e.g. services provided) and final outcomes (e.g. changed client welfare) [6]. This framework is relevant and has already been applied to an international HC study highlighting how personal, environmental and health service characteristics can impact client quality of life [7]. The larger context in which healthcare services are provided and whereby clients are impacted, was later recognized and addressed through the addition of the network (meso-level) and political (macro-level) context to the POW framework [8].

Following from the evolved POW framework [6-8], HRQoL of the HC population is impacted by numerous factors including client characteristics (non-resource inputs), budget, resource inputs, service outputs, network and political context. This suggests that to improve a clients HRQoL, current and comprehensive information is required on HC practices allowing for identification of opportunities available in the current context to enhance HC services.

Production of welfare factors impacting HC clients

Non-resource inputs can include staff attitudes, care environments, and client characteristics [6, 8]. While staff attitudes may vary, formal care providers have stated collaborative care in home for older persons with multimorbidity's can be complex and effected by feelings of trust and security [9]. HC settings can include the home, HC clinics, and/or alternate locations as required [10]. Canada's older adult population (65 years and older) is expected to grow from a current 6.2 million to 10.4 million by 2037, that is approximately 68% over 20 years [11]. Not only is the population of older adults increasing, but this group is also living with an increased rate of chronic disease and functional impairment [12]. For older adults, HC services have become vital in supporting individuals to 'age at home' [13, 14].

Accompanying the challenge of a growing older adult population is the increase in budget required to meet that need. A study commissioned by the Canadian Medical Association has estimated that with the aging population, over the next ten years the corresponding annual cost for older adult care is expected to grow from a cost of \$29.7 billion in 2019 to \$58.5 billion in 2031 [15]. Not only is there an increase in the number of older adults, but in high-income countries such as Canada, there is also a trend indicating elevated levels of health care utilization

with increasing age [16]. As HC does not have an unlimited budget, identifying the most cost-effective interventions and services will be essential to address the growing demand.

Resource inputs, such as paid staff, are identified to directly flow from budgets in the POW framework [6, 8]. Significant variation exists in the health professional services and lifestyle enhancements provided by Canadian HC [17], as this program does not fall under the federally coordinated services of the Canada Health Act [18]. Depending on region, HC can offer services from multiple interdisciplinary healthcare professions, such as registered nurses (RNs), licensed practical nurses (LPNs), social workers (SWs), occupational therapists (OTs), physical therapists (PTs), registered dietitians (RDs), registered respiratory therapists (RRTs), pharmacists, and non-regulated health care aides (HCAs).

Intermediate outcomes based on the POW framework includes production and delivery of service based on the mix of the non-resource and resource inputs and can contain a quality component regarding care provided [6, 8]. Within Canada, the provinces and territories are obliged to provide some HC through public funds although, there is no standard regarding the quantity or type [19]. The bulk (70-80%) of formal HC has been reported to be provided by non-regulated healthcare workers such as HCAs who are largely supporting activities of daily living (ADLs) such as bathing or dressing [19]. Recognizing the importance of service outcomes, Alberta Health Services (AHS) has embarked on a data acquisition strategy to improve population health, client experience of care and reduce per capita cost of care [20, 21]. In collaboration with AHS and Alberta Health a study completed by the Health Quality Council of Alberta used self-reported experience of HC clients and found 37% of professional services were rated as very good and 28% were rated as excellent [22].

Final outcomes, as per the POW framework, are changes in client well-being over time based on resource, non-resource and intermediate outputs [8]. Health outcomes can be measured through mortality and morbidity indicators [23] to support clinical practice and health service programming. A standardized and internationally supported health measure available for the HC population is the Resident Assessment Instrument – Home Care (RAI-HC) [24, 25]. Within Canada this measure is used regularly across nine provinces and a territory [26], evaluating community residing clients' health, function, needs, strengths and preferences [24].

With the increasing presence of chronic diseases and subsequent impact on quality of life, measures outside of mortality are required [27]. Around three decades ago frailty was introduced as a way of understanding the complexity in health status of older adults [28]. With ongoing debate to define this condition it has been understood as a decrease in function across multiple systems, an extreme result of the normal aging with increased vulnerability to stressors, and dynamic in nature [29]. Understanding the risk of poor outcomes based on deficit accumulation, beyond individual consideration of separate diagnosis, could provide useful clinical information [30]. Currently numerous frailty instruments are available, but more validation is required to demonstrate that these tools are assessing frailty as a biological entity, beyond multimorbidity, and can assist in clinical decision making [29].

Similar to this type of measure, there has been an increased recognition for the need to measure a person's healthy years or quality of life [25, 27]. One such method to do this is through assessing an individual's HRQoL which "refers to patient reports of functioning and well-being in physical, mental and social domains of life"[23]. HRQoL measures can monitor health status for a population, support economic evaluation, and development of health systems [27]. Measuring HRQoL is completed through either condition specific or generic measures.

Often generic HRQoL measures are selected as they are intended to represent the complete range of health outcomes [31] and can allow a person to be indexed on a continuum from deceased to full health [23]. Preference-based HRQoL measures provide cardinal measurement of individuals health status and individual scores can be added together, allowing further statistical analysis [27]. Comprehensive HRQoL evaluations are valuable as they can support identification of positive and negative impact of treatment and possible side effects of intervention [23].

Network context

The network context has been discussed as an “environment that cut[s] across and congeal[s] between organizational and sectoral boundaries” [8]. Current issues within the HC network context include the ongoing growth of healthcare providers guidelines and best practice. Clinical education and practice requirements, although not consistent across countries, can be highly regulated in some areas. Within Canada there are established education and registration requirements as per legislation for OTs, PTs, SWs, SLPs, RNs, LPNs, through provincial regulatory colleges [32], that enforce standards of practice and professional conduct to ensure maintenance of quality, safety, competence, and ethics in care. Even though staff are employed by different HC organizations which may provide different services, the network context for each of these registered professions ensures that the healthcare provider is completing care to their required standard and competency for their respective profession.

Extensive evidence exists suggesting rehabilitation services are an effective way to support clients within a broad range of health conditions in the community setting. Intervention from rehabilitation therapists support independence, aide individuals to remain active, assist with community integration, enhance health management, and support older adults remain safely in their homes [14]. More specifically, home-based rehabilitation is able to provide care

interventions for individuals who have experienced a stroke [33], have chronic health conditions such as dementia [34], COPD [35], cardiac issues [36] or have completed uncomplicated total knee arthroplasty [37]. Rehabilitation can be perceived as an investment through helping to avoid hospitalization, and reducing length of stay in hospital as well as enabling individuals to remain independent while minimizing the need for support [38]. Even though there is extensive knowledge surrounding positive impact of rehabilitation, it may be challenging for community-based clinicians, practice leaders, and health system developers to identify which interventions are most effective and efficient for their given situation.

Political context

The political context is reported to be more removed from health production than the network context and taking place in the political sphere [8]. The COVID-19 pandemic has resulted in political level involvement and affected numerous health care programs in recent years, including HC. Clusters of research exist regarding impact from the public health measures implemented to slow infection rates, especially around older adults. Public health measures were reported to impact Canadian adults' activity levels differently for those who were identified as physically active or inactive prior to the pandemic [39]. Challenges reported from Long Term Care note risks of prolonged visiting restrictions were starting to outweigh the risks of a potential COVID-19 infection through possible adverse events such as clients being unable to communicate basic needs (for those who cannot communicate independently), social isolation, and dying alone [40, 41]. It has been suggested these public health measures may augment challenges already experienced by older adults such as depression and loneliness [42, 43]. A rapid review of 135 studies evaluating impact of the pandemic on older adults who did not have a COVID-19 diagnosis notes that there is a "relative scarcity of research on vulnerable older

adult populations, such as those with dementia or Alzheimer disease, during the present pandemic” [44]. This suggests that further research for at risk older adults, such as the HC population, would be useful in addressing the current gap in knowledge.

The Alberta Context

As with other Canadian provinces and territories, healthcare is publicly funded in Alberta. The provincial ministry of health, Alberta Health, funds the provincial health authority, Alberta Health Services (AHS). AHS is a province wide fully integrated health system that delivers hospital, community, and long-term care [20]. The AHS Continuing Care program supports individuals with disability or advanced age for both health and personal care through three streams including HC, designated supportive living and long-term care facility living [45].

The philosophy of AHS HC states the focus “is in creating an environment where you are able to live at home independently for as long as possible” [46]. Similarly, Alberta’s provincial government 2022 budget highlights the importance of funding HC, along with Continuing Care, to ease pressure on acute care programs and support individuals to remain in their home for as long as possible [47]. Understanding the growing need to support people to remain in the community, the Alberta Ministry of Health Operating Expense for 2022-2023 budget has increased from previous years and is estimated to be 750 million dollars for HC [47].

Like many other areas, the demand for HC in Alberta is growing. In 2014-15 HC in Alberta was provided to 73,000 clients which grew to 83,000 as of 2018-19 [22]. This coincides with a survey finding 90% of responding Albertans agreed that they wanted “to live in my own home during my senior years” [48]. HC in Alberta provides both personal and health care services through an array of professions. AHS HC staff can include RNs, RPNs, LPNs, RDs,

SWs, RRTs, OTs, PTs, pharmacists, and recreation therapists. Some professions, in addition to providing direct care from within their scope of practice, also work as Case Managers (CMs). CM roles are to coordinate client services through regular assessment and interaction with the client's care team. To evaluate a client's health needs and functional status, the Resident Assessment Instrument – Home Care (RAI-HC) assessment is used. This measure not only collects information on a person's needs for care planning but, also tracks changes over time and “allows care providers, health authorities and the Ministry to monitor quality outcomes, ensure accountability, understand case mix, prioritize service allocation and support local and provincial planning and policy development” [49].

Methods

Measuring HRQoL for older adults has been noted as challenging for various reasons including a poor relationship between quality of life and disease severity, dynamic nature of self-perceived well-being, and phrasing that may inadvertently discriminate against older adults [50]. Further challenges exist when attempting to collect health and HRQoL information from the full range of HC clients. It has been reported that collecting information from the older adult age groups is difficult for several reasons including physical illness, differing cognitive abilities, and lack of “trust” in answering personal questions [25, 51, 52]. Furthermore, wide variability has been reported between clients and their proxies when completing HRQoL measures, with lower agreement for subjective questions [53].

Alternatively, a process called mapping can be used which takes information from a non-preference-based measure through an algorithm to predict outcomes for a preference-based HRQoL measure [54]. Recent research has developed a mapping process that allows information

collected from the regular HC practice of completing the RAI-HC, to estimate Health Utility Index 3 (HUI3) HRQoL outcomes [25]. This is possible as much of the information collected and scored in the RAI-HC overlaps with the HUI3 domains. This mapping process provides an opportunity to better understand client outcomes, changes over time and variation between regions, for older adults accepting HC services. In this thesis, data collected from AHS HC during regular clinical practice using the RAI-HC was mapped to the HUI3. Mapping in this manner provides the benefit of outcomes based on comprehensive data which allows for a more complete understanding of the heterogeneous HC population.

Study motivations and research questions

Canada is well established in transparency and accountability for its health systems performance, although complexities exist when measuring impact of care provided and health status over longer time frames, with multiple care providers, settings and interventions [55]. It has been noted that despite “significant advances in health information infrastructure over the last two decades, in most cases we lack the data or ability to link data that makes these trajectories visible” [55]. Therefore, further efforts are required to take the information that is already available within the healthcare system and use it to better understand client outcomes to support decision making for clients, clinicians, and policy creators.

As the Canadian Home Care Association states, to provide comprehensive care it is vital to support research and evidence-based decision making to best leverage the “range, location and mix of healthcare services outside of the hospital – in home care” [14]. With the current information available, further research is indicated to improve the understanding of HC interventions and their impact on clients and healthcare system use. Overall, the objective of this

research is to better discern how HC client well-being is impacted by various factors thereby supporting development of the HC program. A further goal is to generate knowledge regarding changes of HRQoL for the long-stay HC population before and during pandemic periods.

To support decision makers and health care providers in optimizing interventions for HC clients under budgetary constraints, the following research questions guided this research:

1. How well are economic evaluations reported within the field of rehabilitation?
2. What research is available regarding new or alternative forms of HC intervention compared to usual care with an accompanying economic evaluation?
3. What factors are associated to changes in HRQoL of older adult HC clients accessing services on a long-term basis?
4. How has the COVID-19 pandemic impacted the HRQoL of older adult HC clients accessing services on a long-term basis?
5. Within the HC program, are there specific professions, activity types or levels of care, associated to HRQoL?

A series of research topics were created to answer these questions.

Study approach and outline of dissertation

Chapter Two addressed question one, through a systematic review. Comprehensive information was collected to understand how well current economic evaluations reported necessary information of rehabilitation interventions. The Consolidated Health Economic Evaluation Reporting Standards (CHEERS) guidelines were used to evaluate reporting quality for journal articles that had been selected by two independent investigators. As numerous evaluations

included at least one study setting in the community or home (N =51), this information can be useful for health system decision makers and healthcare providers in HC to understand reports of economic evaluations within rehabilitation.

Chapter Three addressed question two, through a systematic review. This study completed a comprehensive search to identify new or enhanced HC programs with an accompanying economic evaluation. Identified studies were selected by two independent investigators and then used to create and report on categories of new or enhanced HC interventions with complementary economic evaluations. Information gained from this study can support health care decision makers in understanding new and alternative home care interventions and possible economic outcomes.

Chapter Four addresses question three, to clarify what factors are associated with changes in HRQoL of older adults accessing HC services on a long-term basis. This study implemented a retrospective exploratory method and data was collected from clients accepting HC services on a regular basis from two consecutive measures, 1) Baseline (March 1, 2018 to February 28, 2019) and 2) Follow-up (March 1, 2019 to February 29, 2020). This information improves understanding for ongoing changes in health and HRQoL experienced by older adults accepting HC services.

Chapter Five addresses question four, to investigate associations between the COVID-19 pandemic and HRQoL for older adult HC clients accessing services on a long-term basis. A retrospective exploratory method was used and evaluated change from (two RAI-HC assessments) before COVID-19 to during (one assessment before, one assessment during) COVID-19. This information can be used to support policy updates during possible future waves or pandemics to maintain health and HRQoL for older HC clients.

Chapter Six addresses question five to evaluate if specific professions, activity types or levels of care are associated to changes in HRQoL for older adults accepting HC on a long-term basis through a retrospective exploratory analysis. Associations between HRQoL outcomes and approximately two continuous years of HC service data were evaluated. Results provide a more comprehensive understanding of associations between HC service level factors and HRQoL outcomes for the HC population. This information can be useful for health care providers and policy decision makers in understanding high risk groups within the HC population who may need further support.

Chapter Seven provides a review of the research completed within this dissertation. In addition, this chapter provides an integrated discussion and recommendations regarding these results and provides suggestions for further research.

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Chapter 2: Quality of reporting of economic evaluations in rehabilitation research: a systematic review

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Abstract

The quality of reporting of health economic evaluations for rehabilitation services has been questioned, limiting their ability to provide accurate recommendations for health decisions. The aim of this study was to document current overall reporting quality of the published literature for economic evaluations of rehabilitation using the Consolidated Health Economic Evaluation Reporting Standards (CHEERS), and to identify factors that could influence the quality of reporting. Electronic literature searches were performed using MEDLINE and the NHS Economic Evaluations Database *via* the Cochrane Library. Prospective rehabilitation economic evaluation articles from 2013-2020 were selected. Data were extracted by one reviewer and independently verified by a second reviewer. Title and abstracts of 3,454 papers were reviewed. 204 papers were selected for a full text screening. Of those, 129 potential papers were identified to be included in this study, with 51 of these documents reporting on interventions from community or home setting. Only two databases were used in data collection, and papers were selected from 2013-2020 only. Inconsistent reporting in health economic evaluations of rehabilitation services has continued, despite the availability of the CHEERS checklist. The methods of the analyzed studies were frequently under-reported, thereby creating challenges in determining whether the results reported were valid.

Introduction

Economic evaluations in healthcare research are becoming more common. These evaluations assess the trade-offs between cost and effect for at least two health interventions [1]. Three of the main methodologies that are used in health economic evaluations are cost-benefit analysis, cost-effectiveness analysis, and cost-utility analysis [2]. The results from these studies are crucial for informing patients, clinicians, and decision/policymakers about the most desirable treatments to improve both patient outcomes and the efficiency of health care delivery. With limited health care dollars, it is essential to maximize care with available resources.

Recently, there has been an increase in economic evaluations of rehabilitation services. Rehabilitation services are interested in identifying the most effective and efficient intervention strategies for their complex and distinct patient population. Adequate information from current research is required to provide optimal care with finite resources. Consistent and transparent information assists in optimal decision making and the integration of published research findings [3].

One of the challenges noted in the current economic rehabilitation literature is insufficient information reported in the manuscripts about methods and procedures [4, 5]. Despite interest in remaining financially conscious, many highly cited practice guidelines do not include economic evaluations [6].

The need for improved reporting of health economic evaluations is not new, nor specific to rehabilitation. In 2009, the need for enhanced health economic evaluations was identified by the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) [3]. This organization assembled a team of international experts in academia, industry, government, and journal editors who collaborated with the goal of improving health economic evaluation

reporting [3]. These experts completed a review of current information used to guide reporting of economic evaluations and created a modified Delphi Panel to generate an updated and consolidated list of the most important items to be minimally included in a health economic evaluation. From these efforts to optimize decision making in health care, the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) guidelines, with accompanying checklist, was published in 2013. CHEERS differs from other tools such as the Quality of Health Economic Studies (QHES) [7] and the Consensus on Health Economic Criteria (CHEC) [8], which were developed to assess methodological quality of health economic evaluations, rather than reporting quality.

Although many single studies in the rehabilitation area are now utilizing the CHEERS guidelines to report their findings in health economic related journals, little is known about how CHEERS guidelines have impacted the quality of reporting health economic evaluations in rehabilitation research studies. It would be reasonable to assume that time would be required to disperse and integrate the CHEERS guidelines in rehabilitation research studies. Additionally, to the best of our knowledge, there has been no assessment regarding the quality of reporting for the whole field of rehabilitation following publication of the CHEERS guidelines in 2013.

Although three systematic reviews were identified focusing on specific areas of rehabilitation such as occupational therapy [5], adult rehabilitation programs [9], or physical therapy alone [10], only one of these systematic reviews evaluated the quality of reporting of these studies using the CHEERS guidelines [5]. Two additional systematic reviews were identified that utilize the CHEERS checklist to assess the quality of reporting economic evaluations within healthcare. One study assessed routine data collected as part of standard health care in Germany [11], and the other focused on cardiac surgery [12]. Therefore, the results of these previous systematic

reviews provide only a limited amount of information about the quality of reporting economic evaluations for the broad range of rehabilitation.

Objective

1. To document current overall reporting quality of the published literature on economic evaluations of rehabilitation services.
2. To identify if reporting quality has improved in health economic evaluations within the field of rehabilitation since the publication of CHEERS in 2013.
3. To identify factors that could influence reporting trends in the economic analysis of rehabilitation services (interventions).

Our research questions were: What is the quality of reporting rehabilitation economic evaluations after the publication of CHEERS checklist? Has reporting quality improved in health economic evaluations within the field of rehabilitation since the publication of CHEERS? Which factors influence the quality of reporting rehabilitation economic evaluations (e.g., year of publication, area of rehabilitation [physical therapy, occupational therapy, rehabilitation in general], specific area of focus [e.g., musculoskeletal, neurology, cardiovascular])?

Methods

The reporting of this systematic review is based on the standard PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) guidelines [13].

Data Sources and Searches

A search of bibliographic databases was conducted in two electronic databases and including:

- Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) (2013 - April 22, 2020),
- Cochrane Library NHS Economic Evaluation Database (2013 - April 22, 2020),

Keywords and medical subject headings were identified with the assistance of a librarian who specialized in searching health sciences databases and economical literature. Results were limited to economic studies and analyses, without restrictions regarding the language of publication. The literature search focused on rehabilitation economic evaluation studies from January 2013 – April 2020. Endnote reference management software was used to download all studies identified by the databases and remove duplicates. Refer to Appendix 1 for the complete search strategy.

Study Selection

Studies considered for inclusion were those satisfying the following criteria: 1) any prospective economical evaluation study, performed within a clinical trial (i.e., controlled clinical trial [CCT], a randomized controlled trial [RCT]), an observational study (i.e., prospective cohort study) or a stand-alone economical evaluation; 2) included at least two comparisons; 3) focused on rehabilitation services (e.g., physical therapy, occupational therapy, general rehabilitation); 4) published between January 2013 - April 2020; 5) interventions targeting adult patients (>18 years old). Exclusion criteria were: 1) retrospective studies, pre-post test design studies, case studies, commentaries, and reviews; 2) studies focusing on surgical interventions, children, self-management strategies, or research protocols; 3) studies published before 2013.

Data Screening

Two independent investigators (JF, SAO), experienced health professionals/researchers in the rehabilitation area (occupational therapist and physical therapist respectively) screened the titles of publications found in the databases, and, if available, the abstract of the publication. Records were imported to the Covidence (www.covidence.org) web platform, where duplicates were checked and removed. Covidence was used to screen the articles for inclusion. For a study

to be included in the review, the study publication had to meet all inclusion criteria on the rating form created in Covidence software. Then, the same reviewers (JF, SAO) independently reviewed full texts of potentially relevant studies according to the pre-specified inclusion criterion using Covidence software. Studies were analyzed with the available information. Authors were not contacted to identify additional studies or to complete the information provided in the manuscripts. Disagreements between reviewers on inclusion were resolved by consensus. For duplicate publications, only the most recent or complete reports were included.

Data Extraction

A pretested data extraction (DE) form was used to obtain data from eligible studies. The data extraction form was piloted first with five studies to determine feasibility of DE and also relevance of items collected. Both reviewers independently reviewed the five studies and completed the DE form and the CHEERS checklist. This pilot-testing was used to determine consistency in DE for both independent reviewers and create decision rules to facilitate the process of DE. We extracted data from each individual study for: study characteristics (e.g., authors, year of publication, country of publication, funding, study duration, research design, area of rehabilitation, study objectives, sample size, intervention, control, outcomes, follow-up, setting); study population characteristics (e.g., age, sex); intervention (description, duration of treatment); comparators (description, duration of treatment); outcomes (e.g., primary effectiveness outcome, outcomes for economic analysis); type of economic evaluation (e.g., cost-effectiveness analysis, cost-utility analysis, cost-minimization analysis, cost-consequence analysis, cost-benefit analysis); perspective (e.g., public health payer, private payer, societal, broad government payer); time horizon, discount rate; willingness to pay; and the software used to run the analyses. After full text screening, one reviewer (either JF or SAO) extracted the data

on the remaining studies (129 studies). The other reviewer independently and randomly reviewed 10% of the articles to verify the accuracy and completeness of the data extracted. Discrepancies between reviewers were resolved by consensus, the same as performed during the pilot stage of the DE tool. Data extraction was managed with Microsoft Excel™ (Microsoft Corporation, Redmond, WA).

Quality of Reporting

To evaluate the quality of reporting of the economic rehabilitation literature we used the CHEERS guidelines. This includes a 24-item checklist.

(www.ispor.org/TaskForces/EconomicPubGuidelines.asp). The objective of this checklist is to guide and optimize the reporting of health economic evaluations. The 24 items are organized in six main categories: 1) title and abstract (two items); 2) introduction (one item); 3) methods (13 items); 4) results (four items); 5) discussion (one item), and 6) other (two items). This checklist has been endorsed by several journals in the health economic evaluation field [3].

Quality of reporting of the included studies was assessed independently by two reviewers (JF and SAO) using the CHEERS checklist for the first five studies. Pilot testing the CHEERS DE form was completed and disagreements were discussed until a consensus answer could be reached. One reviewer (either JF or SAO) evaluated the reporting quality of the analyzed studies using the CHEERS guidelines. Another reviewer (either JF or SAO) independently and randomly verified 10% of the articles using the CHEERS guidelines. Discrepancies between reviewers were resolved by consensus, the same as performed during the pilot stage. To ensure consistency of assessments, we followed the guidelines outlined in the CHEERS checklist to score each of the items. Each of the items of CHEERS checklist was scored as follows: yes, no, partial, unclear, and not applicable (NA). Decision rules were developed to facilitate consistency

for scoring. “Yes” was scored when most of the information stated in CHEERS for that item was included in the analyzed paper (over 75% of the information). “Partial” was scored when between 25% and 75% of the CHEERS information was included. “No” was scored when between 0 and 25% of the CHEERS information was included. “Not applicable” was scored when the item was not relevant to the analyzed study. “Unclear” was scored when the information provided by the paper was not well specified and the review authors could not score the information provided with yes, no, partial, or not applicable. To assess the quality of reporting we counted how many studies reported each specific item (i.e., scored ‘yes’). We also evaluated the trend of this reporting quality over time.

Data Analysis and Synthesis

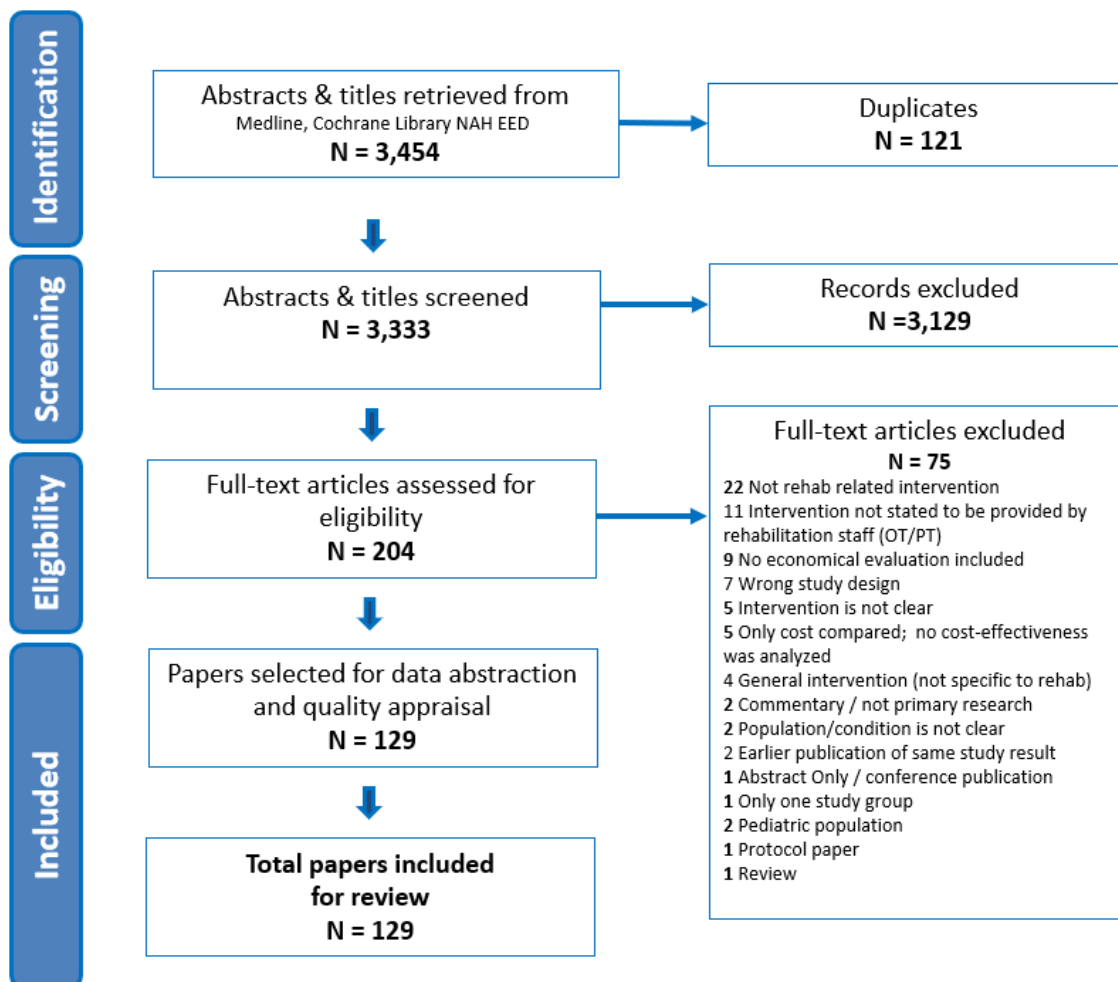
Extracted study details were synthesized using a narrative approach and summarized in evidence tables. In order to determine which factors were related to the quality of reporting, apriori, we chose the following variables that could be linked to quality of reporting: year of publication, location, rehabilitation area (i.e. physical therapy, occupational therapy, and other rehabilitation areas); specific area (e.g., musculoskeletal, cardiorespiratory, neurology); whether the study included an economical model; and total sample size. We run a multivariable regression model considering the CHEERS scores as the dependent variable and the other variables as covariates in the model. We tested each of these factors in univariate fashion and then we entered all the variables at the same time in the model. Statistical significance was set up at $p < 0.05$. All data analyses were performed using STATA software v.14.

Results

Search Results

The search of the literature resulted in a total of **3,454** published articles. Of the **3,454** published articles, **204** were considered to be potentially relevant. Independent review (in duplicate) of these **204** articles led to the inclusion of **129** articles (Figure 1). Appendix 2 provides details of included studies.

Figure 1. PRISMA flow chart



General Description of Included Studies

Of the 129 manuscripts selected, 19 (14.7%) were from 2013 and 2014, 50 (38.8%) were from 2015 and 2016, 36 (27.9%) were from 2017 and 2018, and 24 (18.6%) were from 2019 and 2020. Four countries were identified from which researchers had published a significant amount

of research in this area: the United Kingdom has published 24 studies (18.6%), the Netherlands 22 studies (17.1%), Australia 20 studies (15.5%), and the USA 16 studies (12.4%). Canada, Denmark, and Sweden were the countries of origin for 6-8 papers each. The remaining 15 countries (i.e. Norway, Belgium, Colombia, Finland, Germany, Ireland, Italy, Japan, New Zealand, Switzerland, Spain, Israel, Singapore, Brazil, and France) published four or fewer papers each. For studies that reported at least one setting in the home or community (N=51), the most studies were reported from Australia (N=14), United Kingdom (N=10) and Netherlands (N=8)

The median sample size had 176 participants, with the studies ranging from 9 participants to 139,866 participants. Nine studies did not provide enough information to calculate the total sample size. Eighty-nine of 120 studies (74.2%) had total sample sizes under 300 participants. Of the 129 studies, 97 (75.2%) had two comparators, 20 (15.5%) had three comparators, 10 (7.8%) had four comparators, and 2 (1.6%) had 5 comparators.

The majority of the 129 studies were randomized controlled trials (RCT) (n=100; 77.5%), followed by studies categorized as decision analytic models (e.g., probabilistic decision models and Markov model) (n=20; 15.5%). Four studies were prospective cohort designs (3.1%) with a mix identified in 5 studies (3.9%). The most prevalent area of focus studied was musculoskeletal (75 studies, 58.1%). Twenty-two studies (17.1%) had a cardiorespiratory focus, 19 studies (n=14.7%) had a multiple system focus, and 13 studies (10.1%) had a neurology focus. Similarly, within the subgroup (N=51) of studies reporting at least one setting as home or community, the major focus was musculoskeletal (N=25), with multisystem (N=11) and cardiorespiratory (N=11) next most commonly reported. Ninety-five articles (73.6%) were found to be within the PT scope of practice alone, 15 studies (11.6%) used PT or OT jointly with another profession, and 6 studies (4.7%) used OT services alone. Eight studies were reported for rehabilitation in general (6.2%),

three studies (2.3%) reported using multi-professional teams, and two additional studies (1.6%) did not report the type of profession providing rehabilitation services.

Economic Information Description

The primary type of economic evaluation completed most often was cost-effectiveness analysis (n=51 papers; 39.5%) followed by cost-utility analysis (n=45 papers; 34.9%). Twenty-three of the studies (17.8%) completed a cost-effective analysis with a cost-utility analysis. Ten studies (7.8%) completed different combinations of other economic evaluations, for example cost-minimization analysis with a cost-effectiveness analysis, or cost-utility analysis, cost-benefit analysis & cost-consequence analysis.

The most common perspective reported was the societal perspective (n=32 papers; 24.8%), followed by the societal perspective in addition to a health care system perspective (n=28, 21.7%). Fewer studies (n=25, 19.4%) utilized the public health system perspective, did not report on a perspective (n=16; 12.4%), reported from the health care provider perspective only (n=8, 6.2%) or reported from both the public health payer perspective and the social services perspective (n=6, 4.7%). Fourteen studies (10.9%) reported from a perspective or group of perspectives identified four or less times, for example third-party payer, hospital system, patient, or employer perspective. The time horizon was reported in fewer than half of the studies (n=62, 48.1%). When the time horizon was reported, the median length of study time was 1 year with the time span ranging from 6 weeks to lifetime.

Fifty-three (41.1%) of the studies reported using various regression models (e.g., cox, multi mixed linear, poisson models). Sixteen studies (12.4%) used Markov state models to determine cost information. Another 12 studies (9.3%) used the Decision Tree Modeling for the economic evaluation. One study (0.8%) used ANCOVA for modeling, four studies (3.1%) noted use of

imputation models for missing data and two studies (1.6%) reported use of comparison or mixed model use. Finally, forty-one (31.8%) of the studies did not specify the model used to determine the economical evaluation. The willingness-to-pay threshold was reported in 71.3% of the studies (n=92 papers). A variety of monetary values were included. Currency was reported in Euros (EUR), British pounds (GBP), Canadian dollars (CAD), Norwegian krone (NOK), Australian dollars (AUD), US dollars (USD), Danish krone (DKK), New Zealand dollars (NZD), Swedish krona (SEK, Kr), New Israeli shekels (NIS), and Swiss francs (CHF).

The incremental cost-effectiveness ratio (ICER) and incremental cost-utility ratio (ICUR) were used as the unit of economic analysis for 107 (82.9%) and two (1.6%) studies, respectively. Various studies reported net benefit measures, including: Net Monetary Benefit (N=10, 7.8%), Net Benefit (N=5, 3.9%), Incremental Net Monetary Benefit (N=4, 3.1%), Incremental Net Benefit (N=3, 2.3%), and Net Health Benefit (N=1, 0.8%). Cost-effectiveness acceptability curves (CEACs) (N=66, 51.2%) and cost-effectiveness planes (N=26, 20.2%) were also used to present outcomes.

The outcome used for the economic evaluations was frequently the quality-adjusted life year (QALY) (n=116 papers; 89.9%). A variety of tools were employed to identify client health and preference, including, but not limited to: EuroQol-5 Dimensions (EQ-5D), EuroQol-5 Dimensions 3 Level (EQ-5D 3L), EuroQol-Visual Analogue Scale (EQ-VAS), 36-Item Short Form Survey (SF-36), Assessment of Quality of Life (AQoL), Health Assessment Questionnaire (HAQ), Health Utility Index (HUI) or 12-Item Short Form Survey (SF-12V).

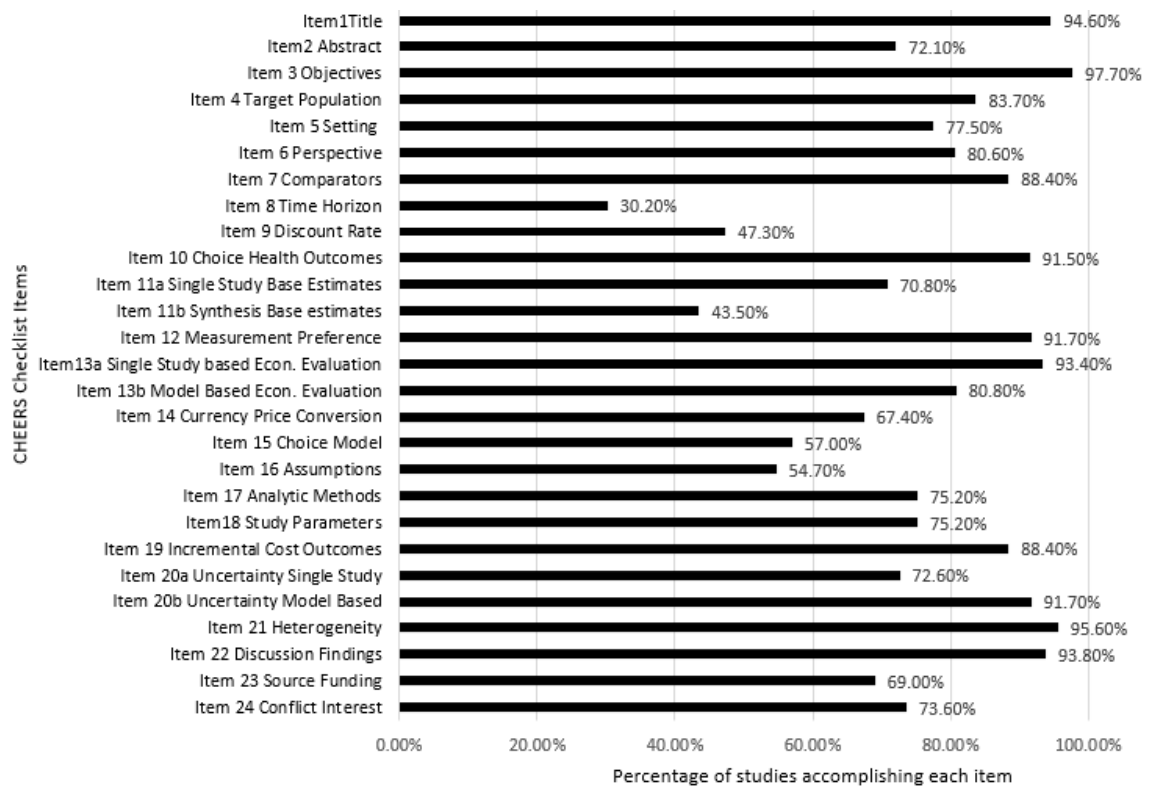
Quality of Reporting Using CHEERS Guidelines

Figure 2 displays the percentage of studies accomplishing each one of the items from CHEERS checklist. Appendix 3 provides details of the CHEERS assessment for each of the studies.

Some items that were well reported by the analyzed studies were statement of the objectives (97.7% of the studies,) followed by recognizing heterogeneity when applicable (95.6%) and reporting use of an economic evaluation in the title (94.6%). Over 90% of the studies completed a discussion of the findings (93.8%), described approaches used to estimate resource use associated with the interventions (93.4%), reported measurement and valuation of preference-based outcomes (91.7%), discussed model uncertainty (91.7%), and reported choice of health outcomes (91.5%). (Table 1).

In general, the quality of reporting of the economical evaluations in the rehabilitation field was inconsistent. The total mean items met for the CHEERS checklist was 17.5 points (range 8-24). For the subgroup of studies (N=51) that had at least one setting within the community or home, the mean items met on the CHEERS checklist was 17.7 points (range 8-23). There were a number of items that demonstrated poor rates of reporting in the selected studies, including the time horizon (30.2%), measurement of effectiveness for synthesis base estimates (43.5%) discount rate (47.3%), assumptions (54.7%), and choice of the model (57.0%). Other items which were not greatly reported in the selected studies were currency price conversion (67.4%), and source of funding (69.0%).

Figure 2. Quality of reporting the analyzed studies using CHEERS checklist



Factors Affecting the Quality of Reporting of Economic Evaluations

Table 1 shows the results from the multiple regression model looking at the association of specific factors and quality of reporting using CHEERS scores, showing respective Beta coefficients and 95% confidence intervals for each one of the factors. Reference categories were years 2013 and 2014, North America, other areas of rehabilitation (different from physical therapy), and non-MSK rehabilitation. Quality of reporting using CHEERS checklist by year (Figure 3), area of rehabilitation (e.g., physical therapy, occupational therapy, and other rehabilitation areas), or specific area of focus (e.g., musculoskeletal, cardiorespiratory, neurology, or multisystems) showed no clear pattern of better or worse quality for this sample. None of the factors investigated (e.g., year of publication, location, rehabilitation area [e.g., physical therapy,

occupational therapy, and other rehabilitation areas]), and specific area of focus (e.g. musculoskeletal, cardiorespiratory, neurology, or multisystem), whether the study included an economical model, and total sample size were found to be significantly associated to the quality of reporting the economical evaluations in the area of rehabilitation (Table 1).

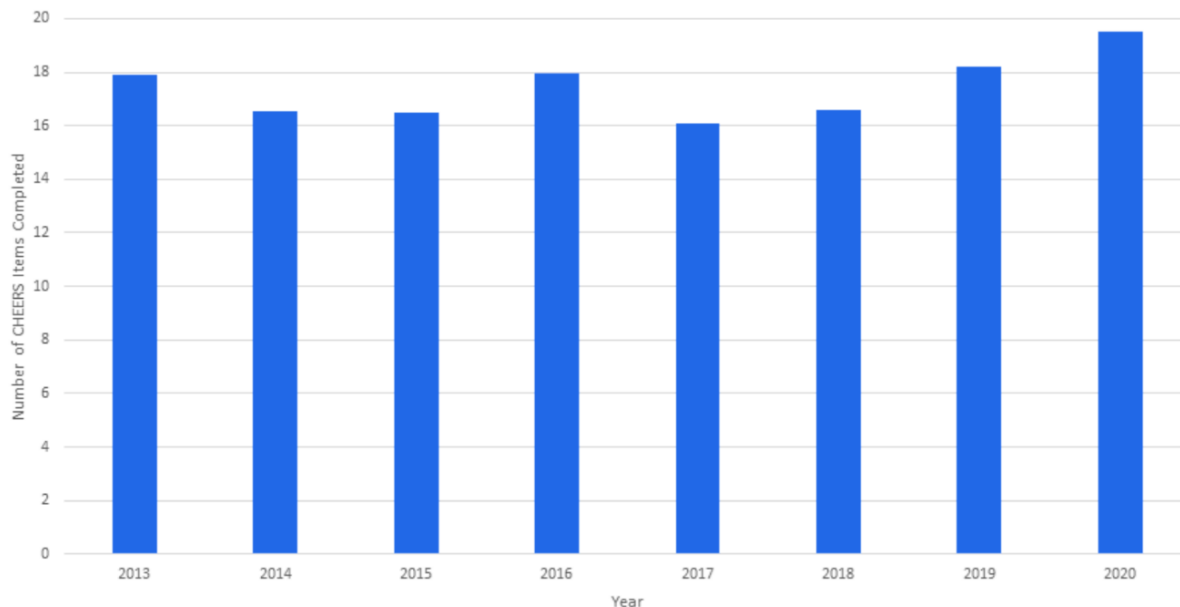
Table 1. Multiple regression analysis of factors related to quality of reporting

CHEERS score	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
2013-2014	0					
2015-2016	-.0981064	.9821972	-0.10	0.921	-2.047245	1.851032
2017-2018	-.4104881	1.008817	-0.41	0.685	-2.412453	1.591477
2019-2020	1.020733	1.114372	0.92	0.362	-1.190702	3.232169
North America	0					
Europe	-.4421704	.9089244	-0.49	0.628	-2.245901	1.361561
Australia	-.5377698	1.06446	-0.51	0.615	-2.650157	1.574617
PT alone vs. Other disciplines	1.006208	.7559625	1.33	0.186	-.4939747	2.506391
MSK vs. Other areas	.5852562	.651405	0.90	0.371	-.7074359	1.877948
Economical model	-.4369348	.9922859	-0.44	0.661	-2.406094	1.532224
Total Sample Size	.0000129	.0000244	0.53	0.599	-.0000356	.0000614
_cons	16.81739	1.32852	12.66	0.000	14.18099	19.4538

PT: Physical Therapy vs. Other disciplines (OT and general Rehabilitation)

MSK: Musculoskeletal vs. Other specific areas (neurology, cardiorespiratory)

Figure 3. Quality of reporting the analyzed studies by year of publication



Discussion

Main Results

The main result of this review is that the quality of reporting economic evaluations in the field of rehabilitation is inconsistent. Most of the analyzed studies did not satisfy the minimal reporting requirements proposed in the CHEERS guidelines. The results of this review highlight the need for improving the quality of reporting of economic evaluations in rehabilitation to enhance transparency and accuracy for the different stakeholders to make decisions for improving health care. The findings from this systematic review raise concerns regarding the quality of the economic evaluations conducted in the area of rehabilitation. Although quality of reporting is not equal to quality of conduct, and bad reporting does not necessarily reflect poor conduct [14], inconsistent reporting precludes readers from adequately assessing whether the study results are reliable and can be trusted for health decision making [15].

Comparison with other reviews in the area

The results of this present study agree with two previous systematic reviews evaluating economic evaluation performed in specific areas of rehabilitation. For example, the study by Ocampo et al. (2017) [4] noted inconsistent reporting of economic evaluations of strategies for the prevention of pressure sore injuries in a hospital setting. This poor reporting reduces the ability to consider the cost-effectiveness of the specific interventions included. Another systematic review completed by Green and Lambert (2017) [5] regarding economic evaluations in occupational therapy found that only a few studies met the CHEERS recommended reporting criteria. Overall, the authors concluded there was insufficient economic information to assist in healthcare decision making. Zervou et al., [6] found similar results regarding the quality of reporting for 148 cost analyses studies. These reviewers reported an average CHEERS of only 18.6 points, highlighting the poor quality of reporting in several areas of health. No reviews evaluating the quality of

reporting across the rehabilitation field using the CHEERS guidelines could be located. Thus, it was not possible to compare the results of this current study with other similar studies. Therefore, the results of this review are novel and provide important insights into the economic literature related to the rehabilitation field.

Earlier literature noted challenges for reporting health economic evaluations. Husereau et al., [3] noted challenges with reporting health related economic evaluations due to the substantial amount of information that must be provided to allow an assessment of the studies results. Authors use of reporting guidelines for the PRISMA-Equity 2012 have been studied and found that although it can function as a helpful reminder and improve consistency in reporting, authors stated concern about the length of time required to consider the items, and issues with increased length and complexity of the subsequent review [16]. This suggests that it may be possible to increase use of reporting guidelines by allowing health studies with accompanying economic evaluations additional text length, figures, and tables.

Limitations and Strengths

There are several strengths associated with this systematic review. This is the first study to systematically review the diverse field of rehabilitation. This study utilized a search strategy led by a librarian experienced in the area of economic evaluations. The data reviewing process was completed with thorough consideration of the methods, including an independent screening of the titles, abstracts, and full texts. The data extraction tool was pilot-tested, and issues raised when including studies or performing data extraction were resolved through consensus. Additionally, the reviewers conducting the systematic review and performing the process of study selection and data analysis were experienced rehabilitation clinicians/researchers.

There were some limitations in this review. As with any systematic review there is the potential for selection bias, since only two databases were searched and only studies of adults were included; however, all the years after the development of the CHEERS tool were included. Additionally, there may be some publication biases within the original studies. For example, researchers may be more motivated to report cost-effective interventions, rather than interventions that were not cost-effective.

Research and policy implications

The results of this review have important implications for research and policy. Investigators should conduct economic evaluations following high standards. In addition, researchers should report the conduct of their work carefully following the CHEERS guidelines. Editors of rehabilitation journals, as well as editors of economics journals, should more actively endorse the CHEERS checklist to ensure proper and clear information is reported from an economic perspective. For example, researchers should be asked to submit the CHEERS checklist together with the manuscript. This type of practice has been associated with better reporting in other areas of health care research when using other checklists such as the CONSORT and PRISMA statements [17]. With a well reported economic evaluation, information can be more easily assessed by decision makers for selecting therapies to implement in the context of the rehabilitation field.

The results of this study should encourage decision makers to investigate the quality of the economic evaluations before making recommendations for health care policy in rehabilitation, including within the home and community setting. Policy makers should also look at several different studies to compare results to assure a better foundation of knowledge for decision making. Based on the information provided by this review, it is uncertain whether the studies

analyzed provide accurate information for decision making since they may not be properly reported; especially for items closely linked to the methods of conducting economical evaluations. Future research should assess barriers in reporting rehabilitation economic evaluations and assess the use of CHEERS in subsequent years to see if the CHEERS guidelines have become more utilized over time.

Clinical implications

From a clinical perspective, the results of this paper are interesting but concerning. Within our current situation of fiscal restraint, interventions provided in healthcare must be cost-effective. If rehabilitation is to grow as a field of expertise, it will need to produce research demonstrating its cost-effectiveness. The results of this systematic review indicate reporting of economic analysis for rehabilitation services are of variable quality. Rehabilitation clinicians cannot depend on complete reporting of economic analysis research for rehabilitation services. Without this information, clinicians cannot assume research results on economic analysis of rehabilitation effectiveness are applicable to their rehabilitation setting. For appropriate healthcare decisions to be made, rehabilitation economic evaluations must provide clearly reported information that can be utilized in identifying optimal solutions for effective and efficient client care.

Although the CHEERS guidelines provide a checklist for ease of use, we would like to suggest further consideration for the creation of an outcome weighting system similar to the Quality of Health Economic Analysis (QHES) [7]. Currently CHEERS utilize a check point system which identifies items equally that may not have equal importance. For example, one check point may be given for reporting conflicts of interest (item 24) and one check point could also be given for summarizing key study findings, how they support conclusions reached, limitations, generalizability and how the research fits in with current knowledge (item 22). If

CHEERS did adopt a weighted output, a global outcome rating could be reported and allow for easier comparison between studies. Looking into the psychometric properties of the CHEERS checklist would be a step forward to improve its usability.

Future research needs to assess barriers to reporting economic evaluations in rehabilitation research. Another systematic review should be completed in the future to see if the CHEERS guidelines are more commonly included in the study evaluations of rehabilitation services. It is also essential to assess the effectiveness of the broad spectrum of rehabilitation services delivered to a variety of populations from children to older adults.

Conclusion

The quality of reporting of economic evaluations in the rehabilitation field is inconsistent. Most studies analyzed, including those completed in the home or community setting, in this review did not accomplish the minimal requirements stated by the CHEERS checklist. Incomplete reporting precludes accurate and sound decision making in health care. Investigators need to conduct economic evaluations following high standards, transparently report the conduct of their work and carefully follow the CHEERS guidelines to facilitate the work of different stakeholders when making decisions about rehabilitative care.

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Chapter 3: Enhanced home care interventions for community residing adults compared with usual care on health and cost-effectiveness outcomes

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Abstract

The need for home care services is expanding around the world with increased attention to the resources required to produce them. To assist decision making, there is a need to assess the cost-effectiveness of alternative programs within home care. Electronic searches were performed in five databases (before February 2020) identifying 3292 potentially relevant studies that assessed new or enhanced home care interventions compared with usual care for adults with an accompanying economic evaluation. From these, 133 articles were selected for full-text screening; 17 met the inclusion criteria and were analyzed. Six main areas of research were identified including the following: alternative nursing care ($N = 4$), interdisciplinary care coordination ($N = 4$), fall prevention ($N = 4$), telemedicine/remote monitoring ($N = 2$), restorative/reablement care ($N = 2$), and one multifactorial undernutrition intervention study. Risk of bias was found to be high/weak ($N = 7$) or have some concerns/moderate ($N = 6$) rating, in addition to inconsistent reporting of important information required for economic evaluations. Both health and cost outcomes had mixed results. Cost-effective interventions were found in two areas including alternative nursing care and reablement/restorative care. Clinicians and decision makers are encouraged to carefully evaluate the quality of the studies because of issues with risk of bias and incomplete reporting of economic outcomes.

Introduction

Home care has been used to maintain and improve client health, replace acute-care service, reduce hospital admission, allow for palliative care in home and delay individuals transitioning to a higher level of care [1, 2]. The need for home care is escalating because of the aging of our population, a higher prevalence of chronic conditions and having acute recovery encouraged at home [3]. With increasing trends towards reducing institutional care and more individuals with disabilities residing in the community, there has been an increasing interest in public policy to find effective and efficient ways to assist individuals to remain in their home [4].

There have been several systematic reviews focusing on economic evaluations of home care services. Fraser completed a systematic review on cost-effectiveness of home health care compared to other locations of health care provision [5]. Their study reported that home care was almost always more cost-effective compared to acute care in a hospital, but when compared with long-term care facilities, the results varied and were regularly ambiguous [5]. Tappenden et al. completed a systematic review within the United Kingdom, which showed that the nurse-led home health interventions can be clinically effective, but only a small portion of the studies included an economic evaluation (3 of 11) for individuals with chronic obstructive pulmonary disease, Parkinsons disease, and elderly discharge from acute care. The review concluded that there was at best a weak suggestion that nurse-led home health programs were cost-effective [6]. The systematic review by Sims-Gould et al. compared the use of reablement, reactivation, rehabilitation and restorative (4R) care model which individualized short-term programs offered by a multidisciplinary team to standard home care intervention [7]. The 4R care showed various cost savings for clients with home care services including a reduced number and duration of

home care visits, as well as decreased hospital costs from reduced number of emergency department visits, unplanned visits to hospital, and total number of days in hospital [7].

Despite ongoing interest in providing effective and economically sustainable home care, current systematic reviews within home care have limited focus to a specific intervention type or a profession providing care. To date, there remains a gap in the literature emphasizing health outcomes combined with economic evaluations spanning the broad scope of services provided within the home care setting. Therefore, this systematic review was designed to fill this gap. Registration with PROSPERO was completed at the onset of the study (CRD42018114979).

Objectives

The objectives for this review are:

- 1) To compile, synthesize, and evaluate the current evidence of new or enhanced home care interventions that include an economic evaluation for community residing adults compared with usual care on both health outcomes and cost-effectiveness results.
- 2) To evaluate the reporting quality of the selected economic evaluation studies.

Methods

Data Sources and Searches

A search was completed in five electronic databases and included the following: Ovid MEDLINE(R) ALL, Embase (OVID interface), CINAHL Plus with Full Text (EBSCOhost interface), SCOPUS, and Abstracts in Social Gerontology (EBSCOhost interface). Databases were searched from inception until 12 February 2020.

The search included 4 concepts that were combined with Boolean AND: home care, community dwelling, elderly, and economic evaluations. Each concept included a list of subject

headings and free text terms that the lead researcher and experienced health sciences librarian (JF and LD) compiled. A librarian (LD) then completed all searches. Results were not limited by language or publication date. Only the most recent report was included from studies that had multiple publications from one data set. The full search strategies for all databases are included in Appendix 4.

Study Selection

The PICO process was used as a framework to guide the development of the search strategy and defined as follows:

Population = Adults (≥ 18 years) residing in a community setting.

Intervention = A new or alternative form of home care was identified to be when a new program was launched or implemented in the community, which was different from the standard home care program that was usually delivered in that community and the authors recognized it as new.

Comparator = Usual home care services that are available as standard care.

Outcomes of interest = Both health (i.e., mortality, admission to hospital) and cost analysis with disaggregated information on costs were required.

The studies considered for inclusion were as follows: (1) any study design that assessed coordinated healthcare services targeted to ongoing clients of home care who were accessing services with chronic health issues; (2) must compare standard home care services to a new or enhanced type of home care intervention; (3) must include cost-effectiveness analysis or cost-consequence (costs and outcomes) of a home care program or provide information on how (disaggregated) costs were accrued; (4) have services provided in-home through home care staff, such as registered nurse, occupational therapist, physical therapist, healthcare aid, licensed

practical nurse, social worker, recreation therapist, dietician, or pharmacist; (5) interventions targeted to adult patients (>18years old); and (6) to be from a country that has a developed economy as defined by the United Nations [8].

Exclusion criteria were as follows: (1) studies reporting on or comparing home care to long-term care, clinic based, day program, hospital care or any other care based outside of the home; (2) aspects of home care being provided outside the home, such as at an outpatient hospital or clinic setting; (3) focus on providing acute home care to clients returning home following discharge from a higher level of care who had urgent care needs that were time limited up to three months; (4) commentaries, editorials, protocol articles, conference abstracts or systematic reviews; and (5) focus on self-management care provision or interventions targeted at care providers to effect change in care providers.

Data Screening

Studies identified by the search strategy were transferred into Covidence (<http://www.covidence.org>). Three investigators with experience in home care (as occupational therapists) independently reviewed and completed screening of titles and abstracts based on inclusion and exclusion criteria through the Covidence platform. Studies were accepted for further consideration when agreed upon by two blinded reviewers. From the selected articles, a full text review was independently completed to identify articles that satisfy the required criteria by two blinded reviewers (DR, JF, JW, or PL). Consensus was used to resolve any disagreements regarding inclusion or exclusion of an article. Authors were not contacted to provide any additional information, and analysis was completed with the information available in the publication and supplemental index available for that document.

Data extraction

A data extraction template was pilot tested with two reviewers over three studies. After discussion, the data extraction template was adjusted to meet the needs of the review and then used for the remainder of the studies.

Data extracted consist of the following: study identification (e.g., study author and country of publication); study characteristics (e.g., design of study and objective of study); sample characteristics (e.g., sample condition and sample size), interventions' characteristics (e.g., type and information on each comparator), and information from the economic evaluation (e.g., model used and results).

Risk of Bias Assessment & Quality of Reporting

Risk of bias was assessed based on the study design. For identified randomized control trials (RCTs), the Revised Cochrane risk of bias (RoB) 2.0 tool was used [9]. This tool includes five domains: assessing for risk due to the randomization process, deviations from the intended intervention, missing outcome data, measurement of the outcome and selection of the reported results. Using the guidelines for this tool, studies were rated at a “high risk of bias” if it had a high risk in at least one domain. The rating of “some concerns” was given to studies with some concerns in at least one domain, and other domains were rated as low risk. A “low risk of bias” rating was given to studies that had low risk in all individual domains [9].

Risk of bias for quantitative studies, excluding RCT studies, was evaluated using the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies designed for literature reviews [10]. This tool evaluates eight components including selection bias, study design, confounders, blinding, data collection methods, withdrawals and dropouts, intervention integrity, and analyses. A study was given a “strong” rating to if no individual component has been identified as weak, a “moderate” rating if the study had only one

component area with a weak rating, and a “weak” rating if it was identified to have had two or more component with weak ratings [10].

The quality of reporting of economical evaluations was performed using the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) list. This checklist was published in 2013 outlining guidelines for reporting health economic evaluations [11]. The checklist identifies 24 items that are considered important for reporting in health economic evaluations (<http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp>). These items are divided into six categories including title and abstract, introduction, methods, results, discussion and other. Each item is rated as either reported on or not [11]. For the purpose of this review, the 24 items in the checklist were recorded as: yes, no, partial, or not applicable (NA). An item would score “yes” when more than 75% of the information was provided, “partial” when 25%-75% of the information was provided, and “no” when less than 25% of the information was provided.

Data Synthesis

Due to the heterogeneity of the information collected, a narrative synthesis was used to provide a descriptive summary of the included studies and findings reported by each of the outcomes of interest. These outcomes were grouped in six categories: (1) function (mobility, falls, activities of daily living [ADLs], instrumental activities of daily living [IADLS]); (2) health-related quality of life (HRQoL); (3) health services use; (4) physical health; (5) mood and mental health; and (6) cognition. For a list of assessment measures grouped into each of these categories see Appendix 5. After each intervention was grouped, it was then reviewed based on health and economic outcomes. Evidence tables were used to present qualitative and quantitative data where appropriate. This study conforms to all Preferred Reporting Items for Systematic

Reviews and Meta-Analyses (PRISMA) guidelines and reports the required information accordingly.

Decision Rules for Outcome Effect: Measure Level, Study Level & Across Studies

Decision rules were developed to identify direction of effect for each health outcome measure. The direction of effect for the health outcome was reported as: (1) *positive*, if more than 50% of the items from the measure were reported as improved; (2) *neutral*, if more than 50% of the items from the measure were reported as neutral (neither positive nor negative effects were found); (3) *negative*, if more than 50% of the items from the measure were reported as worsened; or (4) *mixed*, if the items from the measure reported equivalency (similar number of items with positive, negative or neutral results) or there was no consistent pattern that could be classified as *positive, negative, or neutral*.

To report an overall health direction of effect for each study, further decision rules were created. The overall direction of effect for a study was reported as follows: (1) *positive*, if more than 50% of measured health outcomes for each study were identified as improved; (2) *neutral*, if more than 50% of measured health outcomes for each study were identified as neutral; (3) *negative*, if more than 50% of measured health outcomes for each study were identified as worsened; or (4) *mixed*, if there was reported equivalency among health outcomes in the study (similar number of outcomes with positive, negative or neutral results) or there was no consistent pattern that can be classified as *positive, negative or neutral*.

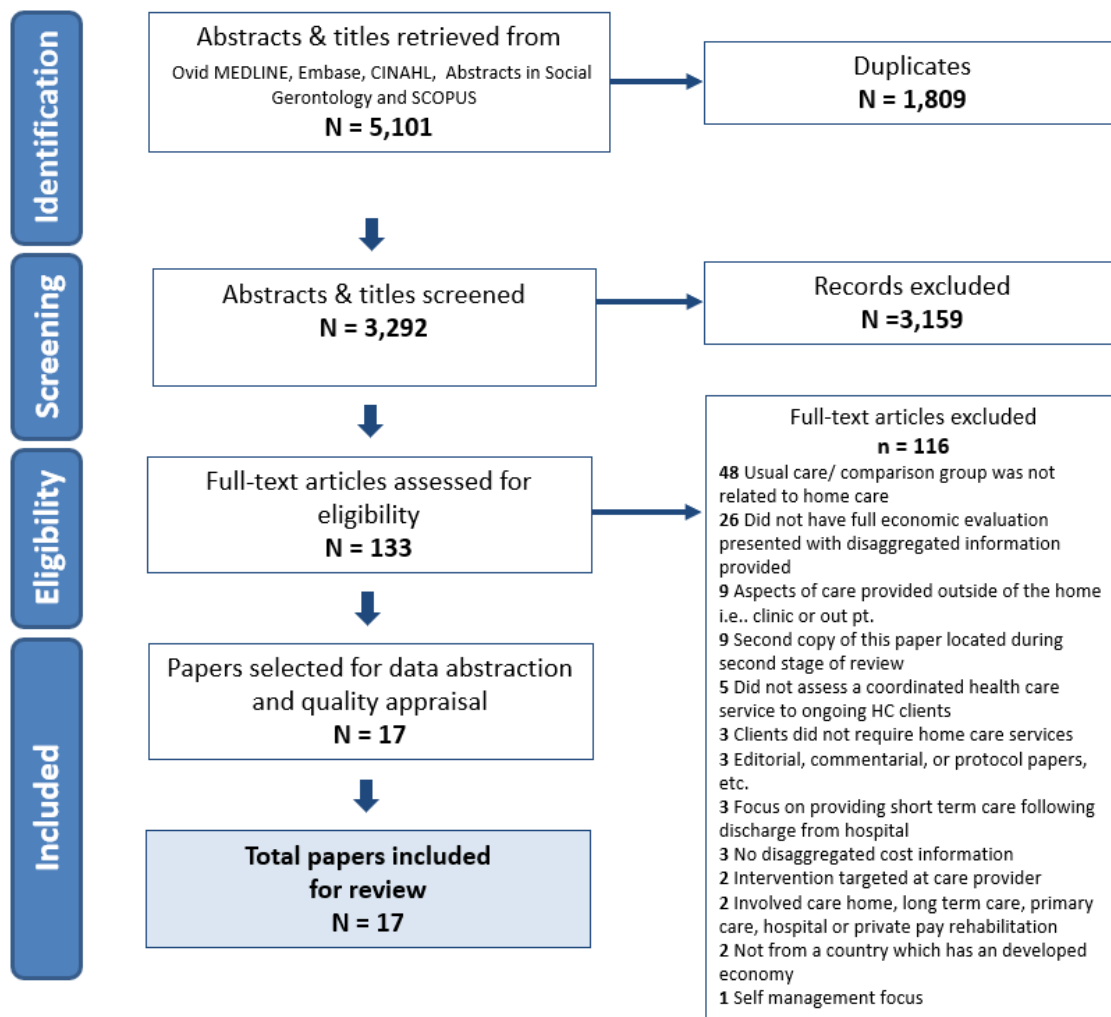
To report an overall health direction of effect and cost-effectiveness across identified study groups, similar decision rules were used. The overall health direction of effect and cost-effectiveness for a study group was reported as follows: (1) *positive*, if more than 50% of the included studies for a specific outcome demonstrated improved health outcomes or economical

outcomes; (2) *neutral*, if more than 50% of the included studies for a specific outcome demonstrated neutral health outcomes or economical outcomes; (3) *negative*, if more than 50% of the included studies for a specific outcome demonstrated worsened health outcomes or economical outcomes; or (4) *mixed*, if there was reported equivalency for the studies groups direction of effect (similar number of studies with positive, negative or neutral results) or there is no consistent pattern that can be classified as *positive, negative or neutral*.

Results

Search results from February 12, 2020, identified 5101 research articles (Figure 4). Of these documents 1809 were removed as duplicates. During the title and abstract screening 3292 articles were reviewed. Using the inclusion and exclusion criteria 3159 articles did not meet the inclusion criteria for this review and thus were excluded. The remaining 133 articles were assessed through a full text review. From these articles under consideration, 116 were identified as not meeting the required criteria and 17 were selected for data extraction. Examples for exclusion of the 116 articles were as follows: those that did not provide an economic evaluation, or aspects of intervention were provided outside the home. For more details on reasons for exclusion see Figure 4.

Figure 4. PRISMA flow chart



General Study Characteristics

The primary study design identified in these studies was randomized control trials (RCT) (n=12). The rest of the studies (n=5) corresponded to quasi-experimental time series with non-equivalent control group, cluster randomized trial, case-control-matched design, case cohort and a retrospective analysis assessing pre/post differences (Appendix 6). The studies being reviewed were published over a 31-year span (1988-2019) with six studies published between 2015 and 2020. The primary location of the studies was the USA (41.1%), followed by Canada (23.5%).

Each of the following countries had one (5.9%) publication: Norway, Finland, Australia, Netherlands, New Zealand, and United Kingdom. All included studies were published in English.

Most identified studies utilized a multidisciplinary team (47.1%), followed by registered nurse intervention focus (17.6%). Approximately half of the studies were directed to older adults, followed by chronic health conditions, such as heart failure and stroke (29.4%), sight impairment (11.8%), and individuals who were experiencing or at risk of undernutrition (5.9%) (Appendix 6). The median sample size from all studies was 148 clients (range 46-1376). The median participant age in these studies was 80.5 years (interquartile range = 8.8) with high proportion of female participants (N=10).

Research Areas of Study

The 17 studies were grouped into six focus areas including alternative nursing care (n=4) [12-15], fall prevention (N=4) [16-19], interdisciplinary care coordination (N=4) [20-23], telemedicine/remote monitoring (N=2) [24, 25], restorative/reablement care (N=2) [26, 27] and one multifactorial undernutrition intervention [28] (Table 2). Across the six areas of focus, positive or cost-effective results were reported in two groups (alternative nursing care and reablement/restorative care). Two additional groups reflect positive or cost-effective results when considering subgroups (fall prevention and interdisciplinary care coordination). Mixed cost-effectiveness outcomes were reported in one group (telemedicine/remote monitoring) and the final study group reported that the intervention was not cost-effective (undernutrition intervention).

Alternative Nursing care

Four studies looked at nursing care programs through various outcomes (function, HRQoL, health services use, physical health, and mood and mental health) [12-15]. Overall, when taken together, mixed results were found for function, health services use, and mood and mental health. However, positive results were found for HRQoL, and neutral for physical health. Therefore, the overall health direction of the effect for these four studies was mixed. These changes were identified through either no additional cost [13, 15] or cost savings [14]. One study found additional costs for specially trained respiratory nursing for similar health outcomes suggesting limited coverage of this service may be appropriate [12].

Fall prevention

Four studies investigated the effectiveness of fall prevention programs through the six categories reported earlier (e.g., function and HRQoL) [16-19]. Overall, neutral results were found across the studies for HRQoL, physical health, mood and mental health, and cognition. Mixed results were found across studies for function and health service use. The overall health direction of effect for these four studies was positive or cost-effective when considering subgroups. One study reported positive cost-effectiveness for a home safety program via providing the incremental cost of implementing the program per fall prevented [16]. Two studies reported that multifactorial fall prevention programs were cost-effective based on age, fall history, and willingness to pay threshold [17, 18]. The final study of this group did not identify a cost per fall prevented as it reported no significant difference in the number of falls [19].

Table 2. Health outcomes grouped by intervention

<i>First Author, year</i>	Function (Mobility, Falls, ADL, IADL)	Health Related Quality of Life	Health Services Use	Physical Health	Mood & Mental Health	Cognition	Overall Health Direction of Effect	Cost	Cost- effectiveness
<i>Outcomes for Alternative Nursing Care</i>									
<i>Bergner (1988) [12]</i>	Neutral	NA	NA	Neutral	Neutral	NA	Neutral	Increased	Negative or not cost-effective
<i>Markle-Reid (2003) [13]</i>	NA	Positive	Mixed	NA	Positive	NA	Positive	Decreased*	Positive or cost- effective
<i>Meng (2010) [14]</i>	NA	NA	Positive	NA	NA	NA	Positive	Decreased	Positive or cost- effective
<i>Popejoy (2015) [15]</i>	Positive	NA	Positive Neutral Negative Overall: Mixed	NA	NA	NA	Mixed	Decreased*	Positive or cost- effective
<i>Direction of Effect</i>	Mixed	Positive	Mixed	Neutral	Mixed	NA	Mixed	Decreased	Positive or cost- effective
<i>Outcomes for Fall Prevention</i>									
<i>First Author, year</i>	Function (Mobility, Falls, ADL, IADL)	Health Related Quality of Life	Health Services Use	Physical Health	Mood & Mental Health	Cognition	Overall Health Direction of Effect	Cost	Cost- effectiveness
<i>Campbell (2005) [16]</i>	Positive	NA	NA	NA	NA	NA	Positive	Increased	Positive or cost- effective

1. Home Safety program	Neutral	NA	NA	NA	NA	NA	Neutral	Increased	Negative or not-cost effective
2. Home exercise program									
Isaranuwatchai (2017) [17]	Mixed NR	NA	Mixed	NA	NA	NA	Mixed	Mixed	Positive or cost-effective~
Markle-Reid (2010) [18]	Neutral Positive Overall: Mixed	Neutral	Mixed	Neutral	Neutral	Neutral	Neutral	Neutral**	Positive or cost-effective ^o
Waterman (2016) [19]	Neutral	Neutral	NA	NA	NA	NA	Neutral***	Increased	NR
Direction of Effect	Mixed	Neutral	Mixed	Neutral	Neutral	Neutral	Mixed	Increased	Positive or cost-effective ^g

Outcomes for Interdisciplinary Care Coordination

First Author, year	Function (Mobility, Falls, ADL, IADL)	Health Related Quality of Life	Health Services Use	Physical Health	Mood & Mental Health	Cognition	Overall Health Direction of Effect	Cost	Cost-effectiveness
Hammar (2009) [20]	NA	Neutral Positive Overall: Mixed	Neutral	Neutral	NA	NA	Neutral	Decreased	Positive for NHP and Neutral for EQ-5D
Hopp (2015) [21]	NA	NA	Positive Mixed Overall: Mixed	NA	NA	NA	Mixed	Mixed	Positive or cost-effective [^]
Markle-Reid (2011) [22]	Neutral	Neutral	Mixed	Neutral	Neutral (n=3)	Neutral	Neutral	Increased*	Neutral

<i>Valluru (2019)</i> [23]	NA	Positive	NA	Neutral	NA	NA	Mixed	Decreased*	Positive or cost-effective
<i>Direction of Effect</i>	Neutral	Mixed	Mixed	Neutral	Neutral	Neutral	Mixed	Mixed	Positive or cost-effective ^a

Outcomes for Telemedicine/ Remote Monitoring

<i>First Author, year</i>	Function (Mobility, Falls, ADL, IADL)	Health Related Quality of Life	Health Services Use	Physical Health	Mood & Mental Health	Cognition	Overall Health Direction of Effect	Cost	Cost-effectiveness
<i>Finkelstein (2006)</i> [24]	Neutral	NA	Positive	Neutral	NR	NA	Neutral	Decreased	Positive or cost effective
<i>Williams (2016)</i> [25]	NA	NA	Neutral	NA	NA	NA	Neutral	Increased	Negative or not cost-effective
<i>Direction of Effect</i>	Neutral	NA	Mixed	Neutral	NA	NA	Neutral	Mixed	Mixed

Outcomes for Reablement/ Restorative Care

<i>First Author, year</i>	Function (Mobility, Falls, ADL, IADL)	Health Related Quality of Life	Health Services Use	Physical Health	Mood & Mental Health	Cognition	Overall Health Direction of Effect	Cost	Cost-effectiveness
<i>Kjerstad (2016)</i> [26]	Positive	NA	Positive	NA	NA	NA	Positive	Decreased	Positive or cost-effective
<i>Lewin (2014)</i> [27]	NA	NA	Positive	NA	NA	NA	Positive	Decreased	Positive or cost-effective
<i>Direction of Effect</i>	Positive	NA	Positive	NA	NA	NA	Positive	Decreased	Positive or cost-effective

Outcomes for Undernutrition

<i>First Author, year</i>	Function (Mobility, Falls, ADL, IADL)	Health Related Quality of Life	Health Services Use	Physical Health	Mood & Mental Health	Cognition	Overall Health Direction of Effect	Cost	Cost- effectiveness
<i>Van der Pol- Vijlbrief (2017) [28]</i>	Positive Neutral Overall: Mixed	Mixed	NA	Neutral Positive Overall: Mixed	NA	NA	Mixed	Decreased*	Negative or not cost-effective [»]
<i>Direction of Effect</i>	Mixed	Mixed	NA	Mixed	NA	NA	Mixed	Decreased*	Negative or not cost-effective [»]

* Not statistically significant

** Neutral overall with Mixed results found in sub-group analysis

*** Study not powered to detect differences in fall rate

~ At a higher willingness-to-pay ($\geq$ \$25,000) for adults 75-84 years and a lower WTP ($<$ \$5,000) for adults over 85 years

◇ For a subgroup of males (75-84 years old) with a fear of falling or negative fall history

□ Cost-effective when considering subgroups

^ For a subgroup of Plan A for clients generally over 65 years of age who survived at least 6 months post entry into study and subgroup of Plan B for a younger population with advanced stage cancer who had no months of care that exceeded US\$70,000.

»Not cost-effective for the primary outcome of body weight, but demonstrated beneficial treatment effects on other outcome measures in the treatment group.

Interdisciplinary care coordination

Four studies looked at interdisciplinary care coordination interventions, utilizing the six categories reported earlier (e.g., function and HRQoL) [20-23]. Overall, neutral results were found across the studies for function, physical health, cognition, mood and mental health. Mixed results were found across studies for HRQoL and health service use. The overall health direction of the effect for these four studies was positive or cost-effective when considering subgroups. Reduced health care service provision was found in subgroups of older adults and younger adults with advanced cancer with no months of service costing over \$US 7000 [21]. The interventions for integrated home and discharge planning were found to be cost effective by the Incremental Cost Effectiveness Ratios (ICERs) when measured by the Nottingham Health Profile (NHP) but not the EuroQol Group EQ-5D measure [20]. The cost-effectiveness plane for the NHP outcome showed results on the southeast quadrant indicating lower cost and improved effect [20]. A study for an interprofessional stroke rehabilitation team reports non-statistically significant increase in cost through health service expenses [22] and the final study notes a non-statistically significant decrease in cost for supports services to delay long-term institutionalization via costs from a case mix classification system [23].

Telemedicine/remote monitoring

Two studies assessed telemedicine/remote monitoring through three outcomes including function, health service use, and physical health [24, 25]. These studies found neutral results for function and physical health, but mixed results for health services use. The overall health direction of the effect for these two studies is neutral. The study by Williams and Wan's [25] did not support remote monitoring as a cost-effective option from an agency perspective, whereas

the study by Finkelstein et al. [24] demonstrated improved client health outcomes with lower cost than usual care.

Restorative care/ reablement

Two studies investigated the effectiveness of reablement (also known as restorative care), using two categories of outcomes (function and health service use) [26, 27]. These studies found positive outcomes for both improved function and reduced health service use and an overall health direction of positive effect. Reablement was reported to demonstrate significant changes in two outcome measures (Canadian Occupational Performance Measure [COPM]- Performance & Satisfaction) at three months. The Canadian Occupational Performance Measure-Performance and Satisfaction measures [i.e., COPM-P and COPM-S] are rated on a 1-10 scale, with a difference of 2 points in the score considered a clinically relevant change [29]. Expenditures required to improve the outcome by one point could be done at a lower cost ($ICER_{COMP-P} = -868.18$ and $ICER_{COMP-S} = -666.30$) compared to the control group in Norwegian krone [26]. The differences for costs and effects were in the southeast quadrant of a cost-effectiveness plan, suggesting that reablement is more cost-efficient compared with usual care, which is completing tasks for clients indefinitely [26]. Results also stated that the aggregated health costs of this intervention were reduced by a factor of 0.83 in Australia over the 2-year follow-up [27].

Multifactorial undernutrition intervention

The study providing intervention for undernutrition reported results in three categories of outcomes (function, HRQoL and physical health) [28]. This study presented mixed outcomes for function, HRQoL, and physical health, also with an overall mixed health direction of effect. The intervention produced an ICER of -741€ for 1kg of weight gain with considerable uncertainty around effectiveness resulting from 51% of bootstrapped cost-effect pairs located in the southeast

quadrant of the cost-effectiveness plane (less costly and larger effects) [28]. A gain of 1 quality-adjusted life year in the intervention group was associated with -32,173€ compared with the control group [28]. The authors suggest that based on weight gain, this intervention cannot be considered cost-effective, although mixed health effects were demonstrated in other outcome measures [28].

Economic Study Characteristics

The primary type of economic evaluation was identified to be cost-effectiveness analysis (n = 9; 52.9%), [14-19, 24, 26, 28] followed by cost-consequence analysis (n = 4; 23.5%) [12, 13, 22, 27]. The cost-benefit analysis method was used by two studies (11.8%) [21, 25] and single studies (5.9%) were identified using a cost-utility analysis [20] and a cost-effectiveness analysis with cost-benefit analysis [23]. Frequently, the perspective taken for the evaluation was societal (N = 7, 41.2%), meaning to include all stakeholder groups [12, 13, 16-18, 22, 28]. One study reported taking a public healthcare payer perspective (5.9%) [15] and another study reported taking an agency perspective (5.9%) [25]. Eight (47.1%) [14, 19-21, 23, 24, 26, 27] studies did not report taking any perspective. (Appendix 6).

Outcome format for the economic evaluation was reported in various ways including three studies (17.6%) [20, 26, 28] through ICERs, and three studies (17.6%) [17, 20, 26] reporting cost effectiveness acceptability curves. One study utilized incremental net benefits [17] and another study reported on cost benefits of the program through monies lost/gained per patient (5.9% each) [25]. Preference-based outcomes were reported in two studies (11.8%) [26, 28] which used the Canadian Occupational Performance Measure and EQ-5D. Three studies (17.6%) [13, 18, 22] reported outcomes from the 36-item Short form Survey, and two studies (11.8%) [19, 28] reported using the 12-item Short Form Survey. A single study (5.9%) [20] used

the NHP. Funding for these studies was most frequently from a government source in addition to other funding (n = 6; 35.3%) [17-19, 22, 24, 26].

Quality of Reporting

The CHEERS checklist was used to provide information on how transparent the reporting was within each of the selected studies (Table 3). The range spanned from 10 [14, 16] to 21 out of a possible 24 items [28].

As highlighted by Figure 5 and Table 3, reporting on objectives, target population, setting, and choice of health outcomes were completed in all studies (17/17). Reporting mean values for the main categories with estimated costs and outcomes of interest, and discussion of findings were completed by 16 (94.1%) of the 17 studies. There were also several areas within the selected studies that were not well reported on. None of the selected papers reported on time horizon. Only two (11.8%) studies noted discount rates, both of which reported that this measure was not used due to length of study. Poor reporting was also found in currency, price date and conversion (N = 5; 29.4%) and assumptions (N = 5; 29.4%).

Figure 5. Frequency of reporting in identified home care economic evaluation studies

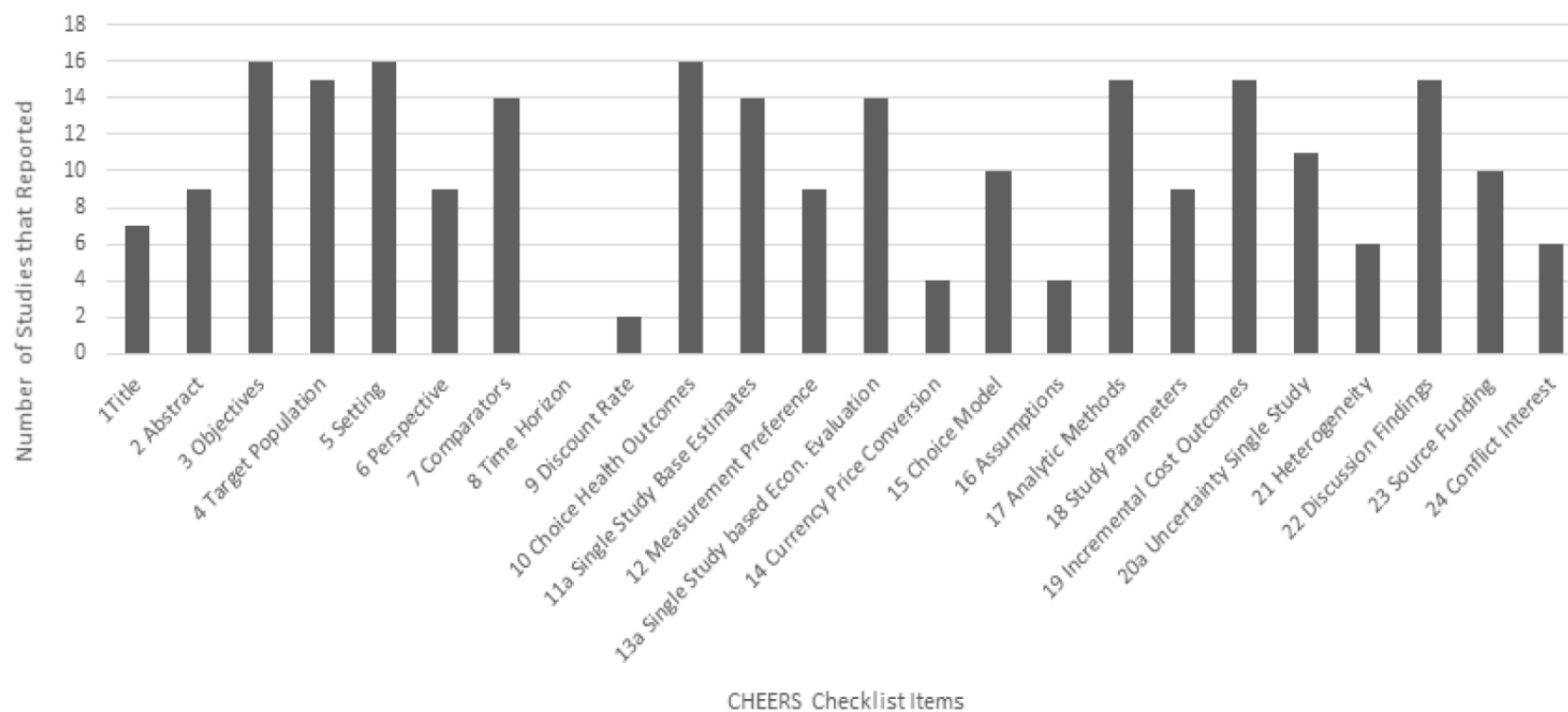


Table 3. Quality of reporting of the included studies using 24 CHEERS statement

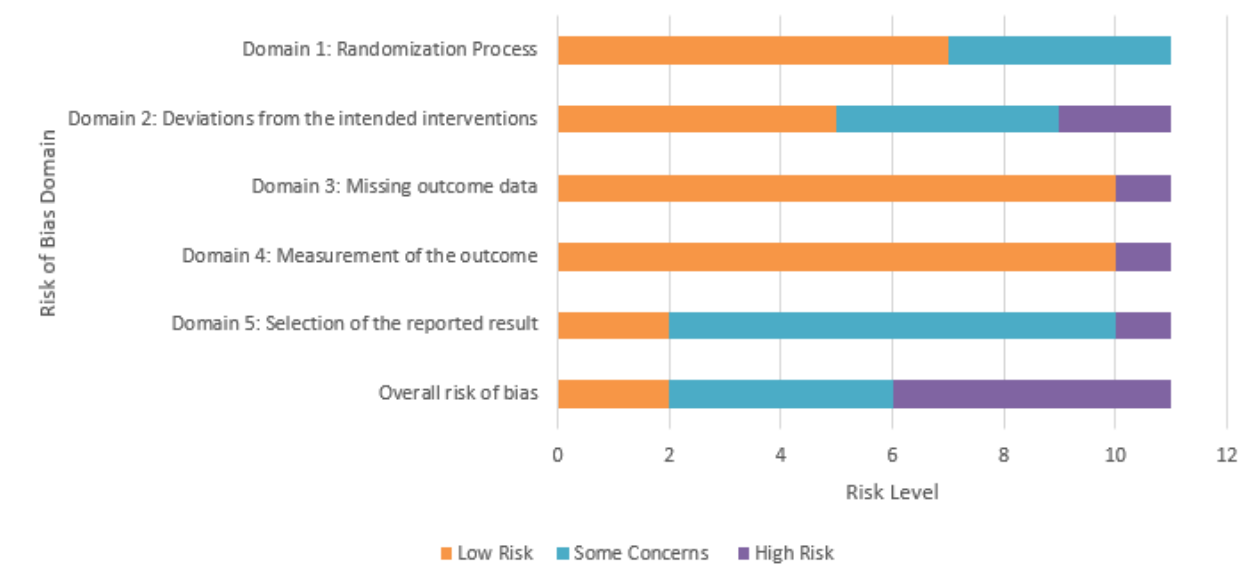
	Total score (#Yes)	24 Conflict Interest	23 Source Funding	22 Discussion Findings	21 Heterogeneity	20b Uncertainty Model Based	20a Uncertainty Single Study	19 Incremental Cost Outcomes	18 Study Parameters	17 Analytic Methods	16 Assumptions	15 Choice Model	14 Currency Price Conversion	13b Model Based Econ. Evaluation	13a Single Study based Econ. Evaluation	12 Measurement Preference	11b Synthesis Base estimates	11a Single Study Base Estimates	10 Choice Health Outcomes	9 Discount Rate	8 Time Horizon	7 Comparators	6 Perspective	5 Setting	4 Target Population	3 Objectives	2 Abstract	1 Title	First Author, Year
Bergner, 1988 ^[12]	12	N	Y	P	Y	NA	N	Y	P	Y	N	Y	P	NA	Y	NA	NA	P	Y	N	N	Y	Y	Y	Y	Y	P	P	
Campbell, 2005 ^[16]	10	Y	Y	Y	NA	NA	N	P	Y	P	N	Y	N	NA	N	NA	NA	P	Y	N	N	Y	Y	P	Y	Y	P	N	
Finkelstein, 2006 ^[24]	13	N	Y	Y	NA	NA	Y	Y	P	Y	N	N	N	NA	Y	NA	NA	Y	Y	Y	N	Y	N	Y	Y	Y	Y	P	
Hammar, 2009 ^[20]	16	N	N	Y	NA	NA	Y	Y	P	Y	P	Y	N	NA	Y	Y	NA	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	
Hopp, 2015 ^[21]	17	Y	Y	Y	Y	NA	Y	Y	N	Y	N	Y	Y	NA	Y	NA	NA	Y	Y	N	N	Y	N	Y	Y	Y	P	Y	
Isaranuwatchai, 2017 ^[17]	20	Y	Y	Y	Y	NA	Y	Y	Y	Y	N	Y	P	NA	Y	Y	NA	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	
Kjerstad, 2016 ^[26]	15	Y	Y	Y	NA	NA	Y	Y	P	Y	N	N	P	NA	Y	Y	NA	Y	Y	Y	N	Y	N	Y	Y	Y	P	Y	
Lewin, 2014 ^[27]	16	N	Y	Y	Y	NA	Y	Y	Y	Y	N	Y	P	NA	Y	NA	NA	Y	Y	N	N	Y	N	Y	Y	Y	Y	P	
Markle-Reid, 2010 ^[18]	16	P	Y	Y	Y	NA	Y	Y	Y	Y	P	N	P	NA	Y	Y	NA	Y	Y	N	N	Y	Y	Y	Y	Y	P	P	

Markle-Reid, 2011 ^[22]	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	NA	Y	Y	NA	P	P	Y	Y	Y	Y	Y	NA	Y	Y	Y	P	18
Markle-Reid, 2003 ^[13]	P	Y	Y	Y	Y	Y	Y	N	N	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	Y	Y	N	NA	NA	Y	N	N	17
Meng, 2010 ^[14]	P	P	Y	Y	Y	N	P	N	N	Y	Y	NA	NA	P	NA	P	Y	N	Y	P	Y	Y	NA	NA	Y	N	N	10
Popejoy, 2015 ^[15]	P	N	Y	Y	Y	Y	P	N	N	Y	Y	NA	NA	Y	NA	Y	Y	N	Y	Y	Y	N	NA	NA	Y	Y	N	14
Valluru, 2019 ^[23]	P	Y	Y	Y	Y	N	Y	N	N	Y	P	NA	NA	Y	NA	Y	N	Y	Y	Y	Y	N	NA	NA	Y	Y	Y	15
van der Pols-Vijlbreif, 2017 ^[28]	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	Y	Y	Y	NA	NA	Y	P	Y	21
Waterman, 2016 ^[19]	P	Y	Y	Y	Y	N	Y	N	N	Y	Y	NA	Y	Y	NA	N	Y	Y	Y	Y	Y	N	NA	NA	Y	Y	Y	17
Williams, 2016 ^[25]	Y	P	Y	Y	Y	Y	Y	N	N	Y	P	NA	NA	Y	NA	P	N	N	P	Y	Y	P	NA	NA	Y	N	N	11
Total of items completed	6	9	17	17	17	8	15	0	2	17	13	NA	8/8	15	NA	5	11	5	15	11	16	10	NA	6/6	16	12	7	
% Yes	35.3%	52.9%	100%	100%	100%	47.1%	88.2%	0%	11.8%	100%	76.5%	NA	100%	88.2%	NA	29.4%	64.7%	29.4%	88.2%	64.7%	94.1%	58.8%	NA	100%	94.1%	70.6%	41.2%	

Risk of Bias Results

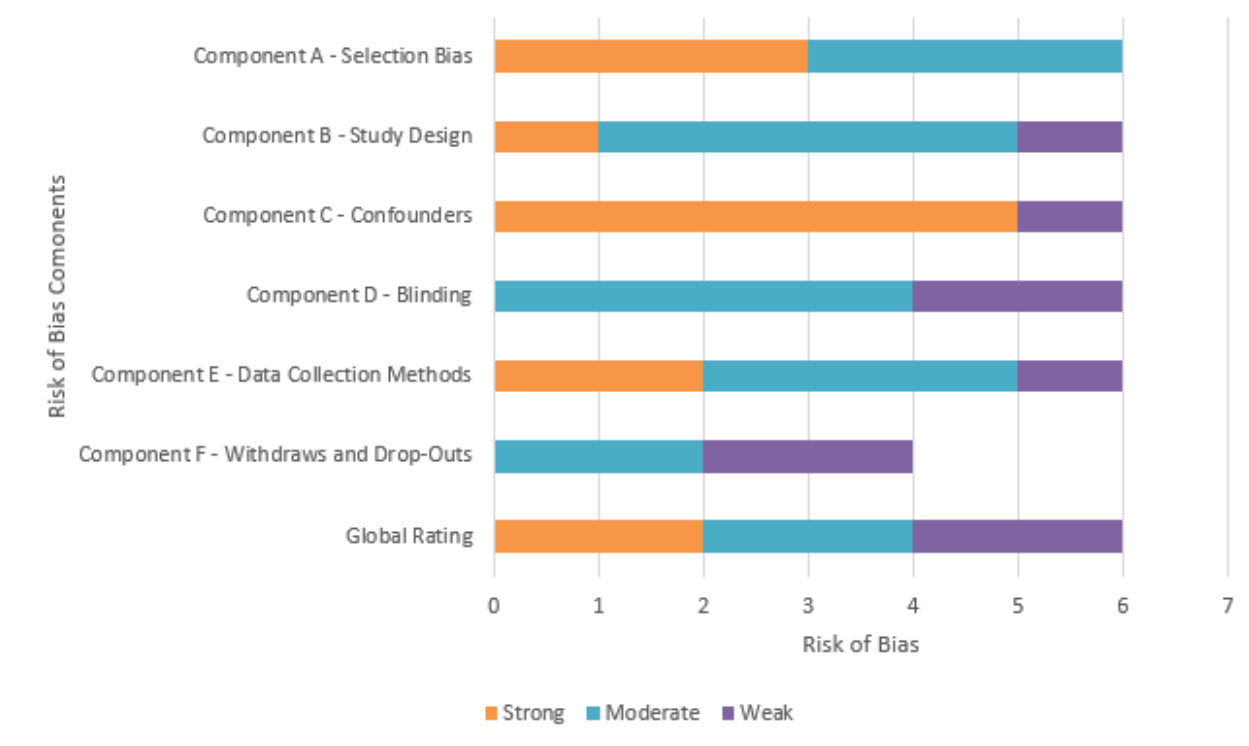
The Revised Cochrane risk-of-bias (ROB 2.0) tool for RCTs (n=11) identified challenges in managing risk of bias; with five studies rated as “high risk of bias” [12, 14, 16, 24, 28], four studies rated as “some concerns” [13, 19, 26, 27] and two studies rated as “low risk of bias” [18, 22]. The Domain risk of bias due to missing outcome data and measurement of the outcome were identified to be most frequently as “low Risk”. (Figure 6)

Figure 6. Risk of bias in randomized home care economic analysis studies



The Effective Public Health Practice Project was utilized to evaluate the risk-of-bias in six studies and identified two studies with the Global rating of “weak” [15, 17], two studies with the “moderate” rating [23, 25] and two studies with the rating of “strong” [20, 21]. A component that was consistently well reported was “confounders”, whereas other areas had challenges in reporting such as “blinding”, and “withdraws and drop-outs”. (Figure 7).

Figure 7. Risk of bias in quantitative home care economic analysis studies



Discussion

This study identified 17 studies from six specialty areas comparing a standard form of home care to a new or alternative form of home care with accompanying economic analysis. These six main areas are difficult to compare even within the groups identified, as the outcomes assessed, and tools used to measure them were also diverse. (Appendix 5).

Promising results for options to improve health and economic outcomes within home care were found in alternative nursing care. Studies assessing alternative forms of nursing home care, such as health promotion and preventative care, found some positive trends in health gains, with an overall positive or cost-effective economic evaluation. The oldest study [12] did not support the additional government funding required to provide specialized respiratory nursing care. The

more recently published studies suggested that alternative nursing care can reduce personal assistant use, hospitalization, and outpatient costs [13-15].

Fall prevention research for clients receiving care in their home identified positive or cost-effective interventions when considering subgroups. Challenges have been reported across studies in this area with decreased adherence to interventions, for example exercise, exercise, that may affect the appearance of program effectiveness [16, 19]. The overall evidence suggests that fall prevention programs may be cost-effective for: (1) specific intervention strategies, such as occupational therapy implemented home safety programs; (2) client subgroups such as men between the ages of 75-84 years; and (3) funders enhanced level of willingness to pay to prevent a fall ($\geq 25,000$ CAD) [16-18]. Markle-Reid et al. suggested that in addition to reduce falls other important outcomes may be valuable to measure, such as slips and trips, as well as subgroup analysis of the population [18].

Alternative systems of interdisciplinary care coordination have also demonstrated positive or cost-effective interventions when considering subgroups. Hammar et al. reported that although both the NHP and EQ-5D-3L instruments were used to provide a parallel measure of generic health status, only the NHP demonstrated cost-effectiveness via changes in health status [20]. This is a relevant consideration as it revealed that the instruments selected to measure health may impact on what seems to be cost-effective.

Mixed results were identified in cost-effectiveness for the use of remote monitoring/telemedicine technology. Williams and Wan found that because of the additional costs of the technology and neutral outcomes, there is a decreased opportunity for these interventions to be cost-effective [25]. This form of intervention may be more appropriate for specific subgroups of the home care population, including those in remote areas with limited access to services or areas

experiencing staffing shortages where cost for care provision may have already become a secondary concern [30].

The two reablement/restorative care studies from Norway and Australia used additional rehabilitation professionals (occupational therapist and physical therapist) to produce cost-effective outcomes [26, 27]. Within some home care contexts, such as Canada, rehabilitation professionals, such as the ones used in the reablement/restorative care interventions, are already often available in standard care. It is possible that in the contexts where these rehabilitation professionals are already in place and would only need to modify their intervention, the costs incurred and changes in health outcome may both be diminished.

Undernutrition can affect a person's ability to remain at home safely. Although the multifactorial intervention to address undernutrition did not produce cost-effective results in improving body weight [28], the improved function identified through the ADL-Barthel score found in this area of research may be more relevant in helping individuals remain at home safely.

Risk of bias for reviewed studies was a frequent concern for both RCTs and other quantitative studies alike. Only a few studies were found to have a "low risk of bias" in RCTs or "strong" global rating in non-RCTs. Noteworthy is that some domains assessing risk of bias were shown to be less successfully completed than others. Researchers need to pay greater attention to identified aspects of conducting and reporting results to potentially reduce the risk of bias in future trials.

The review results also highlight the need for more comprehensive reporting of economic study details. On average, the articles reported information in 15.2 of 24 areas identified in the CHEERS checklist. However, there has been slow improvement in quality of reporting within economic evaluations over time. The mean CHEERS score increased from 12 to 15, and 15.8,

for before 1999, 2000 to 2009, and 2010 to 2019, respectively. These results show that there is still a need to improve the economic evaluation reporting in economic home care studies.

When compared, the RoB and Effective Public Health Practice Project ratings to the economic evaluation reporting (CHEERS), the studies that rated at a “high risk of bias” by the RoB or had a “weak” Effective Public Health Practice Project global rating had on average a lower score in the CHEERS (14.3). Studies that had “some concerns” or had a “moderate” global rating had an average score of 15.2 in the CHEERS, whereas studies with a “low risk of bias” or “strong” global rating were found to have an average of 16.75 CHEERS scores. Thus, on average, studies with a lower risk of bias are also more likely to have necessary economic evaluation information reported, compared with studies with a higher risk of bias.

This study also identifies the need for health care decision makers to thoroughly evaluate the research results being reported because of the potential for risk of bias in both RCTs and quantitative non-RCT studies. Furthermore, without full reporting of economic information as identified on the CHEERS document, it will be difficult to determine applicability to other areas interested in applying the intervention. Researchers should consider utilizing the tools available, such as the Quality Assessment Tool for Quantitative Studies, the RoB 2.0 tool and the CHEERS tool when setting up, conducting, and reporting health economic evaluations.

It is important to notice that only 3 of the 17 studies presented their results as the ICER [20, 26, 28], which has been recommended for reporting economic evaluation results by national agencies like the Canadian Agency for Drugs and Technologies in Health [29]. Without this information, decision makers may not fully comprehend how much value in terms of potential duration and quality of life is received or lost with changes to funding of home care.

One of the main limitations for this study was identifying what usual home care consists of in different studies. For example, stating that the care provided was determined by the underlying health care need of the clients. This rationale does not explain local standards in service provision or copayment requirements, which can have a significant impact on how much support is being accessed by the client. Another limitation is that in the home care setting, a wide scope of interventions are provided and outcome measures used. An in-depth comparison or meta-analysis is not possible for the current study as there is minimal overlap of outcomes; for example, only one study used quality-adjusted life year. An additional limitation is the quality of the reported studies. This information should be considered with caution and in relation to the risk of bias.

This study has also several strengths, including a comprehensive search strategy that was developed with a librarian. The search was not limited by year or language which has facilitated a comprehensive and international approach to data collection. The process of study selection was completed by two reviewers independently. Finally, to the best of our knowledge, this systematic review is the first comprehensive cost-effectiveness evaluation completed for home care.

Conclusions

Current evidence for home care interventions with accompanying economic evaluations suggests that there are opportunities to improve care and possibly at a neutral or lower cost. The quality of reporting in this area of research is problematic because of issues with risk of bias and incomplete, but slowly improved, reporting of economic information. Further research with

improved reporting would allow health care decision makers to feel more confident in considering and selecting alternative cost-effective home care interventions.

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Chapter 4: Health-related quality of life of home care clients in Alberta, Canada

Abstract

Limited information is available in understanding factors related to changes in Health-Related Quality of Life (HRQoL) of older adults accessing home care (HC) services on a long-term basis. This study analyzed factors associated with HRQoL and the changes over approximately a one-year period among HC clients using Alberta administrative data. Regularly collected clinical information was utilized from Alberta Health Services (AHS) supported assessment tool, the Resident Assessment Instrument – Home Care (RAI-HC). A validated mapping process was used that estimates Health Utility Index 3 (HUI3) scores based on the RAI-HC assessments. A total of 8,743 clients with 17,486 observations were included in the study and evaluated at two points in time. HRQoL was evaluated through a comparison of first to second-year outcomes on the approximated HUI3 outcome. The average baseline age was 83.1 (standard deviation (SD) 8.3) years and 5,847 clients (66.9%) were female. The baseline HUI3 score was 0.382 (SD 0.296) and it decreased over the period of approximately one year to 0.298 (SD 0.315). We observed HRQoL (HUI3) decrease in 52.2%, increase in 27.9%, and stable status in 19.9% of clients over time. Clients with stable or improved HRQoL were younger and were less likely to have had a recent change in health condition ($p = <0.001$). Factors associated with decreased HRQoL were being older, having an increase in Comorbidity Index scores, clinical specialties support, and non-regulated support during the study period. The HUI3 estimates can be used to monitor changes in client HRQoL over time and factors associated with the changes can help improve the effectiveness of HC management decisions.

Introduction

Individuals 65 years of age and older are a rapidly growing segment of the Canadian population and by 2030 are predicted to number over 9.5 million, making up 23% of the population [1]. Home care (HC) services are critical to maintaining the health of community-residing older adults and their quality of life [2-5]. Yet, research is just at the beginning stages of investigation into the relationship between HC client characteristics, service use, and quality of life [6].

The goals of HC are to support independence and improve function thereby allowing older people to stay at home for as long as possible [7-9]. In Canada, HC is not federally regulated leading to a variety of services available, such as clinical specialties support (i.e. registered nurses, physical therapists, occupational therapists, and social workers) and non-regulated support (i.e. home health aides, volunteer services, and day programs) depending on the province and community of residence [4, 10].

Incorporating Health-Related Quality of Life (HRQoL) measures, including within HC evaluation, can be a useful tool for health observation, monitoring quality of care, and assessing outcomes on patient, program, and inform policy at a health care system level [11-13]. HRQoL represents multiple components that encompass all important aspects of quality of life relating to health [14] and can refer to values or utilities of different health states [15]. Utility values, generally ranging from 0.0 (dead) to 1.0 (perfect health) are practical as they can be used to create a composite indicator, the quality-adjusted life-year [16]. When considered with costs, utility values allows for comparison between diverse health outcomes and interventions applied via cost-utility analysis [16]. However, there are several barriers to implementing HRQoL measures, including cost, clinical relevance, validity, reliability, ease of use, responsiveness of

the measure and, if necessary, appropriate translation [11]. Measuring HRQoL for individuals accessing HC services presents further difficulties, as not all subgroups of individuals may be represented equally due to results being biased towards the healthy and cognitively intact clients who are able to respond [17]. Earlier research notes that the oldest adults may refuse or be unable to participate due to various health concerns including impaired cognition [18, 19]. One solution is to use proxy measurements for older adults who cannot respond themselves, although that method is time consuming and costly, particularly when used on large scale. Developing methodologies that accommodate for these various challenges are needed to better assess the HRQoL for all older adults accessing HC services.

A common instrument to assess HRQoL internationally is the Health Utility Index (HUI) [20]. In consideration of the frequent application of the HUI, recent research has developed a mapping system that utilized administrative data from a commonly used clinical tool, the Resident Assessment Instrument – Home Care (RAI-HC), to the HUI [17]. This mapping process provides a potential method to better understand the HRQoL for a more diverse group of HC clients [17]. Following from the updated Production of Welfare (POW) Framework [6] it is expected that various personal, environmental and service characteristics will impact HRQoL outcomes. This model highlights the interaction between various input factors and to create both intermediate outputs and final outcomes [6], which allows a comprehensive understanding to how people's HRQoL are impacted by their situation.

There is a gap in the literature addressing HRQoL status for the whole continuum of older adults accessing HC services, and little is known about which factors are associated with declined, stable or improved HRQoL changes over time. As HC programs are expected to continue to grow in the future [7, 21], information from HRQoL outcomes would support

program planning, monitoring and evaluation. This research aimed to study factors associated with changes between two sequential HRQoL assessments completed approximately a one-year apart among HC clients using HUI3 results estimated from administrative RAI-HC data.

Methods

Design, Sample and Setting

This study is an observational retrospective exploratory evaluation of HRQoL for older adults accessing HC for long-term service provision over a period of about one year. Data was used from Alberta Health Services (AHS), a provincial healthcare authority, that was previously collected for service provision within the HC program in Edmonton Zone. Edmonton Zone provided services to approximately 36,000 of the 115,000 clients that accepted HC across Alberta [22].

Inclusion criteria required clients access long-term HC service (over three months) and complete a RAI-HC assessment from both specified collection periods; providing both a baseline and follow-up assessment. Included clients were required to have one assessment between March 1, 2018 and February 28, 2019 (baseline), and a second completed between March 1, 2019 and February 29, 2020 (follow-up). To control for random differences of time elapsed between assessments a selection process was implemented to maximize time between sequential assessment periods. Specifically, the first assessment from the baseline period was kept and then any subsequent measures from this period was dropped. During the follow-up period the final RAI-HC assessment was kept, and any earlier measurements were dropped.

Additionally, inclusion criteria required clients to be categorized as a Long Term Supportive or Maintenance client. Full definitions of client groups are available online [23]. Clients must have received HC in any setting except a Long-Term Care Facility (LTCF), other

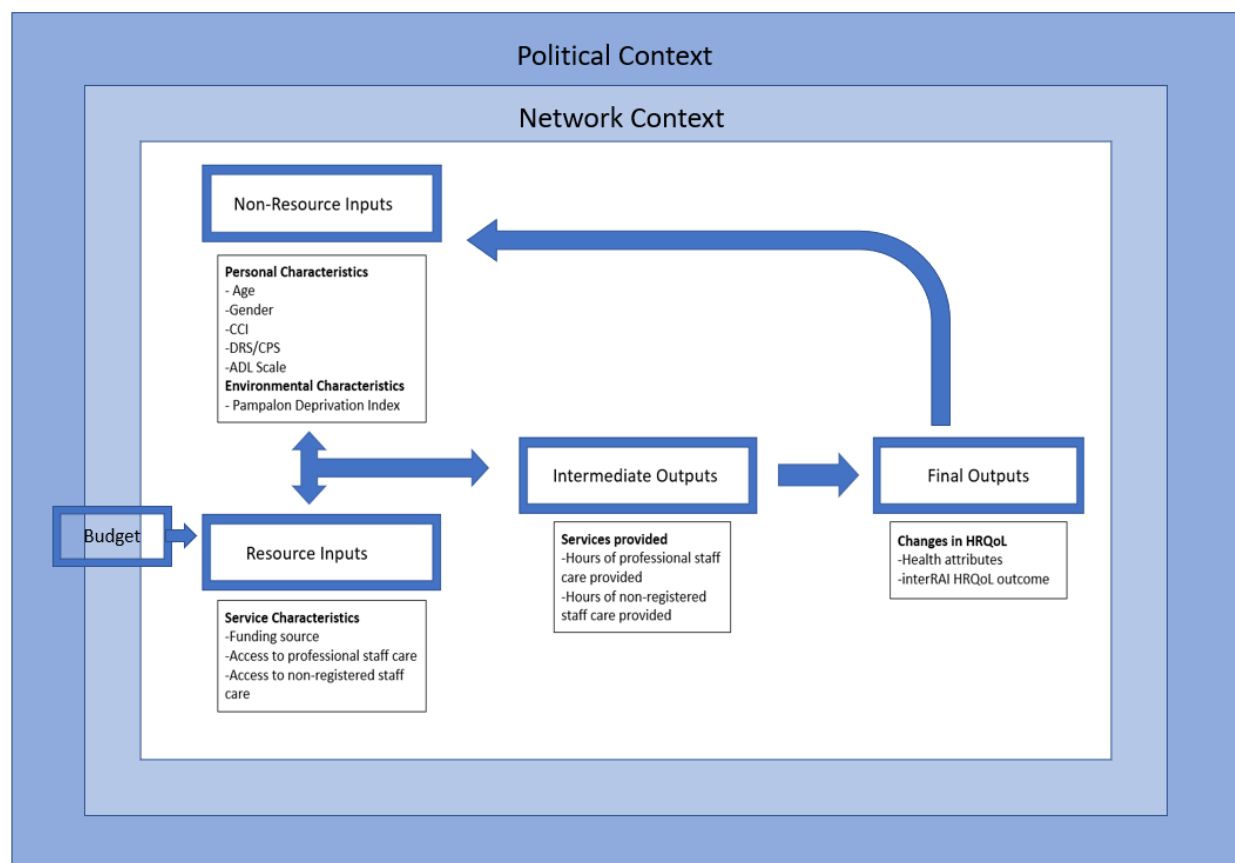
formal care setting such as designated supportive living, or hospice. Included clients were 65 years or older as of March 1, 2018 and were scheduled to receive at least one service visit of any kind per week during the study period to ensure included clients were actively involved with the HC program.

Excluded from the study were clients categorized as Acute, Rehabilitation, End-of-life, Wellness, clients accessing only day programs or funding for self-managed care. Also excluded were clients who did not have assessments from the two points in time identified for data collection, were under 65 years of age as of March 1, 2018 and who were not scheduled for at least one weekly visit from HC.

AHS data analyst provided data for clients that met inclusion criteria removing clients that met exclusion criteria for this series of research projects. Data extracted for the selected individuals included the RAI-HC, basic demographics, health status, and services accessed. Additionally the Pampalon Deprivation Index (PDI) value [24] was collected.

The framework for this research is guided by a model proposed by Knapp [25] noted as the POW Framework and further studied in the HC setting [6]. An updated model (Figure 8) allows for consideration of both available resources and non-resources impacting intermediate outputs of services provided and final output of changes in quality of life. [6].

Figure 8. Applied production of welfare framework to home care clients HRQoL outcomes



Instruments

Resident Assessment Instrument–Home Care (RAI-HC)

The RAI-HC is a comprehensive standardized assessment tool used within not only AHS HC provincially, but also nationally and internationally, to evaluate care needs [17, 26, 27]. The RAI-HC assessment is used to develop a care plan for scheduled care provided by HC staff who are generally not available 24 hours a day. Adults accessing government funded long-stay HC services in Alberta are required to have a RAI-HC completed at intake, annually from the initial assessment date and additionally if there is a significant change in health condition [9]. To ensure the collected data is robust, the RAI-HC assessment collects data through discussion with clients,

care providers and from other available health information including clinical evaluation [9]. The RAI-HC psychometric properties have been reported in various publications and has been found to be reliable and valid [28-30].

Health Utility Index (HUI)

The original HUI1 was developed in 1982 and subsequently refined to produce the HUI Mark 2 (HUI2) [31] and HUI Mark 3 (HUI3) [32, 33]. The HUI is a generic preference-weighted instrument used to identify HRQoL through multiple attributes [32]. It can be used to describe changes over time in health status classification or numerically as a utility scoring formula [32], measure outcomes in clinical studies, provides utility scores for cost-utility and cost-effectiveness studies, and examine quality of population health [20, 33].

The HUI Mark 3, referred to from this point forward as HUI3, functions as a scoring tool using eight independent health attributes (vision, hearing, speech, ambulation, dexterity, emotion, cognition and pain) with five to six levels of function per attribute [32]. This measure provides comparable preference scores with other instruments like the EQ-5D [34]. The HUI3 health attributes are then combined through the Multi-Attribute Utility Function formula to identify an overall single preference score ranging from the worst state at -0.36 to perfect state at 1.0. Significant change within the overall HUI3 score centers around a difference of 0.03 and for individual attributes a score of 0.05 was considered meaningful [20].

Mapping RAI-HC to HUI3 (interRAI HRQoL Outcome)

Hirdes et al. (2018) created a mapping algorithm between the RAI-HC and the HUI3 to reproduce both the clinical and theoretical constructs of the HUI3 while using RAI-HC data. This process uses information collected from the RAI-HC to identify both health attributes and an overall HRQoL value, the interRAI HRQoL. Earlier research notes that data mapped from the

RAI-HC to the HUI3 is sensitive to change in clinical status thereby can be used as a summary indicator for comparison of HRQoL over time, and provide an option to better assess the HRQoL for a group of vulnerable individuals [17]. To create the HUI3 outcome, the RAI-HC questions and levels that represent the eight HUI3 attributes and their levels, were identified and assigned. The HUI3 attribute levels were then given a utility weight based on Canadian population values. Subsequently the standard HUI3 formula was implemented using all eight utility weights [33] to create an interRAI HRQoL score.

Pampalon Deprivation Index (PDI)

The PDI score was used as a scale for socioeconomic deprivation. This index was developed through a “social component” and a “material component” stratifying the population into five quintiles according to a level of deprivation and can be used as a proxy measure for socioeconomic status [35]. If the number of clients in a particular area was too small (less than 5 to prevent possible identification), or any component of the required information was not available the PDI values were coded as zero.

Comorbidity Index (CI)

To classify individuals with various health conditions identified as impactful on mortality in longitudinal studies, a CI was used as a health stratifying platform [36]. The updated version of the Charlson Comorbidity Index presented by Quan et. al., (2002) was selected, and completed with available data from the RAI-HC. Based on the available information from the RAI-HC, 6 diagnoses were compressed or excluded from the list and nine impactful diagnoses were added to the CI summary measure (Appendix 7). A higher CI score indicates lower health level.

Service Utilization

The RAI-HC collects information on the extent of service time provided to the client by a formal caregiver for direct care or care management “over the last seven days or since last assessment if less than 7 days” [37]. Service categories include specialized care and non-specialized care types that are listed in the RAI-HC [38]. Specialized care time (hours) was computed as the sum of the physical therapy, occupational therapy, speech therapy, nursing and social work. Non-specialized care time was computed as the sum of home health aids, homemaking, meals, volunteer services and day care.

Analysis

Results were reported using direct count with percent for categorical variables (e.g., sex, age) and mean with Standard Deviation (SD) for continuous variables (e.g., HUI3 utility). Both descriptive and regression analyses were used to analyze the baseline (Time 1) and follow-up (Time 2) and the change over time based on groups that showed stable (± 0.03), improved (>0.03), or declined (<-0.03) HUI3 utility score. Descriptive statistics were used to report HC client demographics, health, functional status, service provision and HRQoL. Chi-square tests were applied to examine the overall differences in the HUI3 utility change by each covariate. Significant values were set at $p < 0.05$. STATA version 15.0 was used for statistical analysis.

To investigate changes in the HUI3 utility over time, univariate (unadjusted) and multivariate (adjusted) logistic regressions were applied to provide a comparison between clients with decreased to those with improved or stable HUI3 score based on changes over the follow-up. Covariates included in the unadjusted logistic regression model were baseline variables sex, age, CI change, specialized care and non-specialized care change and time elapsed between assessments. In the multivariate logistic regression, model one adjusted for sex, age, CI change, time elapsed between assessments and the baseline HUI3 and CI score. Adjusted model two

further adjusted for the change of care services and their baseline scores. Due to the large amount of missing data for the PDI (41.8%), this variable was removed from the regression analysis. As the unit of HUI3 was relatively small (between -0.36 and 1), and some clients had a negative HUI3 score, a standardized baseline HUI3 utility score was used in the multivariate regression model (computed as individual score minus the mean score and divided by the SD) for ease of the interpretation. As such, the association between the baseline HUI3 utility score and decreased HUI3 (outcome) is interpreted as change in the odds of decreased HUI3 associated with one standard deviation change from the mean score of HUI3 at baseline.

Ethical Considerations

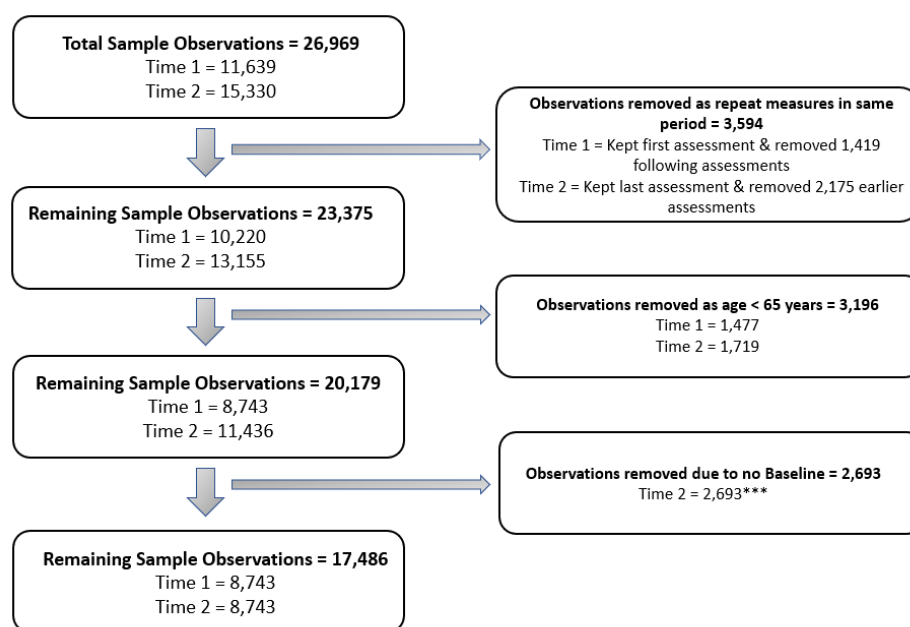
This study was approved by the Research Ethics Board at the University of Alberta (Identification Number: Pro00108790). Information provided to the research team had client identifiers removed.

Results

Description of the sample

The sample consisted of a total of 8,743 clients (66.9% women) and a total of 17,486 observations. Figure 9 shows the sample selection process and Table 4 shows the characteristics of clients. At baseline, the mean age of clients was 83.1 years (SD 8.3) with a range between 65 and 108 years. The highest percentage of clients was in the 85 and older age group (48.6%) followed by 75–84-year-old clients (33.4%).

Figure 9. Sample selection



*Time 1 = Baseline (March 2018 to February 2019)

**Time 2 = Follow-up (March 2019 to February 2020)

***Data was provided for a series of research projects, which included additional observations in Time 2 not applicable to this study.

The mean (SD) CI was 3.18 (1.97) at baseline and 3.51 (2.05) at follow-up. Among the clients, 16.6% had a one-score increase in CI, and 15.9% had a two-score or greater increase in CI over time. The clients in the least deprived PDI (1) category accounted for 17.2% and overall there was missing data in the PDI measure for 41.8% of the sample. When considering differences between those with and without measures for the PDI, analysis shows small effect size for gender and age grouping and no statistically significant difference based on comorbidity index or HUI3 outcome (Appendix 8). At baseline, 69.4% of the clients did not have any clinical specialties support and 21.6% did not have any non-regulated support. Overall, clinical specialties support provided fewer hours of care than non-regulated support, and the most frequent category of time for non-regulated services was less than 5 hours a week (Table 4).

The baseline measures of individual health attributes that create the HUI3 score ranged from 0.841 (SD 0.177) for cognition to 0.994 (SD 0.041) for dexterity (Table 4). The mean HUI3 score at baseline was 0.382 (SD 0.296), ranging between -0.346 and 0.984. The HUI3 scores at baseline by the covariate groups are presented in Appendix 9. Female clients had lower baseline HUI3 utility score than male clients ($p = 0.025$). The younger age categories had higher HUI3 scores (0.393), and the oldest age category showed the lowest HUI3 (0.370) ($p = 0.009$). A trend of decreasing HUI3 score with increasing CI score was observed ($p < 0.01$); the highest HUI3 was found for individuals with 0-1 diagnoses (0.457) and the lowest for 7 or more diagnoses (0.272). At baseline clients with lower HUI3 scores were found to be associated with increasing service time provided by clinical specialties support and non-regulated support ($p < 0.01$).

Change in HUI3 score

Table 4 shows that the mean HUI3 score decreased by 0.084 between the measurements. Decrease in the mean individual health attribute categories occurred in all individual health attributes except dexterity (no change) and pain (increase by 0.01). The largest drop in mean health attribute occurred in the categories of ambulation (-0.04) and cognition (-0.04).

Table 4. Characteristics of the clients, CI score, health care services and HUI3 utility scores

Variable	Time 1: Baseline (March 2018 to Feb 2019)	Time 2: Follow-up (March 2019 to Feb 2020)
Gender: n (%)		
Male	2896 (33.12)	
Female	5847 (66.88)	
Age group: n (%)		
65-74 years	1573 (17.99)	
75-84 years	2922 (33.42)	
≥ 85 years	4248 (48.59)	

PAMPALON index score: n (%)		
1 (least deprived)	1500 (17.16)	
2	799 (9.14)	
3	1131 (12.94)	
4	881 (10.08)	
5 (most deprived)	778 (8.9)	
PAMPALON (not known)	3654 (41.79)	
CI score: mean (standard deviation, SD)	3.18 (1.97)	3.51 (2.05)
CI change group (follow-up score minus baseline score): n (%)		
CI decreased and no change	5907 (67.56)	
CI increased = 1	1449 (16.57)	
CI increased ≥ 2	1387 (15.86)	
Clinical Specialties Support care received* (hours/week): mean (SD)	0.74 (1.86)	1.20 (2.75)
Clinical Specialties Support care change (follow-up hours minus baseline hours): n (%)		
No change and decreased	6179 (70.67)	
Increased	2564 (29.33)	
Non-regulated Support care received** (hours/week): mean (SD)	6.73 (10.19)	8.79 (11.47)
Non-regulated Support care change (follow-up hours minus baseline hours): n (%)		
No change and decreased	4182 (47.83)	
Increased	4561 (52.17)	
HUI3 global and attributes' scores: mean (SD)		
Global HUI3 utility score	0.382 (0.296)	0.298 (0.315)
Vision	0.939 (0.093)	0.927 (0.102)
Hearing	0.946 (0.084)	0.937 (0.089)
Speech	0.969 (0.054)	0.955 (0.068)
Ambulation	0.868 (0.111)	0.825 (0.129)
Dexterity	0.994 (0.041)	0.989 (0.053)
Emotion	0.917 (0.157)	0.912 (0.161)
Cognition	0.841 (0.177)	0.800 (0.196)
Pain	0.933 (0.090)	0.935 (0.088)

CI = Comorbidity Index, HUI3 = Health Utility Index Mark 3

* Physiotherapy, occupational therapy, speech therapy, nursing and social work

** Home health aids, meals, homemaking, volunteer services, day care

Over time, approximately 28% of the clients improved, 20% remained stable and 52% decreased their HUI3 score (Figures 10A, 10B, and Table 5). The mean changes over time per group were 0.207 (SD 0.164) for improved, 0 (SD 0.010) for stable and -0.270 (SD 0.204) for decreased category. Of all the predictors, sex was the only assessed factor that did not significantly impact the distribution of HUI3 change over time. A similar distribution is found within each of the PDI quintiles when compared to the total sample for improved, stable or decreased outcome. The younger age groups had more clients in improved or stable categories compared to oldest age group (85+). In the improved HUI3 category, a higher number of clients with a decreased or no change in CI score was observed. Alternatively in the decreased HUI3 category, a higher number of clients with increases in CI score were observed. For care services, clients with increased hours of specialized and non-specialized care were more likely to have had a decreased HUI3 score than the clients with no change and decreased hours of the same care (Table 5).

Figure 10. HUI3 utility score by population distribution for change over time

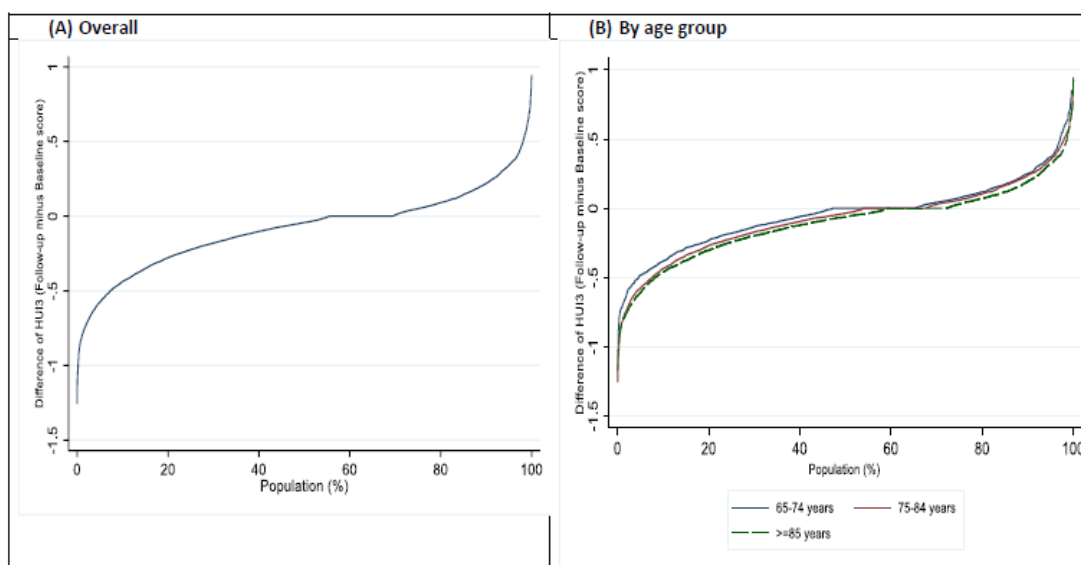


Table 5. Frequency distribution (n (%)) of HUI3 change group by covariates

Variables	Improved HUI3	Stable HUI3	Decreased HUI3	P-value
Total sample	2436 (27.86)	1741(19.91)	4566 (52.22)	
Gender				0.906
Male	811 (28.0)	569 (19.65)	1516 (52.35)	
Female	1625 (27.79)	1172 (20.04)	3050 (52.16)	
Age group (baseline)				<0.001
65-74 years	502 (31.91)	374 (23.78)	697 (44.31)	
75-84 years	875 (29.95)	560 (19.16)	1,487 (50.89)	
>=85 years	1,059 (24.93)	807 (19.00)	2,382 (56.07)	
PAMPALON index score				<0.001
1 (least deprived)	404 (26.93)	304 (20.27)	792 (52.80)	
2	210 (26.28)	176 (22.03)	413 (51.69)	
3	335 (29.62)	233 (20.6)	563 (49.78)	
4	259 (29.4)	202 (22.93)	420 (47.67)	
5 (most deprived)	252 (32.39)	182 (23.39)	344 (44.22)	
PAMPALON (unknown)	976 (26.72)	644 (17.63)	2,033 (55.65)	
CI change group (follow-up score minus baseline score)				<0.001
CI decreased and no change	1777 (30.08)	1420 (24.04)	2710 (45.88)	
CI increased = 1	364 (25.12)	199 (13.73)	886 (61.15)	
CI increased ≥ 2	295 (21.27)	122 (8.80)	970 (69.94)	
Clinical Specialties Support care (follow-up hours minus baseline hours)				<0.001
No change and decreased	1799 (29.11)	1426 (23.08)	2954 (47.81)	
Increased	637 (24.84)	315 (12.29)	1612 (62.87)	
Non-regulated Support care (follow-up hours minus baseline hours)				<0.001
No change and decreased	1089 (26.04)	938 (22.43)	2155 (51.53)	
Increased	1347 (29.53)	803 (17.61)	2411 (52.86)	

CI = Comorbidity Index, HUI3 = Health Utility Index Mark 3

Note: HUI3 stable: difference > -0.03 and < 0.03 ; HUI3 increased if the difference ≥ 0.03 , HUI3 decreased if difference ≤ -0.03)

Logistic regression results for change in HUI3 utility

Table 6 shows the results of logistic regression analysis for clients with decreased HUI3 utility scores compared to clients with improved or stable HUI3 scores. Model 1 presents the unadjusted regression results, and model 2 and model 3 present the adjusted regression results. Age was found to be impactful in both the unadjusted and adjusted models, with increasing age (75-84 years and 85 years or older) demonstrating higher odds for decreased HUI3 score compared to age group of 65-74 years. Sex was not significantly related to decreased HUI3 score. An increase in the CI score during the assessment period was associated with higher odds of decline in HRQoL. Similarly, clients with an increase in clinical specialties and non-regulated support care over time (relative to no change and decrease in receiving the care) were significantly more likely to experience a decreased HUI3 after adjusting for their baseline scores and other covariates. Time elapsed between baseline assessment and follow-up assessment, categorized as under or equal to/over 365 days was not significantly impactful in either unadjusted or adjusted models relating to decreased HUI3 score. Baseline non-regulated care was found to be impactful for HUI3 decrease in the adjusted model 2. Elevated baseline HUI3 and CI scores were related to higher odds of having decreased HUI3 score. (Table 6)

Table 6. Logistic regression models for the odds of decreased HUI3 utilities over time (use change of CI and care)

Variables	Unadjusted model		Adjusted model 1^a		Adjusted model 2[‡]	
	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Female vs. Male	0.99 (0.91, 1.09)	0.871	1.01 (0.92, 1.11)	0.782	1.03 (0.94, 1.13)	0.550
Age						
65-74 years	1.0		1.0		1.0	
75-84 years	1.30 (1.15, 1.47)	<0.001	1.31 (1.15, 1.49)	<0.001	1.30 (1.14, 1.48)	<0.001
≥ 85 years	1.60 (1.43, 1.80)	<0.001	1.67 (1.48, 1.89)	<0.001	1.67 (1.47, 1.89)	<0.001
CCI change groups						
No change and decreased	1.0		1.0		1.0	
Increased 1 score	1.86 (1.65, 2.09)	<0.001	1.95 (1.73, 2.21)	<0.001	1.82 (1.61, 2.06)	<0.001
Increased 2 scores or more	2.74 (2.42, 3.11)	<0.001	2.95 (2.58, 3.36)	<0.001	2.65 (2.32, 3.03)	<0.001
Clinical Specialties Support care change						
No change and decreased	1.0				1.0	
Increased	1.85 (1.68, 2.03)	<0.001			1.88 (1.70, 2.08)	<0.001
Non-regulated Support care change						
No change and decreased	1.0				1.0	
Increased	1.05 (0.97, 1.15)	0.213			1.13 (1.03, 1.24)	0.008
Follow-up time						
< 365 days	1.0		1.0		1.0	
≥ 365 days	1.00 (0.92, 1.09)	0.979	1.02 (0.93, 1.11)	0.695	1.04 (0.95, 1.14)	0.408
HUI3 utility score* (standardized, baseline)			1.61 (1.54, 1.69)	<0.001	1.75 (1.66, 1.84)	<0.001
CCI score (baseline)			1.04 (1.01, 1.06)	0.001	1.03 (1.00, 1.05)	0.031
Clinical Specialties Support care (baseline)					1.03 (1.00, 1.05)	0.027

Non-regulated Support care (baseline)					1.01 (1.01, 1.02)	<0.001
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CI = Comorbidity Index, HUI3 = Health Utility Index Mark 3

Calculation of the standardized HUI3 utility score: the observed score subtracted the mean and divided by the standard deviation for each observation.

▫ Adjusted model 1: adjusted for sex, age, change of CI, follow-up time and baseline HUI3 utility and CI score.

◆ Adjusted model 2: additional adjustment of the change of care services (as two groups) and their baseline scores from adjusted model 1.

Discussion

This study shows that the HRQoL of older adults utilizing HC services is low (mean HUI3 0.382) and for over half of the population HRQoL decreased significantly over about one year period. The HRQoL decrease was mainly related to the highest age categories and increase in chronic conditions during follow-up. The largest dimensional changes were observed in cognition and ambulation. It was also observed that increases in clinical specialties and non-specialized care support was significantly associated with decreases in HUI3 outcomes. Overall, several factors associated to decrease of HRQoL for long-term HC clients from an already modest level.

Like other HC studies [6, 17, 39], our study cohort included more women and a larger group being 75 years or older. In 2018, 56.2% of the Edmonton Zone HC clients were female with a median age of 75 years [40]. As expected, the average age in this study was higher than in the Zone HC program due to the exclusion of clients under 65 years of age and clients who accessed short term or acute care.

The mapping of the RAI-HC scores to HUI3 using the earlier tested algorithm [17] provides a promising option to estimate HRQoL outcomes in HC clients. Dropouts are not an issue when all clients are required to have sequential measurements at regular time points, like once a year in our data. RAI-HC assessments are expected to be accurate as all available sources of data are used as information for its completion and professional staff have extensive training completing the assessment. The only observed issue with missing data from the RAI-HC, was potentially in the section Disease Diagnosis. Specifically, fifty-eight clients were found to have a decrease of four or more health conditions listed in the RAI-HC assessment. Since many of these conditions are considered chronic in nature, it was possible that the second assessment did not

fully identify all conditions. Our observed HUI3 outcomes (0.382 at baseline and 0.298 at follow-up) were like other research for long-stay HC clients in Ontario, Canada with a mean HUI3 score of 0.34 [17]. With consideration of information completeness and accuracy this method does appear to be a feasible and valid way to collect HRQoL data for HC population that is rarely represented in research.

Although there was a tendency to have lower odds of a decreased HUI3 among individuals identified with the highest socioeconomic deprivation level, due to the large portion of missing data on this variable, the deprivation variable was removed from the final model. Exclusion of this variable did not have a significant impact on the HUI3 outcome (Appendix 8). Funding sources outside of the AHS HC program are also collected by the RAI-HC, such as funding provided by another province/territory or Veterans Affairs Canada but were scarcely reported. Therefore, these results were not included, although may be insightful with further research for other jurisdictions.

Results suggest the change in HRQoL was significantly impacted by age; with clients categorized in the older age groups being more likely to have a decrease in HUI3 score. Earlier research has also reported modestly lower HRQoL scores amongst HC clients aged 85 years and older when compared to younger HC clients [17]. One possibility for this is that the older age category may be experiencing an elevated age-related accumulation of health deficits. Research on frailty has suggested that it can be understood as a state of poor health due to an ongoing accumulation of deficits from a variety of functional or health attributes [41]. It is possible that for some of the individuals in this study who demonstrated an ongoing decline in HRQoL this outcome may be indirectly measuring some advancing frailty. Although the idea of heterogeneity

in the aging process and frailty is relevant to HC client research, it was not specifically evaluated in this study due to lack of appropriate frailty measure in the used data. suggests

The categorization of HRQoL changes over time did produce some unexpected results. Unlike other research in this area reporting that females, compared to males, have lower HRQoL [17, 42], this study found equal gender representation once the categories of improved, stable or declined HRQoL were implemented. Both the baseline and follow-up CI score were found to be impactful in categorizing individuals with decreased, stable or improved HUI3 scores. Observed trends suggest that an individual may be more likely to demonstrate an improved HUI3 score with a higher number of health conditions at baseline. This result may be a function of the type of diagnosis. For example, individuals in the improved category may be experiencing health issues that they can recover from such as a fracture whereas individuals in the decreasing category may be more commonly experiencing a chronic illness. Our results were like other Canadian research which has reported decrease in HRQoL with an increase in number of chronic conditions [43]. Logistic regression modeling demonstrated that although CI score at baseline was relevant, an increase in CI score during the assessment period was more highly associated with having a deceased HUI3 outcome. This may suggest that individuals are able to adjust and overcome health diagnosis in the long term, but with a new health diagnosis the negative health effects remain impactful on HRQoL outcomes.

This study identifies an association between decreasing HRQoL and an increase in clinical specialty support care hours. HC staff support is provided based on unmet need. Therefore, results may suggest that the clinical specialties staff are able to successfully identify which clients have experienced impactful changes in HRQoL and increase both clinical specialties and non-registered care provision accordingly.

As a change in overall HUI3 score of 0.03 is considered to be clinically important [20], the change of -0.270 and 0.206 for those in the decreased and improved HUI3 outcomes respectively, are both statistically significant and clinically meaningful for clients. It is a somewhat unexpected result to have the largest group of change identified as decrease in HRQoL, as HC service is provided to assist clients to manage unmet needs and maintain or improve their health outcomes. A possible explanation is that various other factors outside of the health care system are impacting HRQoL for older adults accessing HC services, which HC is unable to compensate for.

Of note is the large number of individuals in this study who have been identified as having some form of cognitive impairment. At baseline, only 2,822 clients (32.3%) were identified as being cognitively intact. Previous research has reported decreased input from older adults who have cognitive impairment and concerns over inaccurate reporting [18]. InterRAI created HRQoL scores have been reported to be lower than survey estimates of HUI3 which “may reflect the impact of non-response bias in the survey data resulting in the exclusion of persons with substantial functional or cognitive impairments in those care settings” [17]. An additional consideration for the lower interRAI created HRQoL scores is the impact of more accurate information collected for clients with impaired cognition during the RAI-HC assessment process. Since the interRAI HRQoL (HUI3) has supported reporting through the assessing clinician, who has an in-depth knowledge of the clients medical and functional history, the scores created through the RAI-HC may provide more accurate information for this population.

Various limitations are present in this study. The collected disease information was limited to the 28 categories in the RAI-HC. An additional limitation is that no information is

available on excluded individuals who did not have two sequential RAI-HC assessments.

Therefore, this study does not contain information on long term HC clients who have moved out of the Edmonton Zone, to a higher level of care, or deceased during the assessment time which prevented a second RAI-HC assessment to be completed, and thereby inclusion in the study. A further limitation is that the PDI had a large number of missing values. This was assessed to not have a significant impact on the model results, since there were no differences in HRQoL between PDI groups.

As data was collected for one metropolitan area in Canada, caution must be used when considering its applicability to other locations. Further research could compare these results to rural communities or other areas across Canada and address the remaining gaps in knowledge for individuals who identify as immigrants, refugees or indigenous. Additional research could also provide information on the impact of frailty on these results and other services/funding that are provided but unaccounted for.

Strengths of this research include utilizing population data collected for Edmonton Zone resulting in a large and diverse sample observed over time. Population-based large cohorts allow for adjustment of various potential confounding variables in regression analyses, thus providing more robust and precise results relative to small sample studies. Information collected from the RAI-HC uses all available sources to provide the most accurate profile of the client. Equally important is that regular RAI-HC certification is required for staff using this tool, which assists in ensuring consistent use. This information could be used to support decision making within the healthcare program to ensure that factors which can be managed through medical intervention and are associated with changes in HRQoL are taken into consideration.

Conclusion

This study used longitudinal administrative health data among HC clients in Edmonton, Alberta to better understand client HRQoL and its changes over time. The study builds on current research by identifying factors that are associated with improved, declined, and stable HRQoL for older adults using HC services on a long-term basis. Factors associated with declined HRQoL are being older (e.g., aged 75 years and older), having an increased number of health conditions, increasing support from clinical specialties and non-regulated support. The HUI3 estimates can be used to monitor changes in client HRQoL over time to help improve the effectiveness of HC management decisions. The findings in this study suggest that health care interventions targeting HC clients in older age groups and with poorer health conditions may enhance their HRQoL.

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Chapter 5: Health-Related Quality of Life for home care clients in Edmonton, Alberta before and during COVID-19 pandemic

Abstract

The impact from the COVID-19 pandemic has been reported for both individuals with direct infection and to a lesser extent for individuals who have been indirectly affected. This research aims to identify changes in Health-Related Quality of Life (HRQoL) of older Canadian home care clients from two cohorts measured before (Cohort one) and during (Cohort two) the COVID-19 pandemic. Administrative data from the Resident Assessment Instrument – Home Care (RAI-HC) from Alberta Health Services (AHS) was mapped using a validated tool to the Health Utility Index 3 (HUI3). Data were collected from two groups: 1) Cohort one from March 2018 to February 2020 and; 2) Cohort two from March 2019 to May 2021. Multivariable logistic regression models identified the impact of factors on the odds ratio for a decrease in HUI3 score. For 16,603 clients, the average baseline age was 83.0 years (SD 8.3) and 67.2% were female. Cohort two was observed to have a larger (-0.10) decrease in the HUI3 outcome compared to cohort one (-0.08) decrease, demonstrating a significant difference between these two groups ($p = <0.001$). There were also higher odds of having a decreased HUI3 outcome (approximately 18%) in Cohort two, compared to Cohort one. Factors associated with declined HRQoL were identified as being in the oldest age groups, increase in diagnosis count, and increase in care. Further investigation into targeted rehabilitation and policy adjustments to moderate identified decline in the health attributes of ambulation, cognition, and communication, may better support older HC clients' well-being during and outside of pandemic periods.

Introduction

After the World Health Organization (WHO) declared COVID-19 a pandemic in March 2020, public health restrictions to minimize infection rates were established around the globe [1-3]. Various public health strategies have been employed to reduce the transmission of COVID-19 including closing borders, non-essential businesses, and schools for various lengths of time, physical distancing, discouraging tourism, limiting mass gatherings, quarantine, and stay-at-home orders [4]. It has been estimated that approximately half of all people, around 4 billion worldwide, were in home isolation or under quarantine by April 2020 [1].

Within Canada, government policy changes to manage the COVID-19 pandemic were initiated promptly. In March 2020 the Parliament was suspended [5], the Canada-US border was closed to non-essential travel [6], and the Canadian Armed Forces pandemic response to support crisis management was activated [7, 8]. Also in March, a public health emergency was declared in Alberta, Canada [9], and restrictions were implemented to limit social gatherings, with the closure of some “close-contact” and “non-essential” businesses [10].

Health impacts from the COVID-19 pandemic have been reported through both direct infection and indirectly through social restrictions and service provision changes. Unintended sequela from periods of public health restrictions have been implicated in the reduction of both physical and mental well-being [11]. For Albertans 16 years of age and older seeking primary care services, 41% reported worse physical health and 60% reported worse mental health than before the COVID-19 pandemic [12] with a larger HRQoL impact on women and younger adults [13]. A decrease in quality of life was also identified for Albertans in facility-based programs, which provide a higher level of care than Home Care (HC), following COVID-19 [14]. Impacts from COVID-19 lockdown that were associated with larger decreases in quality of life for

healthy active older adults were a lower energy level and feeling happy pre-pandemic and having a lower level of physical activity during the pandemic [15].

Despite improved understanding regarding the impact of COVID-19 public health restrictions on segments of the population, there has been limited research on the impact experienced by older adults accepting HC services. Through the first wave (March to September 2020) of COVID-19 in Ontario Canada, the HC population was identified to have significantly fewer HC admissions, reduction in the proportion of clients and amount of personal support and therapy received by clients [16]. Similar results were reported for HC clients with dementia in Ontario, noting initial decreases in personal care and therapies, with service rates mostly recovered by the end of September 2020 [17]. Prior to COVID-19, the older adult HC population was reported to have an overall decline in HRQoL of 0.08 measured by the HUI3, over approximately 1 year [18]. However, there is no similar study regarding the changes in HRQoL among older adults receiving HC services during the COVID-19 period. To provide the most effective HC services during pandemics and potential public health restrictions, it is essential to understand factors impacting health and HRQoL for older adults who require support to remain in the community. This will allow adaptation of service provision and assist in aligning interventions for appropriate and effective care during outbreaks.

Objective

To the best of our knowledge, this is the first in-depth exploration of HRQoL change and associated factors during the COVID-19 pandemic, compared to pre-pandemic reports, for older adults accepting HC services on a long-term basis. This research aims to address this gap in knowledge to report on health attributes affecting overall HUI3 outcomes, and factors associated with these changes comparing Cohort 1 (before COVID-19) to Cohort 2 (during COVID-19).

Methods

Ethics Statement

This study was approved by the Research Ethics Board at the University of Alberta (Identification Number: Pro00108790). Information provided to the research team was made non-identifiable.

Participants

Challenges exist in evaluating HRQoL of HC clients, as results may be biased towards the healthy and cognitively intact [19]. Specifically, the oldest age groups may provide limited responses due to health concerns, especially cognitive decline [19-21]. Therefore, the question evolved of how to accommodate for this challenge while allowing for assessment of HRQoL for the full range of older adults accessing HC on a long-term basis. A recently developed option is a mapping system that uses administrative data from a commonly used clinical tool, the Resident Assessment Instrument – Home Care (RAI-HC) to the Health Utility Index Mark 3 (HUI3) [19].

Procedure

To assess HRQoL changes for older adults accessing HC, from before to during the COVID-19 pandemic, an observational retrospective exploratory method was used. HC data was collected over approximately three years for the Edmonton Zone of Alberta Health Services (AHS), a provincial healthcare authority. Data collection included RAI-HC, demographics, service use and Pampalon Deprivation Index (PDI) score [22]. Two sequential cohorts were generated from HC clients who had accessed long-term (over three months) service. To be included, each cohort required the completion of two RAI-HC assessments in sequential years.

Cohort one was collected for individuals who met inclusion criteria with a first RAI-HC assessment between March 1, 2018, to February 28, 2019, and had a second assessment completed between March 1, 2019, to February 29, 2020. Cohort two was collected for individuals that met inclusion criteria with a first RAI-HC assessment between March 1, 2019 to February 29, 2020, and had a second assessment between June 1, 2020 to May 31, 2021. For cohort two the second measure collection period was delayed by three months to ensure clients had minimally three months of lived pandemic period experience. To be included clients must also have been categorized as Long Term Supportive or Maintenance. Additionally, clients were required to have a minimum of one service visit of any kind per week completed by HC, to ensure regular interaction with the HC program. Inclusion criteria also required the client to be 65 years or older as of March 1, 2018 for cohort one and March 1, 2019 for cohort two.

Clients were excluded from the cohort if they did not have two RAI-HC assessments from the time periods identified. Excluded clients were those who were categorized as Acute, Rehabilitation, End-of-life, Wellness, accessing HC for funding of self-managed care, for coordination of their day program, accepting care in hospice, Long-Term Care Facility (LTCF), or designated supportive living (DSL 3 & 4). Definitions of health programs are available [23]. The sample selection process has been reported elsewhere [18].

Instruments

Resident Assessment Instrument–Home Care (RAI-HC). The RAI-HC is used within eight Canadian provinces and territories [24] and internationally. It is a geriatric assessment tool that has been found to be reliable and valid [25-28]. Using all sources of information available, the purpose of this tool is to provide a comprehensive standardized client assessment of health and functional status and evaluation of care needs [19, 27, 29] to support the development of a care

schedule provided by HC staff. HC clients accepting care on a long term basis are required to have a RAI-HC completed at specific times including intake, annually and following a significant change in health [30].

Health Utility Index (HUI). The HUI3 is a multi-attribute health-status classification system that provides single-summary scores for health attributes and an overall preference-based summary score of HRQoL [31]. The range in the overall global HUI3 score is 1.0 for perfect health to 0.0 representing death, with the lowest possible score of -0.36 representing worse than dead [31]. This measure reports on eight independent health attributes (vision, hearing, speech, ambulation, dexterity, emotion, cognition, and pain), with five to six levels of function for each health attribute [32]. Previous studies report meaningful change for the overall HUI3 score is 0.03 and for individual health attributes a score of 0.05 [31].

interRAI HRQoL. In HRQoL measurement, mapping can be used to transfer information collected from non-preference-based measure to estimate values for another preference-based instrument through statistical association [26]. Earlier research in this area presented a mapping algorithm between the RAI-HC and the HUI3 to create the interRAI HRQoL measure [19]. The goal of the interRAI HRQoL outcome is to maintain both clinical and theoretical constructs of the HUI3 while using RAI-HC data [19]. The RAI-HC is used to identify health attribute levels, each of which is then assigned a corresponding utility weight based on Canadian population values [19]. These values are then used to populate the HUI3 formula to create the interRAI HRQoL outcome [19]. A full description of the mapping process can be obtained in earlier publications [18, 19].

Pampalon Deprivation Index (PDI). The PDI score is commonly used in Canada to measure for socioeconomic deprivation. It consists of both “social” and “material” components

to stratify the population into five quintiles of deprivation [33]. Quintile one is set as least deprived and increasing deprivation up to quintile five [33]. Canadian census data is used to create stratification levels of socioeconomic disparity by postal code, which assigns individuals living within each postal code a corresponding deprivation index value [33]. To maintain client confidentiality, if the number of clients in a specific location were too few, the Pampalon Index values were coded as missing.

Comorbidity Index (CI). As numerous health conditions have been identified to impact mortality in longitudinal studies, the CI was implemented to stratify individuals with these issues [34]. As several versions exist, the revised version of the Charlson Comorbidity Index (CCI) by Quan et. al [35] was employed, then completed with available data from the RAI-HC. Ten impactful diagnoses were added to the CI summary score measure to reflect better the disease burden of HC patients (Appendix 7).

Service Use. Care time provided to the client by a caregiver or from HC case manager from the past seven days [36] was also collected from every RAI-HC completed. Two categories of service were evaluated consisting of clinical specialties support (nursing, physical therapy, occupational therapy, speech therapy, social work) and non-regulated support (home health aids, homemaking, meals, volunteer services, day program).

Analysis

Descriptive statistics were used to report on client demographics, baseline measures and changes over time (cohort one and cohort two). Thresholds for change were set at +/-0.03 for overall HUI3 score and +/- 0.05 for individual health attribute score. Direct count with percent and mean with Standard Deviation (SD) were reported based on groups that showed stable (+/-

0.03) and improved (>0.03) or declined (<-0.03) HUI3 utility score change within cohort one and two. Significant values were set at $p<0.05$.

To evaluate the changes in HUI3 for clients with decreased to those without decreased (improved or stable) HUI3 score, logistic regressions were applied to provide a comparison between level of change between the first and second cohort. Covariates included sex, age, PDI, change in CI, and baseline HUI3 and CI score, care service changes and their baseline scores. The PDI was found to have a large amount of missing data (40.0%), therefore removed from the regression analysis. As the unit of HUI3 was relatively small (ranged between -0.36 for worst health and 1 for best health), the baseline HUI3 utility score used in the regression model was standardized (computed as individual score minus the mean score and divided by the SD) for ease of the interpretation. In addition, we applied multivariable linear regressions to compare the difference in changes of HUI3 between two cohorts, adjusting for the covariates.

Results

Description of the sample

The sample consisted of a total of 16,603 clients with 8,743 and 7,860 clients in cohorts one and two, respectively. Overall, the sample consisted of mostly women (67.2%) and almost half (48.3%) of the group was 85 years of age or older. The mean age of the sample at baseline was 83.0 years (SD 8.3) for each cohort with a range between 65 to 108 years and 65 to 106 years for cohort one and two, respectively. Both age and gender demonstrated similar stratification between cohort one and two; see Table 7 for the baseline characteristics.

The total sample of CI categories score of 0-1, 2, and 3 contain almost 60% of the sample (16.3%, 18.6%, 20.5% respectively). Increasing CI scores are observed to have fewer clients, with the largest CI score of seven or over containing a small number of clients (8.0%). The PDI baseline characteristics between cohort one and two were similar, and both held the largest number of clients in the least deprived category (around 17.3%). Those with and without measures for the PDI have been shown to have minimal differences within the first cohort (Appendix 8). Few clients were found to have received clinical specialty support care (31.5%) in the past seven days. The opposite was found for non-regulated support care with most clients receiving this type of care (79.5%) in the past seven days. Clients of cohort two appeared to be receiving more support care at baseline than clients of cohort one (Table 7).

HUI3 scores and changes between cohorts

The total baseline HUI3 mean score varied from 0.382 (SD 0.296) for cohort one and 0.372 (SD 0.295) for cohort two. Individual health attributes between the two cohorts at baseline demonstrated consistency with the same outcome for each cohort except for cognition which was found to be 0.841 in cohort one and 0.833 in cohort two resulting in a statistically significant difference. Follow-up outcomes for the global HUI3 were higher for cohort one (0.298, SD 0.315) than for two (0.269, SD 0.308). The differences in the overall global HUI3 change between cohorts was statistically significant with an additional decrease in cohort two by -0.019. No significant difference in change was observed between cohorts for the health attributes of vision and pain. An increase in the health attribute emotion (0.006) for the difference in change between cohort one and two was observed. The remainder of health attributes demonstrated a larger decrease in the change in cohort two compared to cohort one including hearing (-0.004), speech (-0.006), ambulation (-0.007), dexterity (-0.002), and cognition (-0.013) (Table 8).

Table 7. Comparing baseline measures between cohort one and cohort two

Variable	Cohort 1 First year of First Study (March 2018 to Feb 2019) n (%)	Cohort 2 First year of Second Study (March 2019 to Feb 2020) n (%)	Total from Cohort 1 and Cohort 2 n (%)	P-values for the difference between Cohort 1 and 2
Total N	8743	7860	16,603	
Gender				0.351
Male	2896 (33.12)	2550 (32.44)	5446 (32.80)	
Female	5847 (66.88)	5310 (67.56)	11,157 (67.20)	
Age group				0.584
65-74 years	1573 (17.99)	1456 (18.52)	3029 (18.24)	
75-84 years	2922 (33.42)	2639 (33.58)	5561 (33.49)	
>=85 years	4248 (48.59)	3765 (47.90)	8013 (48.26)	
CI score (including 21 diseases)				0.576
0-1	1407 (16.09)	1302 (16.56)	2709 (16.32)	
2	1671 (19.11)	1421 (18.08)	3092 (18.62)	
3	1778 (20.34)	1619 (20.6)	3397 (20.46)	
4	1473 (16.85)	1324 (16.84)	2797 (16.85)	
5	1080 (12.35)	943 (12.00)	2023 (12.18)	
6	652 (7.46)	604 (7.68)	1256 (7.56)	
≥ 7	682 (7.80)	647 (8.23)	1329 (8.00)	
PDI score				<0.001
1 (least deprived)	1500 (17.16)	1378 (17.54)	2878 (17.33)	
2	799 (9.14)	797 (10.14)	1596 (9.61)	
3	1131 (12.94)	1140 (14.51)	2271 (13.68)	
4	881 (10.08)	811 (10.32)	1692 (10.19)	
5 (most deprived)	778 (8.90)	745 (9.48)	1523 (9.17)	

Unknown	3654 (41.79)	2986 (38.00)	6640 (40.00)	
Clinical Specialties Support care (hours/week)				0.009
0 hour/week	6067 (69.39)	5305 (67.49)	11,372 (68.49)	
>0 hours/week	2676 (30.61)	2555 (32.51)	5231 (31.51)	
Non-Regulated Support Care (hours/week)				<0.001
0 hour/week	1891 (21.63)	1519 (19.33)	3410 (20.54)	
> 0 hours/week	6852 (78.37)	6341 (80.67)	13,193 (79.46)	

Table 8. Comparing baseline and follow-up HUI3, including global and attributes' scores, between cohort one and cohort two

Variable	Baseline Cohort 1	Follow up Cohort 1	Cohort 1 Changes	Baseline Cohort 2	Follow-up Cohort 2	Cohort 2 Changes	Differences in change between Cohort 1 & 2	P-value for the difference
HUI3 global	0.382 (0.296)	0.298 (0.315)	-0.08	0.372 (0.295)	0.269 (0.308)	-0.10	-0.019	<0.001
Vision	0.939 (0.093)	0.927 (0.102)	-0.01	0.937 (0.094)	0.926 (0.102)	-0.01	0.001	0.635
Hearing	0.946 (0.084)	0.937 (0.089)	-0.01	0.947 (0.083)	0.933 (0.091)	-0.02	-0.004	<0.001
Speech	0.969 (0.054)	0.955 (0.068)	-0.02	0.968 (0.054)	0.948 (0.073)	-0.02	-0.006	<0.001
Ambulation	0.868(0.111)	0.825 (0.129)	-0.04	0.866 (0.112)	0.816 (0.130)	-0.05	-0.007	<0.001
Dexterity	0.994 (0.041)	0.989(0.053)	0.00	0.995 (0.039)	0.987 (0.053)	0.00	-0.002	0.035
Emotion	0.917 (0.157)	0.912 (0.161)	0.00	0.916 (0.158)	0.917 (0.157)	0.00	0.006	0.047
Cognition*	0.841 (0.177)	0.800 (0.196)	-0.04	0.833 (0.178)	0.780 (0.197)	-0.05	-0.013	<0.001
Pain	0.933 (0.090)	0.935 (0.088)	0.01	0.934 (0.090)	0.935 (0.090)	0.01	0.001	0.522

Note: * Statistically significant difference between cohort 1 and cohort 2 at baseline p=0.006. Standard deviation (SD)s for the mean are indicated in parentheses.

Of note is that cohort two demonstrates fewer clients with an overall increase (-1.6%) or stable (-2.1%) HUI3 score and more clients with a decreased HUI3 score (3.7%) compared to cohort one (Table 9). Both cohort one and two demonstrate no significant impact from gender between categorization of improved, stable, or decreased HUI3 score (Appendix 10 for cohort two). Cohort one and cohort two also demonstrated similar patterns of change on HUI3 score through age categorizations. Specifically, both cohorts were observed to have a decreasing number of clients with increasing age for the improved HUI3 score categorization but increasing numbers of clients with increasing age for the decreased HUI3 score categorization (Appendix 10 for cohort two).

Change in CI score and Service

Individuals in cohort two were slightly more likely to have an increase in diagnosed health conditions (CI score) but slightly less likely to have had an increase in clinical specialties support care or non-regulated support care time (Table 9). Within cohort two, between baseline and follow up measurement most clients had a decrease or no change in CI score (64.43%). There was an overall increase in clinical specialty care time (0.92 to 0.93) in hours per week. Most professions demonstrated increases in care time (hours/week) (physiotherapy, occupational therapy, speech language pathology and social work) except for nursing (-0.1). Also, an overall increase in non-regulated support care (from 7.23 to 8.36) hours per week was observed. Increases (hours/week) were found for home health aids (1.55), home making services (0.09), stability in service hours for volunteers, and decreases in meal support (-0.01) and day care services (-0.49).

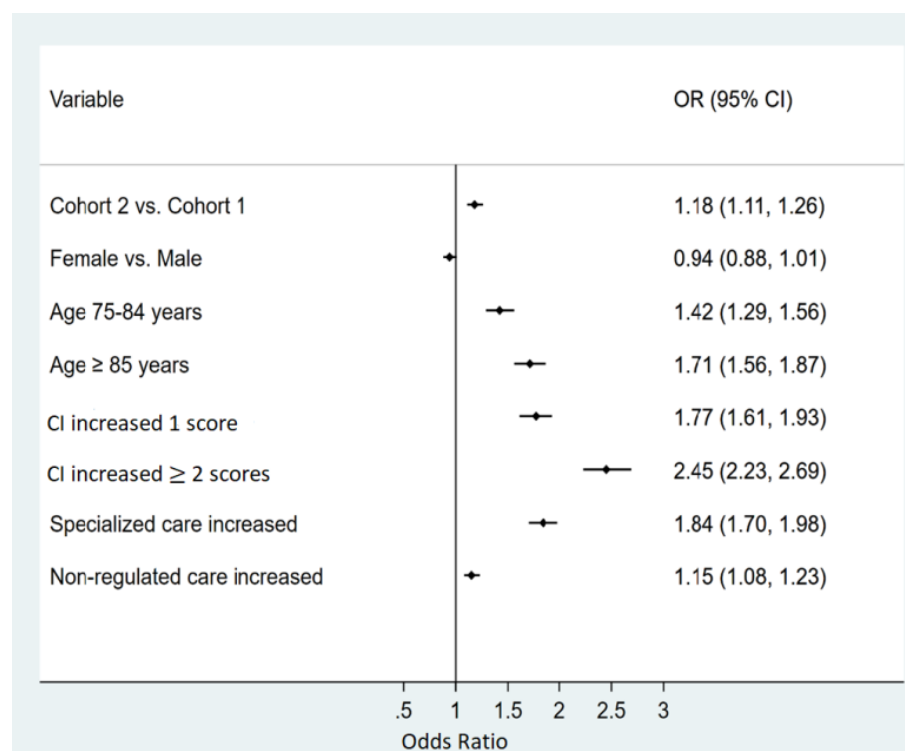
Table 9. Changes of HUI3, CI score and health care services

	Cohort 1 (N = 8743)	Cohort 2 (N = 7860)	Difference	P-values for the difference between Cohort 1 and 2
HUI3 change group, n (%)				<0.001
HUI3 Increase	2436 (27.86)	2067 (26.30)	-1.56%	
HUI3 Stable	1741 (19.91)	1398 (17.79)	-2.12%	
HUI3 Decreased	4566 (52.22)	4395 (55.92)	3.7%	
CI Change Group, n (%)				0.004
CI Decrease or No change	5830 (66.68)	5064 (64.43)	-2.25%	
CI Increase =1	1429 (16.34)	1325 (16.86)	0.52%	
CI Increase ≥2	1484 (16.97)	1471 (18.72)	1.75%	
Clinical Specialties Support care change n (%)				<0.001
Decrease or No Change	6179 (70.67)	5755 (73.22)	2.55%	
Increased	2564 (29.33)	2105 (26.78)	-2.55%	
Non-Regulated Support Care changes n (%)				<0.001
Decrease or No Change	4182 (47.83)	4128 (52.52)	4.69%	
Increased	4561 (52.17)	3732 (47.48)	-4.69%	
Note: CI = Comorbidity Index. Total Clinical Specialties Support care was computed as a sum of the hours of five professions of care services; Total Non- Regulated Support care was computed as a sum of the hours of five non-specialized care services. The change of CI and care services was calculated as the follow-up score minus baseline score. Increased care change is defined as the change score>0.				

HRQoL and Logistic Regression Analysis

Figure 11 illustrates the impact of factors on the Odds Ratio of having a decrease in HUI3 outcome using the fully adjusted model. All the univariate (unadjusted) and adjusted logistic regression models are presented in Appendix 11. Based on the fully adjusted model two, cohort two clients were 18% more likely, compared to cohort one, to have a decreased HUI3 score. Gender was not found to be impactful. Being in the older age groups evaluated significantly increased the odds ratio for individuals to have a decreased HUI3 outcome score. Specifically, after accounting for the effects of covariates, the odds of decrease in HUI3 outcome were 42% higher for 75–84-year old's and 71% higher for clients 85 year of age and older compared to clients aged 65-74 years. CI score was impactful with increased odds for a decreased HUI3 outcome for one diagnosis (unadjusted model: 1.82; adjusted model 2: 1.77), and even more so for two or more diagnosis (unadjusted model: 2.57; adjusted model 2: 2.45 (Appendix 11). HC clients with increases in clinical specialties care were observed to have increased odds (unadjusted model: 1.83; adjusted model: 1.84) for a decrease in the HUI3 outcome. Smaller impact was observed for HC clients with increases in non-regulated care with 15% higher odds for a decreased HUI3 outcome after controlling for the effects of other variables. Higher baseline HUI3 score was also found to increase the odds for a decline in the HUI3 outcome, indicating the higher the initial HUI3 score the more likely the client is to have a decrease over time (Appendix 11). Multivariable difference-in-difference analysis was completed to evaluate for potential confounders and the results were found to be similar to the logistic regression for individual cohort groups in terms of factors impacting HRQoL outcome (Appendix 12).

Figure 11. Impact of variables on odds ratio of decreasing HUI3 outcome



Note: the reference group is 65-74 years for age, no change or decreased for CI, specialized care and non-regulated care change.

Discussion

Primary findings from this study indicate that HRQoL trends experienced over time differ from before to during COVID-19 for home care clients accepting services on a long-term basis. Decreases in HRQoL were found in both cohorts that measured before (cohort one) and pre- to during COVID-19 (cohort two). Although, the decrease in HUI3 scores from cohort two, compared to change measures taken from cohort one, were larger and approximately 18% more likely to occur. Decreases were larger in cohort two in several of the health attributes that create the global HUI3 score, including hearing, speech, ambulation, cognition and to a lesser extent dexterity. This resulted in a larger decrease in cohort two, compared to cohort one, for the global

HUI3 score by -0.019. Decreases in HRQoL for this population are consistently associated with increased age group, recent diagnosis (as per CI), having a higher baseline HUI3 score, increase in clinical specialties support and non-regulated support care received.

This method of creating a HRQoL summary score by using health attribute information collected from the RAI-HC appears to be effective. Data was collected from the RAI-HC and mapped to the HUI3 in a specified manner that has been validated [19]. Only completed assessments with sequential measurements were provided to the research team, therefore missing data could not be reported on. Considering the comprehensive nature of the RAI-HC, expectations around its regular completion and staff training on its use, this method presents as a possible way to efficiently measure HRQoL for a potentially difficult to reach population.

The sample group for this study between cohort one and cohort two at baseline was found to be generally comparable. The combined sample from this study, is similar to other studies in this area, with a higher prevalence of women and a mean age over 80 years [37, 38]. The other significant differences were found for the health attribute of cognition ($p = 0.006$) and the most deprived PDI quintile (5) ($p < 0.001$). It is possible that more people in the second cohort had impairments in cognition.

This research contributes to the current literature by examining the change in trends of HUI3 health-related quality of life scores from before to during the COVID-19 pandemic. Results of this study demonstrate larger decrease in the health attribute outcomes ambulation, cognition, speech, hearing and to a lesser amount dexterity during HUI3 measurements taken pre- to during COVID-19 (cohort two). Lockdown measures for containment of COVID-19 continue to be discussed as they have been linked to unintended consequences such as sedentary behaviour, reduced physical function and mental health outcomes [39]. Research from early

periods of COVID-19 lockdown reported no significant impact on cognition for older adults [40] or only for a small subset of the population [41]. Longer term effects of lockdown for older adults found perceived health decline associated to lower levels of activity, increases in medical conditions during COVID-19 and presence of memory problems prior to COVID-19 [40]. An important consideration is that these areas demonstrating decrease, specifically ambulation, cognition, and dexterity, are amenable to rehabilitation interventions. Both physical therapy and occupational therapy services are already provided in HC and can address these issues of functional decline. For example, the Otago exercise program implemented in a nursing home by physical therapists for older adults with cognitive frailty during COVID-19 was found to be effective in improving functional mobility and mental health [39]. Therefore, when addressing future periods of public health restrictions, it would be valuable to consider assessing effectiveness of proactive rehabilitation services, such as exercise programs delivered remotely, to mediate these identified areas of functional decline.

Further identified in this research is the health attribute outcome decrease for hearing and speech during the pandemic period. Statistics Canada notes that 77% of adults aged 60-69 have hearing loss [42], which is significant considering that many long-term home care clients are older. The necessity of clear communication with clients during health care interactions is of the utmost importance as it ensures that they understand treatment options, maintain trust, follow recommendations, and provide informed consent [43, 44]. Research from the COVID-19 period has identified disproportionate impact on communication for individuals with hearing impairment due to face coverings and social distancing [45]. Further consideration of HC policy modification to address increased challenges with communication are indicated. Alternative research in this area notes methods of improved communication through reduced background

noise, selecting mask type depending on communication needs, possibility of remote microphone technology, speaking slowly and clearly [45] and increased time provided for health care appointments [43].

Increases in both Clinical Specialties and Non-Regulated Support care hours within seven days prior to the assessment has been associated to decreased HUI3 outcomes. Support service provision within the HC program is based upon a client's unmet need. It is therefore possible that the clients Case Managers, who coordinate both Clinical Specialties and Non-Regulated Support care hours, are aware of the change in client's health status resulting in modified service needs and subsequently adjust services accordingly. Future research in this area is required to evaluate specific professions and types of service provision in relation to changes in HRQoL outcomes. Also, economic evaluation utilizing the HUI3 outcomes and cost of services can further our understanding regarding cost-effective service provision.

Several limitations are present in this research, including health information that was limited to the 28 categories which are collected in the RAI-HC. Information was not collected from the "Other Current or More Detailed Diagnosis" category of medical diagnosis. It was therefore necessary to modify the CI due to incomplete overlap between this tool and the RAI-HC. Another limitation is that as the RAI-HC is a clinical tool completed by various professions, some areas including Disease Diagnosis and funding may not be completely reported on, as each profession has overlapping but not exhaustive knowledge. Additionally, no information was provided to the research team on excluded individuals who did not have two sequential RAI-HC assessments within a cohort. These excluded individuals, with only one completed assessment, may have deceased, left home care services, or moved out of province or to a higher level of care within a cohort period. Although, yearly changes in client status are expected to be relatively

stable so they should not have major impact on our results. A further limitation is that some clients who would normally meet criteria to transition to a higher level of care, may have remained in the community longer due to concerns with COVID-19; although this would likely be a very small subset of clients within this study. A further consideration is that the seven-day window prior to the RAI-HC assessment, used as an estimate of services provided throughout the year, may not fully report services provided.

Further caution is required when addressing applicability of these results to other areas, as this data was collected for a city in Canada. Regression analysis was completed using a Difference in Difference score method and when using a change score as dependent variable a limitation is that within-subject correlation of the outcomes is not accounted for. Finally, we were unable to identify which HC clients had tested positive for COVID-19. This count is expected to be small as currently (June 2023) within the entire Alberta population individuals 70-79 years and 80 years and older each accounted for 2% and 4% respectively of the total identified COVID-19 cases [46].

Strengths of this research include use of a large set of population data for HC clients accessing services on a long-term basis resulting in two comparable cohorts over three years. Furthermore, as the RAI-HC uses all available sources it provides a comprehensive report of clients assessed.

Conclusion

This research demonstrates that for clients accepting HC services on a long-term basis the odds having a decrease in HUI3 outcome grew approximately 18% during the pandemic relative to before the pandemic. Decreases in health attributes were found for hearing, speech, ambulation, dexterity, and cognition leading to a larger global HUI3 decrease during COVID-19.

Furthermore age, change in health condition during the time of the study and increases in both clinical specialties and non-regulated support care are associated with decreasing HUI3 outcome. These findings suggest that further investigation of targeted rehabilitation interventions and policy updates within HC may support older adults accessing long-term services to maximize HRQoL. Further economic evaluation can be completed to better understand cost-effectiveness of HC services provided.

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Chapter 6: The associations between formal home care service levels and health-related quality of life of older adults receiving this care in Edmonton, Alberta

Abstract

The home care client population is growing with many of these individuals requiring increasingly complex health care services. This research aims to identify and describe associations between formal home care service levels and the health-related quality of life (HRQoL) of older adults receiving this care. This retrospective longitudinal study mapped administrative data collected from the Resident Assessment Instrument – Home Care (RAI-HC) to a previously validated HRQoL tool, the Health Utility Index 3 (HUI3). Data was collected from 8,743 clients aged 65 years or older accepting HC services on a long-term basis in Edmonton, Alberta between March 1, 2018 and February 29, 2020. Changes over time in HRQoL outcomes are discussed based on profession of the service provider and activity care type with measurements categorized as improved (>0.03), stable (± 0.03), or declined (<-0.03). Multivariate logistic regression provides odds ratios (ORs) for factors associated with HRQoL for improved or stable outcomes. Generally, results indicate a significant decrease in mean HRQoL outcomes over time, irrespective of the activity type or profession of the healthcare provider. Within each activity type, individuals who had less health care service were found to have higher HRQoL outcomes at baseline and follow-up compared to those with more time in the same group. Higher odds for improved/stable HRQoL outcomes presented for clients accessing overnight hospital and emergency room care during the first year. Our results allow for an improved understanding of the HC clients' HRQoL as they age which can support decision-making in services offered from both a healthcare provider and policy perspective.

Introduction

Formal Home Care (HC) is a group of services designed to assist people of all ages who require support from healthcare providers or volunteer organizations to remain at home [1, 2]. Although these services vary depending on the location of provision, they can include physician, nursing, rehabilitation, social work, health care aid, nutritional and pharmaceutical services, companionship, volunteer support, transportation, laboratory, and x-ray imaging [3]. The importance of HC services for older adults continues to grow for numerous reasons including an aging population, an increase in the number of people accessing HC, client preference for in-home care, and control of health care costs [4]. Many countries have prioritized enabling people with complex health needs to remain in their homes longer by providing additional support and more diverse resources [5]. Within this context, it is essential to develop in-depth knowledge regarding the effect of HC services on older adults.

The aging process is not consistent between individuals but is characterized by a variety of issues including changes in strength, mobility, cognition, dependence, and physical disease [6]. Older adults in many cases can experience multiple chronic conditions concurrently [7] and have a higher prevalence for some conditions which can result in the need for complex health care [8]. Thus, completing comprehensive assessments and providing multiprofessional interventions are essential for older adult health care service provision [9]. It has been suggested that many of the changes resulting from the aging process are functional and can be adapted to [6], which provides an opportunity for impactful evidence-informed interventions. For example, the use of tailored physical activity and nutrition interventions for older adults with frailty or pre-frailty are noted to be evidence-based modifiable lifestyle factors [10].

Although there has been growing evidence of the benefits of HC services, evaluation of these programs have been challenging due to a lack of relevant comparison groups and outcome measures that are not able to capture the entire range of possible benefits [11]. Historically health outcomes have been objectively measured through morbidity, mortality and life expectancy [12] although these traditional indicators are inadequate [13]. As there are improvements in life-saving treatments allowing older adults to live longer and with numerous health conditions the quality of extended life is becoming more important to individuals, health care providers and the public health community [14, 15]. There has been a growing recognition from both researchers and healthcare providers regarding the need for a comprehensive health status measure to include health-related quality of life (HRQoL) [16]. HRQoL is useful as an indicator as it provides a value to measure the health status of a person within a group [12] and it allows comparison over time [13].

The importance of considering HRQoL outcomes for the HC population has been established by researchers in this area. HRQoL measurements have been implemented to identify basic associations within the HC population including lower HRQoL outcomes for women, lower education level, presence of decubitus ulcer [17], and a heightened fear of falling [18]. HRQoL measures have also been implemented to evaluate the impact of specific interventions such as preventative care home visits [9] and fall interventions [19]. Numerous studies have been conducted evaluating treatment of cancer for home based patients compared to standard care [8]. Current research has begun to evaluate HC clients HRQoL beyond client indicators and direct care interventions to address impact from variations in the larger health system. System level impact on HRQoL has been addressed relating to the COVID pandemic impact for older adults

receiving home care [20], discharge practice from hospital to home [21], and considering models of care for older adults in care [22].

Although the HRQoL has been identified as a valuable measure within the HC population, it has not been widely used. Measuring HRQoL within the HC population has presented challenges, such as fewer responses from the oldest age groups, due to decline in physical and cognitive health [23-25]. Therefore, research results may be biased towards the healthiest and those with stronger cognitive abilities [23], leading to underrepresented segments of the HC population. Alternatively, within HC the Residential Assessment Instrument – Home Care (RAI-HC) is often used. This measure is a comprehensive standardized evaluation of health, function and care needs for the older adult population using all available health information which allows for comparison over time and between different locations [23, 26-28]. HC has four groups of quality indicators including physical, psychosocial, safety and other clinical issues which have been built into the RAI-HC measurement to assist with “quality initiatives, program evaluation, peer comparisons and benchmarking” [29], but they do not provide a HRQoL outcome.

To compensate for reduced ability to measure HRQoL in the HC population, recent research has proposed a mapping process from the RAI-HC data to the Health Utility Index 3 (HUI3), a HRQoL measure [23]. The HUI3 is a generic preference-based multi-attribute HRQoL measure that is used internationally [30, 31]. This mapping process from the RAI-HC to the HUI3 can provide a HRQoL outcome for all individuals accessing HC, even those who may be systematically under-reported. Currently, there is a gap in evidence regarding interaction between HRQoL outcomes and HC service provision. Information is needed to address the organizational challenge of creating high quality and effective home care services. Therefore, the

overall aim of this research was to investigate the associations between formal home care service levels and health-related quality of life for older adults receiving this care in Edmonton, Alberta.

Methods

Study design, setting and population

We used an observational retrospective exploratory design employing data that had previously been collected from two sources within provincial healthcare authority, Alberta Health Services (AHS). The first set of data was collected through regular clinical practice from the RAI-HC. As the RAI-HC only reports on health services accessed in the past seven days, or since last assessment if less than seven days prior [32], a second set of administrative data was accessed from AHS to provide a complete report of HC services accessed for the entire study period. This second set of data was a record of two continuous years of HC services for clients meeting inclusion and not exclusion criteria. All data was collected from the Edmonton Zone Home Care program operated by AHS. All community dwelling individuals 65 years of age and older, who were accessing publicly funded HC services, were considered for inclusion.

Ethical considerations

The University of Alberta Research Ethics Board has approved (Identification Number: Pro00108790) the study. Approval was also received from AHS, the organization that provides publicly funded home care services. Information provided to the research team was anonymized prior to release from AHS.

Inclusion Criteria

For inclusion, clients were required to receive HC from AHS in the community. Clients were required to have completed two RAI-HC assessments within sequential measurement

periods, first between March 1, 2018 to February 28, 2019 and a second assessment completed between March 1, 2019 to February 29, 2020. Clients had to be 65 years of age or older on March 1, 2018. Clients were required to be coded as Long Term Supportive or Maintenance (definitions available online [33]) with a minimum of one service visit per week to ensure they were actively engaged in HC.

Exclusion Criteria

Clients were excluded if they were not receiving weekly care from AHS HC in the community. Clients were also excluded if they did not have two sequential assessments completed in the required time range noted earlier or were under the age of 65 as of March 1, 2018. Clients were excluded if they were accessing HC for day program services only, self-managed care, hospice care, Long-Term Care facilities, designated supportive living facilities (DSL 3 or 4) or were coded as Acute, Rehabilitation, End-of-life, or Wellness. Sample selection has been reported elsewhere [34].

Measurements

Demographics were collected from clients RAI-HC assessment including age, gender and the first three digits of the postal code of residence. Clients Pampalon Deprivation Index (PDI) score was also provided by AHS. The PDI is regularly used in Canada to provide a measure for socioeconomic deprivation that stratifies the population into quintiles based on “social” and “material” components [35].

Health status was evaluated primarily through the RAI-HC assessment which collects information on a range of physical, mental and social abilities, for example: mobility, communication, depression, home safety, health conditions, cognition, hydration, use of care services, falls, medication use and pain [36]. This measure has been reported to have acceptable

reliability and validity [27, 37-39]. The RAI-HC is completed within AHS at intake, annually and following any significant change in client health [40] to support HC's client care plan development. Additionally, a Comorbidity Index (CI) was created to stratify clients to account for the numerous health conditions that have been identified earlier to affect mortality in longitudinal studies [41]. An updated version of the Charlson Comorbidity Index created by Quan et al. [42] was selected, and then updated by 10 impactful diagnoses to better represent the HC client population disease burden (see Appendix 7). Data was also collected for higher levels of care accessed for 90 days prior to completing the RAI-HC on: 1) Admissions to hospital with an overnight stay; 2) Visits to Emergency Room (ER); and 3) Emergent care defined as “unscheduled nursing, physician, or therapeutic visits to office or home” [32].

Health-related quality of life was assessed using the interRAI HRQoL outcome, which maps information from the RAI-HC to provide answers for questions in the HUI3 using preference values based from a Canadian sample. The goal of the interRAI HRQoL is to maintain the clinical and theoretical constructs of the HUI3 [23]. The HUI3 is a health-status classification system which produces both independent health attribute scores and an overall preference based summary HRQoL outcome [31]. The eight health attributes include vision, hearing, speech, ambulation, dexterity, emotion, cognition and pain with five or six levels of function for each [43]. A complete description of the creation and validation of this process can be accessed through an earlier publication [23]. For improved clarity, from this point forward, the interRAI HRQoL outcome will be referred to as the HUI3 or HRQoL outcome.

Client service use data was provided by AHS, Enterprise Data Warehouse (Data Integration, Measurement & Reporting). Service was defined as a formal care provided by the HC team and rendered between March 1, 2018 to February 29, 2020. Service data included three

items: identification of the type of healthcare worker who provided care (service profession), categorization of the type of care provided (activity type), and total minutes of services provided for the year for each grouping of profession and category of care. Due to the large number of categories from which information was collected, larger more encompassing groups were formed. Service profession was comprised of five categories including: 1) nursing (registered nurse (RN) and licensed practical nurse (LPN)); 2) rehabilitation (occupational therapy (OT), physical therapy (PT) and therapy assistant (TA)); 3) health care aid (HCA); 4) social work (SW); and 5) other (services less consistently accessed such as dietitians, pharmacists, and registered respiratory therapists). Activity type was composed of four categories including: 1) case management services (case management); 2) clinical specialties services (professional assessment, Alberta aids to daily living, and professional health service); 3) non-regulated services (homemaking and personal care); and 4) respite services (respite). As service time was provided in minutes per year, for ease of understanding, this was converted into an average of hours per month.

Data analysis

For descriptive statistics continuous data was reported through means and standard deviation (SD) whereas categorical data was reported through count and percentages. Client demographics were reported as well as service time in hours/month. Infrequent outliers in service time data were truncated to the highest actual possible measure of time provided per month, like 40 hours/week of physical therapy care creating a cap of 160 hours/month of physical therapy care. A study design using within-subject (repeated-measures) evaluation was completed. The HUI3 outcomes are reported in quartiles for baseline HC service time provided. The first quartile of baseline service time identifies the lowest quarter of service time provided with increasing

quartiles reporting higher levels of service. Using the baseline service time groupings, accompanying quartiles for mean HUI3 outcomes at follow-up and change over time are reported. The outcome measure HUI3 was categorized as improved (>0.03), stable (± 0.03), and declined (<-0.03), as earlier research noted a meaningful change for the overall HUI3 score as 0.03 [31]. Statistical analysis was completed using STATA (V.15).

To report on the impact of factors associated with HRQoL outcomes, multivariate regression analysis was completed based on independent variables available to the study group including age, sex, CI diagnosis count, service time provided by category of service profession and activity type. Adjusted regression results were used to report odds ratio (OR) for clients with stable or improved HRQoL outcomes as the dependent variable. Significant values were set at $p < 0.05$.

Results

General characteristics of sample

This study included 8,743 clients with a mean age of 83.1 (8.3 SD) years. Nearly half of the population was 85 years of age or older (Table 10). Women represented a larger portion (66.9%) of the sample. Individuals were frequently found to have two (19.1%) or three (20.3%) comorbidities. The PDI identified clients to most commonly be reported in the least deprived quintile, but due a significant number (41.8%) of individuals within this study having an unknown outcome for this measure, it was removed from further evaluation. Emergent care was only reported for approximately 5% of the sample so this factor was also removed from further evaluation.

Table 10. Client demographics at baseline

	Baseline Measure (March 2018 to Feb2019)
	N (%)
Total	8743
Gender	
Male	2896 (33.1)
Female	5847 (66.9)
Age group	
65-74 years	1573 (18.0)
75-84 years	2922 (33.4)
>=85 years	4248 (48.6)
Comorbidity Index score (including 21 diseases)	
0-1	1407 (16.1)
2	1671 (19.1)
3	1778 (20.3)
4	1473 (16.9)
5	1080 (12.4)
6	652 (7.5)
>=7	682 (7.8)

Baseline Service Use

During the baseline year, non-regulated service accounted for the largest mean number of activity type service hours provided (29.6 hrs/month) and case management services provided the lowest (1.1 hrs/month). Based on service profession, HCAs who are often contracted agency staff provided the highest mean number of hours (29.9 hrs/month) which far surpassed care time provided from other professions including nursing (3.8 hrs/month), rehabilitation (0.7 hrs/month), social work (0.6 hrs/month), and other (0.4 hrs/month) (Table 11). Most clients accessed case management (99.8%), clinical specialties services (100%) and non-regulated service (92.5%) with a minority of clients accepting respite services (7.1%). Higher levels of care were accessed less commonly within 90 days of the baseline assessment with 20.5% of clients admitted to a hospital with an overnight stay and 15.6% of individuals accessed ER care.

(Table 11). The baseline hours of service showed the largest range in care time provided was for non-regulated service (1.3-76.3 hrs/month), with clinical specialties (0.5-8.1 hrs/month) and case management (0.3-2.6 hrs/month) showing much less variation. (Appendix 13)

Changes in service use and HRQoL over time

Table 12 presents the mean HUI3 outcomes based on quartiles of service time (hrs/month) at baseline with the lowest service time provided in the first quartile and highest service time provided in the fourth quartile. Overall, there was a decrease in the average HUI3 outcome of -0.083 (SD 0.27) between baseline and follow-up measures. The lowest level of service time at baseline and their follow-up measurements generally had the highest HUI3 outcome which decreased with additional service time (quartiles) for case management, non-regulated, and clinical specialties services. The largest levels of change in HUI3 outcomes over time were found for the lowest amount of service provided for non-regulated services. (Table 12)

Over time most individuals were found to have decreased HUI3 outcomes (52.2%), followed by improved HUI3 outcome (27.9%) and stable HUI3 outcome (19.9%). With increasing case management service time, there were increasing percentages of individuals with improved and decreased HUI3 outcomes and fewer stable HUI3 outcomes. Increase in non-regulated service time was found to have a slightly higher percentage of individuals with stable HUI3 outcomes and slightly fewer decreased HUI3 outcomes. An increase in clinical specialties services time was found to accompany more individuals with improved HUI3 outcomes and fewer individuals with stable outcomes. (Appendix 14).

Table 11. Presence of service provision at baseline and corresponding mean HUI3 score at baseline (March 2018 to Feb 2019) and follow-up (March 2019 to Feb 2020)

Variables	Frequency (%) by the service provision at baseline	Mean hours / month provided at baseline (SD)	Mean HUI3 (SD) at baseline	Mean HUI3 (SD) at follow-up
Activity Type				
Case management				
Provided	8724 (99.8)	1.14 (1.09)	0.382 (0.296)	0.298 (0.315)
Not Provided	19 (0.2)	N/A	0.378 (0.357)	0.323 (0.410)
Clinical specialties service				
Provided	8743 (100)	2.90 (4.66)	0.382 (0.296)	0.298 (0.315)
Not Provided	0	N/A	N/A	N/A
Non-regulated service				
Provided	8084 (92.5)	29.62 (40.17)	0.382 (0.295)	0.301 (0.314)
Not Provided	659 (7.5)	N/A	0.377 (0.316)	0.268 (0.328)
Respite				
Provided	625 (7.1)	13.36 (14.38)	0.174 (0.260)	0.097 (0.262)
Not Provided	8118 (92.9)	N/A	0.398 (0.293)	0.314 (0.313)
Service Profession				
Health care aids				
Provided	8135 (93.0)	29.90 (40.16)	0.379 (0.295)	0.298 (0.314)
Not Provided	608 (7.0)	N/A	0.419 (0.312)	0.306 (0.333)
Rehabilitation				
Provided	5724 (65.5)	0.74 (2.33)	0.351 (0.290)	0.268 (0.305)
Not Provided	3019 (34.5)	N/A	0.439 (0.300)	0.355 (0.325)

Nursing				
Provided	8551 (97.8)	3.82 (6.58)	0.381 (0.296)	0.298 (0.315)
Not Provided	192 (2.2)	N/A	0.406 (0.289)	0.321 (0.301)
Social work				
Provided	2096 (24.0)	0.61 (0.78)	0.330 (0.302)	0.252 (0.311)
Not Provided	6647 (76.0)	N/A	0.398 (0.293)	0.313 (0.315)
Other				
Provided	4466 (51.1)	0.35 (0.85)	0.367 (0.290)	0.280 (0.307)
Not Provided	4277 (48.9)	N/A	0.397 (0.302)	0.317 (0.322)
Emergency Room Use**				
Provided	1362 (15.58)	Mean # of visits 1.45 (0.93)	0.357 (0.302)	0.297 (0.311)
Not Provided	7381 (84.42)	N/A	0.386 (0.295)	0.298 (0.316)
Number of times admitted to a hospital with an overnight stay**				
Provided	1791 (20.48)	Mean # of visits 1.20 (0.61)	0.363 (0.293)/	0.315 (0.310)
Not Provided	6952 (79.52)	N/A	0.386 (0.297)	0.294 (0.316)

* Each service category was identified as either provided (over zero hours of care reported) or not provided (zero hours of care reported). Service time is presented for the provided service from the baseline year of the cohort.

**Is reported for visits in the last 90 days or since last RAI-HC assessment, if less than 90 days

Table 12. Mean HUI3 score (SD) at baseline and follow-up, and the changes by the baseline groups of activity affiliation (N=8743)

Variable	HUI3 Baseline	HUI3 Follow-up	Change
Overall	0.382 (0.296)	0.298 (0.315)	-0.083 (0.268)
Activity quartile or category at baseline			
Case management			
First quartile	0.457 (0.297)	0.374 (0.325)	-0.084 (0.255)
Second quartile	0.400 (0.291)	0.326 (0.314)	-0.074 (0.259)
Third quartile	0.351 (0.286)	0.266 (0.304)	-0.085 (0.264)
Fourth quartile	0.315 (0.291)	0.224 (0.294)	-0.091 (0.297)
Non-regulated services			
First quartile	0.448 (0.293)	0.347 (0.321)	-0.102 (0.291)
Second quartile	0.477 (0.275)	0.392 (0.303)	-0.085 (0.277)
Third quartile	0.391 (0.276)	0.308 (0.301)	-0.082 (0.269)
Fourth quartile	0.211 (0.265)	0.146 (0.277)	-0.065 (0.235)
Clinical specialties services			
First quartile	0.460 (0.289)	0.373 (0.319)	-0.087 (0.244)
Second quartile	0.409 (0.289)	0.316 (0.307)	-0.092 (0.282)
Third quartile	0.359 (0.289)	0.275 (0.312)	-0.085 (0.285)
Fourth quartile	0.298 (0.294)	0.228 (0.305)	-0.070 (0.262)
Respite services			
Not provided	0.398 (0.293)	0.314 (0.313)	-0.084 (0.270)
Provided	0.174 (0.260)	0.097 (0.262)	-0.077 (0.260)

Note: change in service time measured as hours per month between baseline and the follow-up (follow-up score minus baseline score). SD: standard deviation.

Regression analysis

Multivariate logistic regression analysis models are presented using OR for an improved/stable HUI3 outcome for each activity type in Table 13. Overall, regardless of activity type, an increase in provided service hours coincides with a lower probability of improved/stable HUI3 outcomes. For example, case management service (Model 1) was found to have a 9%, 26% and 34% decrease in OR for an improved/stable HUI3 outcome for the second, third and fourth

quartiles, respectively. It should be noted that the second quartile change is not statistically significant. The exception to this trend was in non-regulated services (Model 2), where there was an increase in likelihood (15%) that individuals in the second quartile would have improved/stable HUI3 outcome compared to the lowest level of service provision. Clients who were provided with respite services (Model 4) were 35% less likely to have an improved/stable HUI3 outcome. Several factors demonstrated consistency across all models. No statistically significant differences were found between men and women in the OR for an improved/stable HUI3 outcome. Significant differences were found based on age group, with the older age groups having diminished odds for an improved/stable outcome. Individuals were more likely to have a decreased HUI3 outcome for an additional diagnosis during the study period, and even higher for two or more additional diagnoses. Individuals with higher baseline HUI3 outcomes had significantly lower odds for an improved/stable HUI3 outcome. Baseline CI score although statistically significant, was minimally impactful on the models. In addition, both ER visits and overnight hospitalizations from the baseline year of measurements (capturing 90 days prior to the RAI-HC assessment) increased the OR for improved/stable HUI3 in each service type model ranging between 1.10 to 1.16, and 1.21 to 1.32, respectively. (Table 13)

Table 13. The association of HUI3 improved / stable using the baseline healthcare service time by activity provision (N= 8743)

Variables	Model 1 Case management service		Model 2 Non-regulated service		Model 3 Clinical Specialties service		Model 4 Respite service	
	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Hours of service at baseline (quartile)								
First quartile	1.0		1.0		1.0		NA	
Second quartile	0.91 (0.8, 1.03)	0.129	1.15 (1.02, 1.31)	0.026	0.86 0.76, 0.98)	0.023	NA	
Third quartile	0.74 (0.65, 0.84)	<0.00 1	1.02 (0.90, 1.16)	0.730	0.76 0.67, 0.87)	<0.00 1	NA	
Fourth quartile	0.66 (0.58, 0.75)	<0.00 1	0.73 (0.64, 0.83)	<0.001	0.71 0.63, 0.81)	<0.00 1	NA	
Respite care								
Not provided	NA		NA		NA		NA	
Provided							0.65 (0.54, 0.77)	<0.001
Gender								
Male	1.0		1.0		1.0		1.0	
Female	1.01 (0.92, 1.11)	0.837	1.03 (0.93, 1.13)	0.605	1.01 (0.92, 1.11)	0.889	1.00 (0.91, 1.10)	0.949
Age group								
65-74 years	1.0		1.0		1.0		1.0	
75-84 years	0.76 (0.67, 0.87)	<0.00 1	0.76 (0.67, 0.86)	<0.001	0.76 (0.67, 0.86)	<0.00 1	0.77 (0.67, 0.87)	<0.001

≥ 85 years	0.59 (0.52, 0.67)	<0.001	0.60 (0.53, 0.68)	<0.001	0.59 (0.52, 0.67)	<0.001	0.60 (0.53, 0.67)	<0.001
CI change								
No change and decreased	1.0		1.0		1.0		1.0	
CI increased = 1	0.54 (0.48, 0.61)	<0.001	0.53 (0.47, 0.60)	<0.001	0.53 (0.47, 0.60)	<0.001	0.53 (0.46, 0.59)	<0.001
CI increased ≥ 2	0.36 (0.32, 0.41)	<0.001	0.35 (0.31, 0.39)	<0.001	0.36 (0.31, 0.41)	<0.001	0.35 (0.31, 0.40)	<0.001
Baseline variables								
HUI3 score baseline	0.18 (0.15, 0.21)	<0.001	0.16 (0.14, 0.19)	<0.001	0.18 (0.16, 0.22)	<0.001	0.19 (0.16, 0.22)	<0.001
CI score baseline	0.96 (0.94, 0.99)	0.002	0.97 (0.94, 0.99)	0.003	0.97 (0.95, 0.99)	0.006	0.96 (0.94, 0.98)	<0.001
Emergency Room Visits - Without an overnight stay								
Non-provided	1.0		1.0		1.0		1.0	
Provided	1.16 (1.03, 1.32)	0.018	1.10 (0.97, 1.25)	0.122	1.13 (1.00, 1.28)	0.045	1.13 (0.99, 1.27)	0.061
Admission to Hospital – With an overnight stay								
Non-provided	1.0		1.0		1.0		1.0	
Provided	1.32 (1.18, 1.48)	<0.001	1.21 (1.08, 1.36)	0.001	1.29 (1.15, 1.44)	<0.001	1.25 (1.11, 1.39)	<0.001

Discussion

This study was completed within a publicly funded health care system to investigate HRQoL of older adults accepting HC services on a long-term basis. Irrespective of the activity type, the majority of HC clients experienced a decrease over time in HRQoL outcomes. The descriptive analysis showed that increasing amounts of clinical specialties service at baseline were found to have a corresponding increase in percentage of clients with improved HRQoL. However, in the multivariable regression analysis the high levels of service use were related to decreased HRQoL levels. These results indicate that some clients with increasing amounts of service time are improving in measured health outcomes, but overall high service users are generally decreasing in HRQoL outcomes. Unexpectedly it was observed that access to some higher levels of care, such as ER care, was accompanied by a smaller reduction in HRQoL at follow-up, compared to those who did not access these services.

The population within this study was found to be comparable to other HC studies with a higher percentage of clients identified as women and many over 80 years of age [17, 18, 44]. Similarly, to other HC studies, we observed a large diversity of healthcare providers including nursing (97.8%), health care aids (93%), rehabilitation 65.5%), and other healthcare providers such as dietitians, pharmacists, and registered respiratory therapists (51.1%). In Europe the number of HC workers was reported to range from three types of professionals in countries such as Greece, Hungary and Iceland, up to 13 professionals providing care in Norway [45]. This indicates that although there is generally a mix of professions involved in HC, the number of health care service providers identified in this study falls within the range identified in other HC studies.

Previous research has reported the older adult population is accessing a higher volume of health services on a long-term basis resulting in this group having larger costs [46] with interest in meeting these needs in a home-based environment [47]. To meet client need, a broad mix of types of services is demonstrated in this study and other research [45]. Recently, a Finnish study reported on 17 different components of needs and interventions within HC, with the most frequently noted categories being daily activities (11%), activity physical & sleeping (10%), and coordination of multi-vocational service including care and evaluation (10%) [48]. A 2018 study by Gilmore reported a variety of types of care accessed including nursing (46%) followed by personal or home support (45.7%), medical equipment or supplies access (22.5%), other health care (19.4%), and other services (11.9%) [2]. Within the current study, most clients were also accepting a variety of care activity types including case management (99.8%), clinical specialties (100%), and non-regulated services (92.5%). However, comparisons between this and other HC studies are limited because of the inconsistent defining and grouping of care activities in different regions.

With increased understanding for the importance of supporting informal caregivers, respite services are a growing area of interest. Respite care “provides a scheduled break for caregivers from caring for the chronically or terminally ill person living at home” [49]. This study found that respite care (7.1%) was provided less frequently than other activity types. Their baseline HRQoL was much lower than other HC clients not accepting this type of care and continued to diminish over time. These results suggest that this form of care is being directed to clients who have much more impairment in factors that affect HRQoL, when compared to the other HC clients, and potentially have challenges related to informal caregiving by the family and kin-network.

The small group of HC population accessing overnight hospital and ER services were found to have lower baseline and about the same follow-up HRQoL when compared to those not accessing these services. The decrease in health outcomes over time was smaller for individuals accessing these services, which may indicate use of these health interventions may support recovery for some individuals. Similar research has found that older adults accessing ER care report a significantly lower quality of life compared to those who are not using them [50]. Evidence suggests incorporating HC following hospital discharge may assist in preventing hospital readmission [51] and decrease ER visits [52]. This highlights the variety of interacting factors that are impacting HRQoL for individuals who are accessing both HC and higher levels of care.

The changes in the HRQoL outcomes clearly demonstrate that irrespective of activity type and service profession, there was a significant decrease between baseline and follow-up. Within the service profession groupings, lower HRQoL outcomes were observed for individuals provided with care compared to those who had not received the same care at both baseline and follow-up. This indicates that HC clients who are not accessing HCAs, rehabilitation, nursing, social work, and other professionals care, may be more medically stable or more independent and consequently have a higher HRQoL than their counterparts who do require services. Similar to the current results, research from adults in Shandong, China reported a declined HRQoL with increasing multimorbidity and age [53]. This study further reported a decrease of health service use with increasing age, citing limited health care access due distance to health facilities and economic concerns [53]. As age was not specifically compared to service level in the current study, we are unable to compare to these specific results. In Alberta this trend would be unlikely as payment is not required for HC services and care is generally provided in the client's home.

A couple of trends were observed with respect to service level and HRQoL changes over time. Specifically, individuals accessing non-regulated service and clinical specialties service generally showed larger decreases in HRQoL over time at lower levels of service provision (first and second quartile). Of note is the low HRQoL outcomes for individuals with the highest level of non-regulated amount of service provided at baseline. This group was found to have the lowest decrease in HRQoL over time, but this may be affected by starting with a low outcome. However, individuals accessing the highest levels of case management services (third and fourth quartiles) were found to have the largest decreases in HRQoL, compared to other quartiles of service within this activity type. This result is expected, as when HC clients have unstable health conditions, HC case managers are often the primary contact to support change in care services which can result in increased HC staff time. This finding emphasizes the importance of case management service time in supporting client wellbeing when needed, as high levels of this service are associated to significant decrease in HRQoL. Similarly in other recent research, HC case managers activity level has been found to increase along with increases in client intensity scores [54].

The multivariate logistic regression analysis demonstrated that HC clients are more likely to have an improved/stable HUI3 outcome with a stable diagnosis profile, being in a younger age group, accessing lower service levels and having accessed within 90 days overnight hospital and ER services. Similar HC studies have reported HRQoL to diminish incrementally with increasing number of chronic conditions and increasing age [55]. This suggests that if healthcare providers are interested in bolstering individuals most at risk for a decreasing HRQoL, targeting interventions towards clients with recent diagnoses, being in older age groups, and accessing larger amounts of services, should be considered. Targeted interventions to support HRQoL of

clients could consider further evaluation of programs that address multicomponent behavior intervention and home repair [56], aspects of self-management [57], social isolation [58], higher-dose physical activity [59] or supporting rehabilitation when medically appropriate following an injury/diagnosis.

It is a possibility that for HC clients experiencing a significant decrease in their HRQoL outcome, this measure is indirectly reporting on an increase in frailty. Providing care to older adults with frailty maybe be challenging as health care interventions can result in significant injury, highlighting the importance of understanding end-of-life care “ through the frailty lens” [60]. End of life care research in Canada has recommended that additional training is needed for health care providers as well as further efforts to build collaborative care teams which include family members [61]. Further consideration and evaluation are required for this group of individuals with significantly decreased HRQoL outcomes to have services provided that are in alignment with evidence-based care. For example, evaluating interventions that promotes feelings of choice and identity while counter acting feelings of helplessness and isolation [62] for individuals with significantly declined HRQoL, may improve client centered care.

Limitations & Strengths

This study has several limitations including the use of service time data which was collected from a system that assigns a pre-specified amount of time for each recorded task completed through an electronic charting system. This means that staff can spend more or less time on the activity, but only the pre-assigned time value is recorded. Another issue is that HCA care is largely provided through contracted agencies therefore leaving systematic differences between the training and employment of these staff and AHS staff. The impact of vacant staff

positions may also be impactful on service provision levels and indirectly client HRQoL, although this was not addressed in this study and could provide an area for further evaluation. This data was only collected from individuals who had two sequential RAI-HC assessments completed during the specified time frames. Therefore, individuals who were unable to complete the second assessment, for example due to death or leaving HC services for a higher level of care or moving out of province, were not included. This study did not collect information regarding care time provided outside of the publicly funded Alberta HC system and is therefore not collecting information from individuals accessing similar services through other avenues such as informal care or Workers Compensation Board. This study may not be representative of individuals residing in rural areas or all levels of socioeconomic diversity, as data was collected from the large city of Edmonton and had a significant percentage of missing data from the PDI, a variable which was eventually excluded. This study also used a method based on comprehensive data collection from clients and various others but did not directly have clients self-report on a HRQoL measure.

Strengths of this study include a pragmatic design with collaboration from the local health care provider to identify factors related to HRQoL for the older adult long-stay home care population. The mapping process allowed for a time efficient evaluation of the large and diverse group of individuals accessing HC services. Thus, this study was able to provide a comprehensive evaluation of the full range of older adults that home care services are provided to, rather than relying on data from the healthiest subpopulations of older adults. The sample size of this study was large allowing for a representative measure of the Edmonton HC population. All individuals included in this study had health measurements collected from two time points

allowing for a better understanding of actual client change over time. The assessment measures HUI3 and RAI-HC are well known and may improve generalizability of these results.

Conclusion

This evaluation shows that over time, there is a significant decrease in mean HUI3 outcomes, irrespective of the activity type or service profession of the healthcare providers evaluated in this study. Various factors were identified which correlated to a lower average HRQoL such as HC clients with a recent health diagnosis, being in an older age group, accessing respite care, accessing higher levels of services, and those accessing hospital care. Now that these factors relating to diminished HRQoL have been identified, further research is needed to evaluate possible interventions targeting this issue. Due to challenges with comparability in HC research, it is recommended that subsequent work provide clear descriptions of the population under assessment and their comparators, as well as in-depth reporting on interventions provided. This will allow health care providers and policy decision makers to have a firm understanding of the applicability of research to their specific situation.

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Chapter 7: Conclusion and future directions

Introduction

An aging population with people living longer and likely experiencing more than one age-related chronic condition [1] will have profound effects on the health and social care systems. The need to provide value-based care for older adults will continue to grow in demand. As older adults increasingly choose to “age in place”, consideration of physical and mental abilities will be increasingly important given the complex and chronic health conditions [2] that arise as individuals live longer lives. The ability of health and social care programs to support this growing segment of the population calls for an understanding of the nuances of aging and how to appropriately meet those needs. Care decisions, policy development and service delivery require rigor based on current and comprehensive information from programs that support community-residing older adults such as Home Care (HC).

In the Canadian health care system, HC is integral in providing support to individuals so that they may age with dignity and independence in their own homes [3]. A variety of services can be accessed within HC, including both professional health services and personal care services [4]. Professional health services include for example, assessing health status, providing treatment, and rehabilitation, whereas personal care services include assisting with personal hygiene, dining, and administering medication [4]. Given the resource scarcity and the funding competition between different services or delivery models, cost-effectiveness studies on HC services can provide valuable input regarding efficiencies to decision-makers, however, research suggests conclusions in this area are limited [5]. With the aim of reducing the knowledge gap regarding community-residing older adults and health services accessed, five separate

evaluations were completed leading to recommendations for health care providers and policy-makers.

Rehabilitation is an important component of the HC program offered through interdisciplinary collaboration of healthcare professionals and their associated interventions [6]. Challenges have arisen with comparative analysis of health interventions on costs and effects or consequences, relating to transparency and standardized reporting [7]. A systematic review of 129 articles using the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) guidelines found inconsistent reporting of economic evaluations of rehabilitation services [8]. Most of the identified studies did not meet the minimum requirements proposed by the CHEERS guidelines. For example, very few studies reported on time horizon (30.2%) and discount rate (47.3%). Researchers in this area should follow the CHEERS guidelines checklist, or other reporting guidelines, appropriate for their study methodology and purpose, to ensure the necessary information is provided to facilitate others in evaluating and building from their work.

The second objective was achieved through a systematic review which compiled and evaluated evidence of new or enhanced HC interventions, compared to usual HC with an accompanying economic evaluation [9]. Several interventions comparing a standard HC to an alternative form of HC were identified, but only some interventions were found to have improved outcomes. Both restorative care or reablement and alternative nursing care, such as health promotion and preventative care, demonstrated cost-effective results. Furthermore, fall prevention programs were found to be cost-effective for subgroups, such as for OTs implementing home safety programs. Risk-of-bias and inconsistent reporting for economic evaluations were identified as being problematic, therefore due diligence is required when considering applicability of these study results.

Chapter four addressed question three through reporting on factors associated with HRQoL of older adult HC clients accessing services on a long-term basis. Based on a validated mapping process from the Resident Assessment Instrument-Home Care (RAI-HC) to the Health Utility Index 3 (HUI3), a significant decrease in HRQoL was found for a majority of HC clients (52.2%), followed by 27.9% improving in HRQoL and 19.9% identified as stable over approximately one year. Overall, the baseline average HUI3 outcome was found to be 0.382 (SD 0.296) which decreased to 0.298 (SD 0.315) over approximately one year. Factors associated with a decrease in HRQoL included an additional diagnosis during the study period, being in an older age group and having more care time provided by clinical specialties and non-regulated staff during the study. It is of importance to note that this research does not suggest that increased staff time causes poorer HRQoL. These results may indicate that HC clients who are less medically stable or are more dependent, with a lower HRQoL, have been identified by case managers to have higher levels of healthcare need leading to increased time or levels of health services.

The fourth question of this thesis was explored in chapter five which reported on changes in HRQoL for HC clients from before to during the COVID-19 pandemic. It was identified that HC clients had larger decreases in HRQoL as well as higher odds for this decrease during the COVID-pandemic period, compared to the pre-pandemic period. Several health attributes had a larger decrease during the COVID-19 period, compared to before, including ambulation, cognition, dexterity, hearing, and speech. It is interesting to note that even though individuals during the pandemic period were slightly more likely to have an increase in diagnosed health conditions, they were less likely to have an accompanying increase in clinical specialties support care or non-regulated support care.

Chapter six reported on associations between client HRQoL outcomes and formal HC service use (Question 5). The Alberta HC program provides a complex mix of services designed to support community residing individuals which varies depending on location and client need. Within the Edmonton zone, results indicate that despite the activity type (case management, clinical specialties service, non-regulated service, respite) or profession providing care (HCA, Rehabilitation, Nursing, SW, Other), the majority of clients accessing these services displayed a decrease in HRQoL over time. Individuals categorized as accessing higher quintiles of service time during the baseline year were commonly correlated to a lower HRQoL outcome. Individuals who accessed overnight hospital stays and ER visits were found to have lower baseline HUI3 scores but showed less decrease in this outcome a year later compared to those not accepting these services. This could indicate that these higher-level services may support some recovery of health conditions for some long-stay HC clients. Although, it has been widely acknowledged that many older adults experience decreased ability to complete ADLs following hospital admission compared to baseline as well as developing new functional impairment during their time in hospital [10]. These results suggest a complex interaction for older adults accepting services within the hospital system, with not all individuals able to recover to baseline or even admission functioning level [10]. Respite services were provided to a smaller percentage of clients who were generally found to have a significantly lower HRQoL compared to other HC clients.

Application of a framework for the well-being of HC clients

The Production Of Welfare (POW) framework was applied to support understanding of the complex relationship of factors surrounding older adults accepting HC services on a long-term basis (Figure 8). Within the POW framework, non-resource inputs, such as the clients' own

personal characteristics, are suggested to be a factor of influence in the production of well-being [11]. Chapters four, five and six provide a detailed account of the HC population demographics including information on age distribution, gender balance, and diagnosis counts, and discussed the impact of these factors on HRQoL.

This study was completed in the context of a publicly funded health care system, hence the resource inputs provided to HC clients are assumed to be based on need and equity among individuals. Variation in resource input with respect to a client's ability to pay was assumed to be small. Previous research reported that HRQoL for older adults was not associated to household income in Canada, unlike the United States, while controlling for other factors such as gender, race, marital status, smoking status, physical activity level and having a regular physician [12]. As the data set provided for this evaluation contained large amounts of missing information for the Pampalon Deprivation Index (PDI) measure, an in-depth evaluation of this factor interacting with clients HRQoL was not able to be completed. Information available based on those who did and did not have a PDI outcome reported identified a minimal difference in HRQoL between these two groups (Appendix 8). A further challenge evaluating the socioeconomic impact of HRQoL is that a significant amount of client care in the community setting is reported to come from unpaid informal care providers [13], which may affect client need for formal care providers. Therefore, further evaluation of associations between socioeconomic status and HRQoL is suggested for clients accessing HC on a long-term basis, while also considering impact from informal care time provided.

Unlike earlier models [11, 14], the applied POW framework suggests that intermediate outputs (service provision) flow directly from the interaction between both non-resource inputs and resource inputs. In the HC environment, services are provided based on a client's identified

health need and willingness to accept services offered. If clients choose to decline services, the care is not rendered. Therefore, care provided is based on the interaction between both the client (non-resource) and the health care service provider (resource) working together in a partnership to provide health care services (intermediate output).

The systematic review in chapter three provides a summary of HC interventions (intermediate outputs) and impact on different aspects of a client's well-being [9]. Due to the diversity of health outcomes evaluated in these studies, categories were created for similar measurements including HRQoL, cognition, physical health, functional changes (mobility, falls, ADLs, IADLs), mood and mental health [9]. As reported in chapter six, some services may support some recovery of health conditions for some long-stay HC clients, such as care provided within ER's and during overnight hospital stays supporting the applicability of the POW framework for HC clients. The earlier POW model presented by Kendall and Knapp suggested cyclical feedback following final outcomes [14]. Although ongoing cyclical adjustment between final outputs and client characteristics (non-resource inputs) is plausible, evidence of this interaction was beyond the scope of this thesis.

The applied POW framework suggests that both network and political context have impacts on client well-being. Health policy in Alberta, especially during the COVID-19 pandemic period, has undergone numerous revisions and updates. For example, AHS and their contracted facilities, have maintained masking protocol and additional measures for infection prevention and control until June 2023 [15, 16]. The AHS 2021-22 Bi-Annual Performance Report notes ongoing efforts to support the aging population through increases in community capacity as quickly and safely as possible [17]. Chapter five exemplifies that during the COVID-19 pandemic there were greater odds within the HC population for a diminished HRQoL and a

larger decrease in HRQoL outcomes when compared to the pre-pandemic period, over approximately the same amount of time. These results do not discredit the theory presented by the applied POW framework in that the client's network and political context can be impactful to their well-being.

Health Service Implications

The systematic reviews completed in Chapter two on rehabilitation interventions and in Chapter three on new or alternative types of HC, identified that only 5.4% and 23.5% of the studies identified were completed within Canada respectively. The low number of these studies suggests that additional research within our unique context could allow for more meaningful adaptations of assessed services and thereby provide more applicable program modifications to support HC clients. To develop rehabilitation and HC services, within a budget-constrained environment, we must complete research within Canada that demonstrates the cost-effectiveness of these services using comprehensive reporting.

Personal characteristics of clients have been identified as impactful on client's well-being in this thesis. People who require rehabilitation are at a critical point with respect to their future quality of life and potential to remain independent [18], therefore services must be carefully considered. A major finding from this research is that the largest average decreases over time in HC client's health attributes were found in measures of ambulation and cognition. Therefore, healthcare interventions to support individuals experiencing significant changes in ambulation and cognition would be an ideal group to focus interventions towards for improving HRQoL. There are a variety of interventions available to community residing clients to enhance mobility, [19, 20] lower-body strength and balance [21] as well as providing adaptations to manage

cognitive changes [22]. Additional consideration is suggested not only for rehabilitation but also for preventative care. Similar research has demonstrated that the use of physical activity and preventative health services for older adults in Mexico was associated to higher self-perceived HRQoL outcomes [23]. The use of health services to recover, stabilize or prevent changes in health conditions within the context of HC has potential (as noted in Chapter three) but needs further evaluation regarding cost-effective application in the desired health care setting.

This thesis presents evidence of ways to improve client outcomes. However, a review of related research needs to be carefully considered based on current context and availability of information given inconsistent reporting in this domain of research. For example, positive trends in health outcomes for HC clients were identified for nursing health promotion and preventative care, reablement or restorative care, treatment of undernutrition, subgroups for fall prevention programs, and interdisciplinary care coordination [9]. This research identified concerns with the risk-of-bias and inconsistent reporting for economic evaluations within HC studies and inconsistent reporting in economic evaluations within rehabilitation studies [8, 9]. Health care providers must consider the context of the service provision, as this can impact both costs and outcomes, depending on what changes to standard practice are required. Earlier research also highlights that the choice of measurement tools used to evaluate changes in health outcomes can impact if the intervention appears cost-effective [24]. Therefore, health care providers selecting a new intervention are advised to consider how the context and tools used to measure outcomes may affect the intervention's viability for their specific situation.

HRQoL outcomes are important for the client centered care model. Research in this thesis identified groups of HC clients who are more likely to have a diminished HRQoL, such as being in an older age group, having a recent medical diagnosis, or having high levels of clinical

specialty and non-regulated support care time. This information can be used to educate health care providers to improve quality of care [25]. With more attention and understanding of HC clients' HRQoL, health care providers can complete further assessments and interventions based on individual client situations. This type of data-driven process assists in tailoring HRQoL interventions which are relevant for both healthcare providers and clients.

Changes in physical health and mental well-being has been implicated as unintended sequela from periods of public health restrictions during the pandemic [26]. The Canadian Institute of Health Research's Institute of Health Services and Policy Research identified seven COVID-19 priorities for health services and policy research [27]. One priority identified in their report states "Research that informs system adaptation and organization of resources and care in the COVID-19 era is urgently needed" [27]. This thesis identifies information relevant to this priority with respect to system adaptation. Specifically, there was an average decrease in HRQoL of HC clients during the pandemic period and when compared to changes that occurred pre-pandemic, some health attributes impacted more than others. This suggests that during pandemic, healthcare regulators need to consider modifying their established standards of practice to adjust to current changes in client health needs.

During the pandemic period, there were significantly larger decreases in the health attributes of cognition, ambulation, hearing, speech, and dexterity. During potential future waves of pandemic or periods of public health restrictions, HC care providers and their managers may develop preventative exercise programs and cognitive interventions that can be implemented without requiring face-to-face interactions. Although, as noted in chapter two, consideration must be provided regarding available information and applicability of research to the considered implementation. To support effective communication with clients and their families, health care

providers should be mindful of communication barriers such as PPE and social distancing [28], and possible decreases in speech and hearing (chapter five). Potential strategies could include scheduling additional time to support communication, speaking slowly and clearly, writing down necessary information, or if needed to repeat a sentence try rephrasing it [28, 29].

Policy Implications

Identifying the optimal balance of HC services offered is challenging, especially in Canada where the federal government does not regulate publicly provided HC services. Adding to this onerous task, is a complex evidence base within HC research that uses a variety of study designs, populations, services, and costs [5, 30]. The use of economic evaluations for HC development is beneficial, as this form of assessment provides an essential framework of how to evaluate clinical evidence while considering all alternatives on health, care costs and other effects identified as valuable [31]. HC economic evaluations during the 1970s assessed HC as an substitute form of care for hospital admissions, early hospital discharges and LTC [30]. This tradition has continued and is seen in work such as the systematic review completed by Curioni et al. in 2023 on cost-effectiveness of HC services compared to hospital care for older adults [5].

The use of economic evaluations to compare HC to higher levels of care is useful to support the matching of client need to an appropriate level of health care while also considering costs of services. Previous research has discussed that depending on a clients functional ability, their needs may be better met by different care settings such as HC, LTC or hospital settings with little disagreement about what kind of care is cost-effective at either end of the functional spectrum [32]. HC clients who are close to being transitioned to a higher level of care are a group well-suited for marginal analysis. Marginal analysis “refers to the fact that assessments of

costs and benefits is best addressed ‘at the margin’” with focus on benefit or loss from an increase or decrease in a unit of resource [33]. Client groups who are on the verge of needing to transition from HC to a higher level of care should be under this kind of economic evaluation.

Individuals not matched to the most appropriate level of care has been reported as a costly issue. Policy solutions in Canada have recommended HC in favor of long-term care (LTC), when appropriate, and to reduce reliance on alternative levels of care in hospital by providing these clients with HC or LTC which could “result in a better match with care needs and result in health care system savings of \$2.2 billion in 2031” [34]. In this thesis, the production of HUI3 outcomes for the HC client population can support understanding of the range of HRQoL outcomes and specific characteristics associated to low HRQoL. More specifically, through observing the range of HRQoL outcomes we can see groups associated with the lowest outcomes, such as clients with multiple recent diagnosis. Tailoring HC programs for individuals on the lowest range of HRQoL outcomes, may enable older adult clients to ‘age in place’ longer. With timely interventions prior to deconditioning, clients may be able to recover with lower levels of health care involvement [35] and safely remain in their current environment. Earlier identified gaps in knowledge were highlighted in this thesis including challenges with reporting economic evaluations for both rehabilitation and home care programs. This thesis builds on knowledge through systematically reviewing possible cost-effective evaluations for home care interventions and identifies numerous factors impacting community residing older adults HRQoL.

This thesis uses large AHS administrative data sets to assess older adult HRQoL and HC services. The use of information systems can enable services like rehabilitation to be provided in an appropriate and equitable manner which can lead to improvement in quality of life and health

[18]. AHS information systems can provide data for rehabilitation interventions targeting cognitive and ambulation changes for older adults accepting HC. Despite these challenges, opportunity may exist for updating rehabilitation [36] and HC [37] practice interventions that have enhanced outcomes at a decreased or neutral cost.

Future Directions

Although this thesis included all eligible participants, further subgroup evaluation of traditionally underrepresented communities could provide valuable insight into the HC population; for example if based on location (e.g. rural location), language (e.g. not speaking the primary language), cognition (e.g. having intellectual challenges) or social status (e.g. being on a visa) [38]. Future research is indicated for several areas including evaluation of barriers for reporting economic evaluations within rehabilitation and HC. With the goal of continued development for HC interventions, clinical staff and policy developers may find additional applicability of research if comparison groups were based within Canada. Further evaluation within the context under consideration for earlier identified cost-effective interventions such as reablement, nursing health promotion or falls prevention programs should be considered. To expand our understanding of the HC system involvement in HRQoL of HC clients, results identified in this study can be compared to other areas across Canada and internationally.

Impact of frailty within the realm of the home care population requires further evaluation. Evidence suggests that frailty is an important risk factor for poor quality of life for older adults who are accepting health care at home [39]. Due to the overlap in concepts between frailty and HRQoL it is possible that some of the decline in HRQoL may be an indirect measure of advancing frailty. For example there is overlap between the HUI3 and Frailty Index-CLIN for

evaluation of ambulation, cognition, and emotion/depression [40, 41]. Further evaluation of this concept remains challenging for several reasons. For example there is no consensus on the definition of frailty [39], no standard assessment instrument for frailty, and more validation is needed to demonstrate which instruments are measuring the biological entity of frailty over and above multimorbidity [42]. Measuring frailty and HRQoL simultaneously will be problematic due to the multicollinearity of factors under evaluation. Further evaluation using a validated frailty measure within this population could provide valuable information to understand the interaction between frailty, HRQoL and the RAI-HC measure.

Additional evaluation is warranted regarding the usefulness of implementing an embedded Outcome Scale for HRQoL within the RAI-HC, based on the previously identified mapping process. Using mapped data from the RAI-HC to HUI3 provides a low-cost way to routinely access client HRQoL. By embedding the HUI3 into the RAI-HC, along with the other embedded Outcome Scales such as the Depression Rating Scale or the Cognitive performance scale [43], clinical care providers and policy decision makers would be able to easily monitor current client HRQoL outcomes, subgroups of the HC population as well as changes over time. This method of data use may provide a way to measure outcomes from new health interventions or policies implemented. Regular evaluation of clients under consideration to transition to a higher level of care will provide a better understanding of this group's health attributes and overall HRQoL. Additionally, as the RAI is also used in LTC programs within Alberta, the HRQoL measure could provide a way to assess the impact of transitioning from HC to LTC and allow these two populations to be compared simultaneously. Research could be completed to identify if specific HC services are associated with delays in admission to higher levels of care

and if this leads to any avoided days in facility living or changes in costs from health and social care services.

Strengths and Limitations

Several limitations from this body of research exist. At this time the systematic reviews in chapters two [8] and three [9] should be updated; although it is unlikely that significant changes would be reported as only small changes over time were reported in the original work. Another limitation is that not all HC clients were included in this research, therefore the results may not be generalizable to other specialized groups such as the pediatric or younger adult group and rural population. This study did not include clients with only one RAI-HC outcome which may result in an under representation of clients who are healthier and left services, required more help than HC could provide and moved to a higher level of care or expired. Therefore, it is possible that these results are more representative of medically stable older adults requiring ongoing HC services. The research based in Alberta evaluated outcomes for HC clients but not associated costs, therefore further research could be completed in this area. Another limitation is that the services offered within Edmonton, Alberta are specific to this region. Other areas may offer different mixes of care services and costs associated with their regions' HC program which will reduce how applicable these results are in other areas.

Various strengths exist for this research, including two comprehensive systematic reviews. As administrative data was used, all clients in the zone under evaluation who fulfilled the criteria reported on in chapters four, five and six, were included therefore strengthening the argument that this large group is representative of the Edmonton long-stay HC population. Data collected was longitudinal in nature and therefore able to demonstrate changes over time for this

population. The RAI-HC and HUI3 are commonly used tools within Canada and internationally, meaning these results can be compared widely. This research demonstrated a cost and time efficient way to collect diverse HRQoL information from a population that has previously been under reported [44, 45].

Conclusion

Research presented in this thesis supports health care providers and policy decision makers with evidence that can be used to provide enhanced care for older adults accepting HC services. This includes information regarding the effectiveness of varying types of HC services while identifying that caution is required with respect to applicability of economic outcomes. Information was gained regarding HC clients HRQoL using an earlier validated mapping process of the RAI-HC to the HUI3 [7]. This thesis has reported on several factors impacting HRQoL of older adults accepting HC services on a long-term basis, including client characteristics (non-resource factors), services provided (intermediate outputs), HRQoL (final outcomes), and context factors such as the COVID-19 pandemic. Generally, higher HRQoL outcomes are found in HC clients who are in younger age groups, are medically stable, and access lower levels of services. Application of this research can support the well-being of older adults accepting long-term HC services from an interdisciplinary group of health care professionals providing a variety of health care services.

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Appendix 1. Detailed Search Strategy

This search was conducted by the IHE Research Librarian on March 7 and 12, 2018. A search update of Medline was conducted on April 22, 2020. No limits were imposed.

Database	Date/Yield	Search Strategy
Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present	March 7, 2018 2704 results	1 exp Manipulation, Orthopedic/ or manipula*.ti. or exp Manipulation, Chiropractic/ or exp Manipulation, Spinal/ 22655
		2 exp Chiropractic/ or spinal adjustment.ti.3108
		3 exp Manipulation, Osteopathic/ or exp Osteopathic Medicine/ or osteopathic*.ti. 4062
	April 22, 2020 1144 results	4 (orthopedic* or orthopaedic*).ti. or exp Orthopedics/ 32216
		5 musculoskeletal therap*.mp. 37
		6 exp Musculoskeletal Manipulations/ 14934
		7 manual therap*.mp. 2131
		8 exp Physical Therapy Modalities/ or exp Exercise Therapy/ 134094
		9 physiotherap*.mp. 21993
		10 physical therap*.mp.48339
		11 rehabilitation.ti. or exp "Physical and Rehabilitation Medicine"/ or exp Mouth Rehabilitation/ or exp Rehabilitation/ 301633
		12 relaxation therap*.mp. or exp Relaxation Therapy/ 8515
		13 relaxation training.mp. 1234
		14 continuous passive motion.mp. 575

		15	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14	387237
		16	"Activities of Daily Living"/	58441
		17	Occupational Therapy/	12050
		18	recreation therapy/ or rehabilitation, vocational/	9261
		19	(occupation* adj5 (therap* or rehabil*)).mp.	19640
		20	((activit* adj3 daily living) or ADL).ti.	2514
		21	(recover* adj5 function*).mp.	81633
		22	(everyday adj3 (activit* or functioning)).ti.	369
		23	recreation therap*.mp.	157
		24	"Task Performance and Analysis"/	28396
		25	"Recovery of Function"/	43112
		26	16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25	190399
		27	15 or 26	488741
		28	Economics/	26978
		29	exp "Costs and Cost Analysis"/	213172
		30	exp "Fees and Charges"/	29149
		31	exp Budgets/	13230
		32	(economic* or cost or costs or costly or costing or price or prices or pricing or pharmaco-economic* or pharmaco-economic* or expenditure or expenditures or expense or expenses or financial or finance or finances or financed).ti.	165964
		33	(value adj2 (money or monetary)).ti,ab,kf.	1946

		34 exp models, economic/ 13074 35 economic model*.ab,kf. 2735 36 markov chains/ 12541 37 markov.ti,ab,kf. 18483 38 monte carlo method/ 24891 39 exp Decision Theory/ 10999 40 (decision* adj2 (tree* or analy* or model*)).ti,ab,kf. 18804 41 or/28-40 402041 42 27 and 41 11385 43 limit 42 to (english language and yr="2013 -Current") 2704 44 limit 42 to (english language and yr="2018 -Current") 1144
Cochrane Library NHS EED	March 12, 2018 23 results	#1 MeSH descriptor: [Manipulation, Orthopedic] this term only #2 MeSH descriptor: [Manipulation, Chiropractic] this term only #3 MeSH descriptor: [Manipulation, Spinal] explode all trees #4 MeSH descriptor: [Chiropractic] explode all trees #5 MeSH descriptor: [Manipulation, Osteopathic] this term only #6 MeSH descriptor: [Osteopathic Medicine] explode all trees #7 manipul*:ti (Word variations have been searched)

		#8	orthopedic* or orthopaedic*
		#9	musculoskeletal therap*
		#10	manual therap*
		#11	physiotherap*
		#12	physical therap*
		#13	rehabilitation
		#14	relaxation therap*
		#15	relaxation training
		#16	continuous passive motion
		#17	#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 Publication Year from 2013 to 2015

Appendix 2. Characteristics of the analyzed studies

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Abbott, 2019[18] Country: New Zealand Design: Factorial Randomised Controlled Trial Study Length: 2 Years Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: Health Research Council of New Zealand and the NZ Lottery Grants Board	Objectives: To investigate the incremental clinical- and cost-effectiveness of an exercise therapy programme and/or a manual therapy programme, delivered in addition to usual medical care, compared to usual medical care only for the management of hip and knee OA. Condition: Osteoarthritis Number of Interventions: 4 Comparators: 1. Usual care control 2. Usual care + manual therapy 3. Usual care + exercise therapy 4. Usual care + combined exercise + manual therapy Total sample size: Total N=206; 1. Usual care control n=51; 2. Usual care +	Type of economic evaluation: Cost-Utility Analysis Unit of economic analysis: Incremental Cost-Utility Ratio (ICUR) and Incremental Net Benefit (INB) Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: SF-6D Model used: Linear (pain, physical function, and global change) and logistic (OMERACT-OARSI response) regression models. Willingness to pay threshold: Willingness to pay thresholds of one, two, and three times GDP per capita (NZ\$42,981, NZ\$85,962, and NZ\$128,943, respectively) Software used: Stata	Results: Exercise physiotherapy and manual physiotherapy dominated usual care, demonstrating cost savings; combined therapy did not. Exercise therapy had the highest incremental net benefits (INBs), statistically significant at all willingness-to-pay (base-case: societal New Zealand (NZ)\$6,312, 95%CI 334 to 12,279; health system NZ\$8,065, 95%CI 136 to 15,994). Conclusions: Individually supervised exercise therapy is cost-effective and clinically effective in addition to usual medical care at 2-year follow-up, and leads to cost savings for the health system and society.	CHEE RS Score: 22

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
	manual therapy n=54; 3. Usual care + exercise therapy n=51; 4. Usual care + combined exercise + manual therapy n=50			
Aboagye, 2015[19] Country: Sweden Design: Randomized controlled trial Study length: 12 months Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal	Objectives: To evaluate the cost-effectiveness of medical yoga as an early intervention compared with evidence-based exercise therapy and self-care advice for non-specific low back pain. Condition: Low back pain Number of interventions: 3 Comparators: 1. Medical yoga 2. Exercise therapy 3. Evidence-based self-care group Total sample size:	Type of economic evaluation: Cost-utility analysis, cost-benefit analysis, cost-consequence analysis Unit of economic analysis: Incremental cost-effectiveness ratio (ICER), net monetary benefit Perspective: Societal, other Time horizon: NR Discount rate: No discount; cost within a year of recruitment Outcome for economic evaluation: Adjusted mean incremental quality-adjusted life years (QALYs) Measurement preference-based outcome: EQ-5D	Results: Societal perspective: Considering intervention cost and production losses to society due to sickness absence, medical yoga costs EUR 1,519 and EUR 2,124 less per individual, compared with exercise therapy and self-care advice, respectively. Incremental net benefit: Yoga has an INB of EUR 1,749 and EUR 2,469 compared with exercise therapy and self-care advice, respectively. Conclusions: Medical yoga is more cost-effective than exercise and advice from an	11

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Specific area: Physical therapy (PT), other rehab Funding: Industry	Total N=159; 1. Medical yoga n=52; 2. Exercise therapy n=52; 3. Advice n=55	Model used: Regression model: Outcome HRQL and beta coefficient for treatment was considered the mean incremental QALY Willingness to pay threshold: EUR 11,500; equivalent to SEK 100,000/QALY, according to Swedish National Board of Health and Welfare Software used: SPSS v. 20	employer's perspective as well as from a societal perspective in a 1-year timeframe.	
Ademi, 2016[20] Country: Switzerland Design: Decision analytic model Study length: 2 Years Setting: NR Area of rehabilitation: Neurology Specific area: PT Funding: Other	Objectives: To assess the cost-effectiveness of primarily surgical treatment vs. primarily conservative treatment on adults with intermediate severity, acute or subacute, lumbar radicular syndrome due to intervertebral disc herniation. Condition: Lumbar radicular syndrome due to intervertebral disc herniation Number of interventions: 2 Comparators:	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, costs Perspective: Societal Time horizon: Estimated to 2 years Discount rate: 0.02 Outcome for economic evaluation: Costs per treatment, QALYs per treatment, incremental cost-effectiveness Measurement preference-based outcome: EQ-5D Model used: Decision tree	Results: From a healthcare systems perspective, the PST approach leads to a 0.0634 additional QALYs per person over 2 years, at a net cost of CHF 7,198 per person, compared with the PCT approach. Conclusions: A PST approach, when compared with a PCT approach, may be cost-effective from the societal perspective based on a willingness to pay threshold of CHF 100,000/QALY gained. However, treatment is	17

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
	1. Primarily surgical treatment (PST) 2. Primarily conservative treatment (PCT) Total sample size: Total N=465; Study 1 n=56; Study 2 n=126; Study 3 n=283	Willingness to pay threshold: CHF 100,000/QALY Software used: Excel in combination with @Risk (v. 6, 2013)	less cost-effective from the perspective of the Swiss healthcare system.	
Adie, 2017[21] Country: UK Design: Randomized controlled trial Study length: 6 months Setting: Community/home Area of rehabilitation: Neurology Specific area: PT, OT	Objectives: To evaluate the effectiveness and cost-effectiveness of using Nintendo Wii Sports (WiiTM) to improve affected arm function after stroke when compared with exercises at home only. Condition: Stroke Number of interventions: 2 Comparators: 1. Exercises with Wii 2. Only exercises Total sample size: Total N=235	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: Other Perspective: NR Time horizon: NR Discount rate: NR Outcome for economic evaluation: Incremental cost per QALY Measurement preference-based outcome: EQ-5D 3L Model used: Listwise deletion Willingness to pay threshold: NR Software used: R Foundation for Statistical Computing, v. 2.15.1 Vienna Austria	Results: The estimate of the probability that the WiiTM arm is dominated (more expensive and less effective) is 0.866. Conclusions: The trial showed that the WiiTM was not superior to arm exercises in home-based rehabilitation for stroke survivors with arm weakness. The WiiTM was well tolerated but more expensive than arm exercises.	8

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Funding: Government				
Albert, 2016[22] Country: USA Design: Prospective cohort study Study length: 12 months Setting: Community/home Area of rehabilitation: Musculoskeletal Specific area: PT, OT	Objectives: To evaluate the effectiveness of the Healthy Steps for Older Adults (HSOA) screening for falls risk and intervention program with respect to a control group to compare the number of falls incidents, hospitalizations, emergency department treatments with estimated and potential cost savings. Condition: Elderly adults Number of interventions: 2 Comparators: 1. Healthy Steps for Older Adults (HSOA)	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: Other, ICER, quality of life (QoL) utilities Perspective: NR Time horizon: NR Discount rate: NR Outcome for economic evaluation: Medical costs associated with visits to emergency department and hospitalizations, and QoL; ICER discussed but actual value not reported Measurement preference-based outcome: EQ-5D	Results: On average intervention accumulated savings of \$718-\$840 per person compared to the comparison group. The mean QoL for the HSOA was 0.833 compared to the comparison group of 0.825. Conclusions: It was concluded that HSOA is cost-effective as a primary prevention intervention of falls. Also, that using the HSOA is a reasonable public health investment.	17

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Funding: Government, academic	2. Control Total sample size: Total N=1,833; Treatment n=814; Control n=1,019	Model used: Decision tree in TreeAge Willingness to pay threshold: "For values less than or equal to \$200,000 per QALY, the intervention strategy was likely to be favored over the non-intervention arm." Software used: TreeAge Pro 2015		
Allen, 2018[23] Country: Canada Design: Markov Model Study Length: 1 Year Area of Rehabilitation: Multisystems Specific Area: PT, OT, Other Rehab Funding: Ontario Stroke Network	Objectives: To perform a 1-year prospective evaluation of utility outcomes and costs among clients of the Community Stroke Rehabilitation Teams (CSRTs). Condition: Stroke Number of Interventions: 2 Comparators: 1. Community Stroke Rehabilitation Team 2. Usual Care Total sample size: CSRT Participants Total N=164	Type of economic evaluation: Cost-Utility Analysis Unit of economic analysis: ICER Perspective: NR Time horizon: 35 Years Discount rate: 35 Years Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-5L Model used: Markov model Willingness to pay threshold: Willingness to pay of 20,000\$ USD Software used: TreeAge Pro 2013	Results: The CSRT programme has a net monetary benefit (NMB) of \$43,655 over Usual Care, and is both less costly and more effective (incremental cost = -\$17,255; incremental effect = 1.65 Quality Adjusted Life Years). Incremental cost-effectiveness of the CSRT programme is superior in 100% of iterations when compared to Usual Care Conclusions: CSRT model of care is cost-effective, and should be considered when evaluating potential stroke	CHEE RS Score: 19

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
			rehabilitation delivery methods.	
Andelic, 2014[24] Country: Norway Design: Prospective cohort study Study length: 5 years Setting: Inpatient (hospital), outpatient/clinics Area of rehabilitation: Neurology	Objectives: To estimate the long-term cost-effectiveness of the early initiated, continuous chain of rehabilitation after severe traumatic brain injury (TBI) compared with the broken chain of rehabilitation. Condition: Traumatic brain injury (TBI) Number of interventions: 2 Comparators: 1. Continuous chain of rehabilitation 2. Broken chain of rehabilitation	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, other, cost-effectiveness acceptability curve (CEAC) Perspective: NR Time horizon: 5-year Discount rate: 0.04 Outcome for economic evaluation: DRS points Measurement preference-based outcome: NA Model used: Decision tree model Willingness to pay threshold: NOK 100,000 Software used: TreeAge Pro 2009	Results: The continuous chain of treatment was considered as the dominant strategy. For each patient with severe TBI, NOK 37,000 could be saved, and 4.06 DRS points could be gained. This was confirmed by the PSA analysis. The probability that the ICER falls below NOK 100,000 is 85%. Conclusions: The trajectory of continuous rehabilitation represents a dominant strategy in that it reduces costs and improves outcomes after severe TBI.	14

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Specific area: PT, other rehab Funding: Academic, industry	Total sample size: Total N=59			
Arias-Buria, 2018[25] Country: Spain Design: Randomized clinical trial Study Length: 1 Year Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: NR	Objectives: To evaluate the cost-effectiveness of the inclusion of trigger point–dry needling (TrP-DN) into an exercise program for the management of subacromial pain syndrome. Condition: Subacromial Pain Syndrome Number of Interventions: 2 Comparators: 1. Exercise Group 2. TrP-DN Total sample size: Total N=50; 1. Exercise Group n=25; 2. TrP-DN + Exercise Group n=25	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-5L Model used: NR Willingness to pay threshold: NR Software used: Stata V. 13.1	Results: The combination of exercise plus TrP-DN was less costly (mean difference cost/patient = € 517.34, P = 0.003) than exercise alone. Incremental QALYs showed greater benefit for exercise plus TrP-DN (difference = 2.87, 95% confidence interval = 2.85–2.89). Therefore, the inclusion of TrP-DN into an exercise program was more likely to be cost-effective than an exercise program alone. Conclusions: The inclusion of TrP-DN into an exercise program was more cost-effective for individuals with subacromial pain syndrome than exercise alone.	CHEE RS Score: 18
Barker, 2020[26]	Objectives: To evaluate the clinical and cost-effectiveness	Type of economic evaluation: Cost-Effectiveness Analysis	Results: At 12 months, there were no statistically	CHEE RS

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Country: United Kingdom Design: Randomized controlled trial Study Length: 1 Year Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: National Institute for Health Research	of different physiotherapy approaches for people with osteoporotic vertebral fracture(s). Condition: Osteoporotic vertebral fractures Number of Interventions: 3 Comparators: 1. Exercise Therapy 2. Manual Therapy 3. Single Session of Physiotherapy Total sample size: Total N=1. Exercise therapy n=216; 2. Manual therapy n=203; 3. SSPT n=196	Unit of economic analysis: ICER Perspective: Public health payer Time horizon: 1 Year Discount rate: 1 Year Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-5L Model used: Different imputation models used in sensitivity analysis Willingness to pay threshold: 20,000 Pounds Software used: R version 3.4.1 and STATA 15.0	significant differences between groups. Mean QUALEFFO-41: – 1.3 (exercise), – 0.15 (manual), and – 1.2 (SSPT), a mean difference of – 0.2 (95% CI, – 3.2 to 1.6) for exercise and 1.3 (95% CI, – 1.8 to 2.9) for manual therapy. Exercise provided more quality-adjusted life years than SSPT but was more expensive. Conclusions: Benefits at 4 months did not persist and at 12 months, we found no significant differences between treatments. There is inadequate evidence a short physiotherapy intervention of either manual therapy or home exercise provides long-term benefits.	Score: 21

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Barnhoorn, 2018[27] Country: Netherlands Design: Randomized controlled trial Study length: Pain Exposure Physical Therapy: Maximum 5 physical therapy sessions Setting: Outpatient/clinics Area of rehabilitation: Neurology Specific area: PT Funding: Industry	Objectives: To analyze cost-effectiveness of Pain Exposure Physical Therapy compared to conventional treatment alongside an RCT in patients with complex regional pain syndrome type 1 Condition: Complex Regional Pain Syndrome Type 1 Number of interventions: 2 Comparators: 1. Pain Exposure Physical Therapy 2. Dutch conventional guidelines Total sample size: Total N=42; 1. Experimental group n=23; 2. Conventional treatment n=19	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, net monetary benefit, direct and indirect healthcare costs Perspective: NR Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: Generalized linear model with a log link function and with a gamma distribution Willingness to pay threshold: NR Software used: Unable to identify	Results: No significant effects were found for QALYs (mean difference=-0.02; 95% confidence interval [CI] -0.10 to 0.04) and clinical outcomes. A cost minimization analysis showed a significant difference in costs between groups. The conventional treatment was 64% more expensive than the Pain Exposure Physical Therapy. Conclusions: This economic analysis shows that Pain Exposure Physical Therapy compared to conventional treatment is cost-effective.	16

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Beaupre, 2020[28] Country: Canada Design: Feasibility trial Study Length: 1 Year Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: Alberta Innovates Health Solutions Population Health Investigator Establishment Grant	Objectives: The intent was to perform a cost-effectiveness analysis on an outreach rehabilitation program for nursing home residents following hip fracture. Condition: Hip fracture Number of Interventions: 2 Comparators: 1. Outreach Intervention 2. Control (Usual Care) Total sample size: Total N=76; 1. Intervention n=46; 2. Control n=30	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: Incremental costs and incremental effects Perspective: Public health payer Time horizon: 1 Year Discount rate: 1 Year Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-3L Model used: Comparison model Willingness to pay threshold: NR Software used: Amelia 2 v1.7.3 and R	Results: EQ5D QALYs scores were nonsignificantly higher for intervention participants. Inpatient readmissions were two times higher among controls, with a cost difference of −\$3,350/patient for intervention participants. The adjusted incremental QALYs/patient difference was 0.024 favoring the intervention, with an incremental cost/patient of −\$621 for intervention participants. Conclusions: The assessed intervention may be cost-saving, through reduced postfracture hospital readmissions.	CHEERS Score: 21

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Bornhoft, 2019[29] Country: Sweden Design: Randomized controlled trial Study Length: 1 Year Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: Healthcare subcommittee Region Västra Götaland	Objectives: The aim of this study was to evaluate the cost-effectiveness from the societal perspective of this new care-pathway through primary care regarding triaging patients with MSD to initial assessment by physiotherapists compared to standard practice with initial GP assessment. Condition: Musculoskeletal disorder Number of Interventions: 2 Comparators: 1. Intervention 2. Treatment As Usual (TAU) Total sample size: Total N=53; 1. Intervention n=27; 2. TAU n=26	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: 1 year Discount rate: 1 year Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-3L Model used: NR Willingness to pay threshold: 20,000 Software used: STATA V.15	Results: The group who were allocated to initial assessment by physiotherapists had slightly larger gains in QALYs at lower total costs. At a willingness-to-pay threshold of 20,000 €, the likelihood that the intervention was costeffective from a societal perspective including production loss due to MSD was 85% increasing to 93% at higher thresholds. Conclusions: From the societal perspective, this study indicated that triaging directly to physiotherapists in primary care has a high likelihood of being cost-effective.	CHEERS Score: 19

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Bove, 2017[30] Country: USA Design: Randomized controlled trial Study length: 1 year Setting: NR Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Government	Objectives: The study objective was to compare the cost-effectiveness of 4 different combinations of exercise, manual therapy, and booster sessions for individuals with knee osteoarthritis. Condition: Knee osteoarthritis Number of interventions: 4 Comparators: 1. Exercise only (EX) 2. Exercise plus booster sessions (EX+B) 3. Exercise plus manual therapy (EX+MT) 4. Exercise plus manual therapy and booster sessions (EX+MT+B) Total sample size: Total N=300; 1. Ex n=75; 2. Ex+B n=76; 3. Ex+MT n=75; 4. Ex+MT+B n=74	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, CEAC Perspective: Societal Time horizon: 2 years and 5 years Discount rate: 0.03 Outcome for economic evaluation: QALYs Measurement preference-based outcome: US version of EQ-5D Model used: Markov state-transition model Willingness to pay threshold: Threshold of both \$50,000 and \$100,000/QALY used Software used: TreeAge Pro 2015	Results: In the 2-year analysis, booster strategies (EX+MT+B and EX+B) dominated no-booster strategies, with both lower healthcare costs and greater effectiveness. EX+MT+B had the lowest total healthcare costs. EX+B cost \$1,061 more and gained 0.082 more QALYs than EX+MT+B, for an ICER of \$12,900/QALY gained. Conclusions: Spacing exercise-based PT sessions over 12 months using periodic booster sessions was less costly and more effective over 2 years than strategies not containing booster sessions for individuals with knee osteoarthritis.	22

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Brodin, 2015[31] Country: Sweden Design: Randomized controlled trial Study length: 1 year Setting: Community/home Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Government, academic, foundation	Objectives: To evaluate the cost-effectiveness and cost-utility of the Physical Activity in Rheumatoid Arthritis (PARA) intervention where the physical activity is performed within each participant's daily life. Condition: Rheumatoid arthritis Number of interventions: 2 Comparators: 1. Intervention, PARA group 2. Control group Total sample size: Total N=228; 1. Intervention, PARA group n=94; 2. Control group n=134	Type of economic evaluation: Cost-effectiveness analysis, cost-minimization analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: EQ-VAS, HAQ (Activity Limitation), EQ-5D Measurement preference-based outcome: EQ-VAS, HAQ (Activity Limitation), EQ-5D Model used: NR Willingness to pay threshold: NR Software used: Excel, Statistical (Stat Soft)	Results: To gain one extra point of improvement in EQ-VAS in the IG compared to the CG, the cost was EUR 116. By offering the intervention exclusively to the MO participants, the cost of gaining one extra point of improvement in EQ-VAS in the IG compared to the CG was EUR 39. Using the EQ-5D ordinary PT was the most cost-effective alternative. Conclusions: Physical activity for RA resulted in improved effect in health status for the IG with a cost of EUR 116 per extra point in VAS. The intervention was cost-effective if targeted towards a subgroup of more affected patients when evaluating the effect using VAS and HAQ.	14

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Brusco, 2015[32] Country: Australia Design: Randomized controlled trial Study length: NR Setting: Inpatient (hospital) Area of rehabilitation: Multisystem Specific area: PT, OT Funding: Government, academic	Objectives: To determine short-term cost-effectiveness of providing an additional Saturday rehabilitation service to inpatients in addition to Monday to Friday compared to Monday to Friday rehabilitation alone, and if it is sustained 12 months following discharge from rehabilitation. Condition: NR Number of interventions: 2 Comparators: 1. Intervention group 2. Control group Total sample size: Total N=996; 1. Intervention group n=496; 2. Control group n=500	Type of economic evaluation: Cost-effectiveness analysis, cost-utility analysis Unit of economic analysis: ICER, CEAC Perspective: Public health payer, private payer Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs, functional independent scores (FIM) Measurement preference-based outcome: EQ-5D-3L Model used: NR Willingness to pay threshold: Different thresholds for sensitivity analyses: AUD 50,000, AUD 23,000, or AUD 0 Software used: SPSS, STATA, Excel	Results: The ICER was statistically significant at 6 months following discharge showing a cost saving of AUD 112,320 (95% CI 6,556 to 336,631) per QALY gained for the intervention group compared to the control group. Non-significant cost savings were found between groups per every QALY and every point of the FIM at 12 months after discharge. However, the ICERs and 95% CI were located at the bottom right quadrant, indicating that the treatment was most likely to be cost-effective. Conclusions: There is a high degree of certainty that providing additional rehabilitation services on Saturday is cost-effective.	13

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Burge, 2020[33] Country: Australia Design: Randomized controlled equivalence trial Study Length: 12 Months Area of Rehabilitation: Cardiorespiratory Specific Area: PT Funding: National Health and Medical Research Council (Australia)	Objectives: To compare the cost-effectiveness and cost-utility of home and centre-based pulmonary rehabilitation for adults with stable chronic obstructive pulmonary disease (COPD). Condition: Chronic obstructive pulmonary disease (COPD) Number of Interventions: 2 Comparators: 1. Centre-based 2. Home-based Total sample size: Total N=159; 1. Centre-based n=82; 2. Home-based n=77	Type of economic evaluation: Cost-Utility Analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: 12 Months Discount rate: 12 Months Outcome for economic evaluation: QALY Measurement preference-based outcome: SF-6D Model used: Linear mixed effect model and linear regression model Willingness to pay threshold: \$300 (AUD) was used to indicate a threshold value for acceptability Software used: SPSS v25.0	Results: Between-group mean difference point estimates for cost (−\$4497 (95% CI: −\$12 250 to \$3257), utility (0.025 (−0.038 to 0.086) QALY) and effectiveness (14 m (−11 to 39) Δ6MWD) favoured the home-based group. Cost-utility analyses demonstrated 63% of estimates falling in the dominant southeast quadrant and the probability that the new home-based model was cost-effective at a \$0 threshold for willingness to pay was 78% Conclusions: Home-based pulmonary rehabilitation provides a cost-effective alternative model for people with COPD who cannot access traditional centre-based programmes.	CHEERS Score: 19

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Burns, 2016[34] Country: UK Design: Randomized controlled trial Study length: 12 months Setting: Other Area of rehabilitation: Cardiorespiratory Specific area: PT, OT Funding: Government	Objectives: To present an economic evaluation conducted alongside a randomized controlled trial of a low-intensity maintenance program over a time horizon of 1 year delivered in UK primary and secondary care settings. Condition: Chronic obstructive pulmonary disease (COPD) Number of interventions: 2 Comparators: 1. Intervention 2. Control Total sample size: Total N=148; 1. Control n=75; 2. Intervention n=73	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, CEAC Perspective: Public health payer Time horizon: 1 year Discount rate: Costs were not discounted as the time horizon of the study was 1 year Outcome for economic evaluation: Point estimate cost and outcome (QALYs and change in CRQ) per patient in each group, increments and ICERs from the perspective of the NHS and social services Measurement preference-based outcome: EQ-5D-3L Model used: Ordinary least squares model Willingness to pay threshold: Assumes a threshold of £30,000/QALY Software used: STATA	Results: At 12 months, incremental cost to the NHS and social services was -£204.04 (95% CI -£1,522 to £1,114). Incremental CRQ and QALY gains were -0.007 (-0.461 to 0.447) and 0.015 (-0.050 to 0.079), respectively. Based on point estimates, PR maintenance therefore dominates treatment as usual from the perspective of the NHS and social services in terms of cost per QALY gained. However, there is much decision uncertainty: 95% CIs around increments did not exclude zero, and there is a 72.9% (72.5%) probability that the ICER is below £20,000 (£30,000) per QALY. Conclusions: Future research should explore whether more intensive maintenance regimens offer benefit to patients at reasonable cost.	23

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Canaway, 2018[35] Country: Israel Design: Controlled trial Study Length: 1 Year Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: Maccabi Healthcare Services	Objectives: To assess the cost-effectiveness of an enhanced transtheoretical model of behaviour change in conjunction with physiotherapy compared with standard care (physiotherapy) in patients with chronic lower back pain. Condition: Chronic lower back pain (CLBP) Number of Interventions: 2 Comparators: 1. Control 2. Intervention Total sample size: Total N=220; 1. Control n=111; 2. Intervention n=109	Type of economic evaluation: Cost-Utility Analysis Unit of economic analysis: Net Monetary Benefit Perspective: Healthcare Time horizon: 1 Year Discount rate: 1 Year Outcome for economic evaluation: QALY Measurement preference-based outcome: SF-12; SF-6D Model used: Multilevel generalised linear model Willingness to pay threshold: 50,000 New Israeli Shekels (NIS) Software used: STATA V.14	Results: The cost per QALY point estimate was 10,645 NIS (£1737.11). There was an 88% chance the intervention was cost-effective at NIS 50,000 per QALY threshold. Excluding training costs, the intervention dominated the control arm, resulting in fewer physiotherapy and physician visits while improving outcomes. Conclusions: The enhanced transtheoretical model intervention appears to be a very cost-effective intervention leading to improved outcomes for low cost.	CHEERS Score: 21

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Cheng, 2016[36] Country: Australia Design: Markov Model Study length: 30 years Setting: Community/home Area of rehabilitation: Multisystem Specific area: NR Funding: Other	Objectives: To evaluate the long-term cost-effectiveness of two home-based cardiac rehabilitation (CR) interventions (Healthy Weight [HW] and Physical Activity [PA]) for patients with cardiovascular disease, who had been referred to CR but had not attended. Condition: Individuals with cardiovascular disease who have chosen not to attend a hospital based cardiac rehabilitation program Number of interventions: 3 Comparators: 1. Control group 2. Healthy Weight (HW) 3. Physical Activity (PA) Total sample size: NR	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, tornado diagrams, CEAC Perspective: Other Time horizon: 30 years (60 cycles) Discount rate: 0.05 Outcome for economic evaluation: Costs, QALYs Measurement preference-based outcome: Assessment of Quality of Life Model used: Markov model Willingness to pay threshold: \$50,000/QALY Software used: TreeAge Pro 2013	Results: Given a willingness to pay threshold of \$50,000/QALY, both the HW and PA interventions are cost-effective compared with usual care. While the HW intervention is more effective, it also costs more than both the PA intervention and the control group due to higher intervention costs. However, the HW intervention is still cost-effective relative to the PA intervention for both men and women. Conclusions: These results provide evidence of the long-term cost-effectiveness of home-based CR interventions for patients who are referred to CR but do not attend. Both the HW and PA intervention can be recommended as cost-effective home-based CR programs, especially for people lacking access to hospital services.	18

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Coombes, 2016[37] Country: Australia Design: Randomized controlled trial Study length: 1 year Setting: Community/home Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Government, academic	Objectives: To determine the cost-effectiveness of corticosteroid injection, PT, and a combination of these interventions, compared to a reference group receiving a blinded placebo injection Condition: Epicondylalgia Number of interventions: 4 Comparators: 1. Placebo (saline injection) 2. Corticosteroid injection 3. Saline injection plus PT 4. Corticoid injection plus PT Total sample size: Total: N=165; 1. Placebo n=39; 2. PT + Placebo n=39; 3. Corticosteroid n=40; 4. Corticosteroid + PT n=36	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, direct and indirect health cost Perspective: Societal Time horizon: NR Discount rate: No discount; cost within a year of recruitment Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: Generalized linear modelling Willingness to pay threshold: AUD 50,000/QALY Software used: STATA, Excel	Results: The probability of being more cost-effective than placebo at values above AUD 50,000/QALY was 81% for PT and 53% for corticosteroid injection. Conclusions: PT was a cost-effective treatment for lateral epicondylalgia. Corticosteroid injection was associated with a lower probability of being cost-effective if a willingness to pay threshold of AUD 50,000 is assumed.	17
Cuperus, 2016[38] Country: Netherlands	Objectives: To evaluate, from a societal perspective, the cost utility and cost-effectiveness of a nonpharmacologic face-to-face treatment program compared with a telephone-based treatment program for	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: CEAC, net benefit Perspective: Societal Time horizon: 1 year	Results: Medical costs of the face-to-face treatment and telephone-based treatment were estimated at EUR 387 and EUR 252, respectively. QALYs were similar for both groups according to the EQ,	17

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Design: Randomized controlled trial Study length: 1 year Setting: Outpatient/clinics, community/home, other Area of rehabilitation: Musculoskeletal Specific area: PT, OT Funding: Other	patients with generalized osteoarthritis (GOA). Condition: GOA Number of interventions: 2 Comparators: 1. Face-to-face treatment group 2. Telephone-based treatment group Total sample size: Total N=147; 1. Face-to-face treatment group n=75; 2. Telephone-based treatment group n=72	Discount rate: No discounting applied Outcome for economic evaluation: QALYs, costs Measurement preference-based outcome: EQ-5D-3L, EQ rating scale from 1-100, and the SF-36 converted to SF-6D Model used: Multilevel mixed linear regression models Willingness to pay threshold: Thresholds between EUR 20,000 and EUR 80,000/QALY were considered Software used: Stata/IC, v. 13.1	but were significantly in favour of the face-to-face group, according to the SF-6D (difference 0.022, 95% CI 0.000 to 0.045). Since both societal costs and QALYs/effects were in favour of the face-to-face program, the economic assessment favoured this program, regardless of society's willingness to pay. Conclusions: This economic evaluation from a societal perspective showed that a nonpharmacologic, face-to-face treatment program for patients with GOA was likely to be cost-effective, relative to a telephone-based program.	
D'Amico, 2016[39] Country: UK Design: Randomized controlled trial	Objectives: This study aims to evaluate the cost-effectiveness of a dyadic exercise regimen for individuals with dementia and their main carer as therapy for	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, CEAC, net benefits Perspective: Societal Time horizon: NR Discount rate: 0.035	Results: Mean intervention cost was £284 per dyad. The exercise intervention was more cost-effective than treatment as usual from both societal and health and social care perspectives for the measure of behavioural and	18

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Study length: 12 weeks Setting: Community/home Area of rehabilitation: Neurology Specific area: Other rehab Funding: Government	behavioural and psychological symptoms of dementia. Condition: Dementia Number of interventions: 2 Comparators: 1. Intervention 2. Control Total sample size: Total N=52; 1. Control n=22; 2. Intervention n=30	Outcome for economic evaluation: QALYs Measurement preference-based outcome: QALYs calculated using the DEMQOL-Proxy scores Model used: Seemingly Unrelated Regression model Willingness to pay threshold: Within the range of £0 to £10,000 Software used: STATA 13	psychological symptoms. It does not appear cost-effective in terms of cost per QALY gain. Conclusions: The exercise intervention has the potential to be cost-effective when considering behavioural and psychological symptoms but did not appear cost-effective when considering QALY gains.	
Dang, 2017[40] Country: USA Design: Markov Model Study length: Cycle length of 1 week Setting: NR Area of rehabilitation: Cardiorespiratory Specific area: PT Funding: Other	Objectives: To provide an integrated overview of the cost-effectiveness of heart failure managements including multidisciplinary management program, exercise training program, and usual care. Condition: Heart failure Number of interventions: 3 Comparators: 1. Multidisciplinary management program (MMP)	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, CEAC Perspective: Societal Time horizon: 10 year Discount rate: 0.03 Outcome for economic evaluation: Life years (LYs) Measurement preference-based outcome: NR Model used: Markov model	Results: From a societal perspective, the expected cost of MMP was \$20,695, slightly higher than the cost of UC (\$20,092). The cost of ETP was much higher (\$48,378) because of its high implementation expense and the wage loss it incurred. The ICER of MMP versus UC was \$976/LY gained, and the ICER of ETP versus MMP was \$165,702/LY gained. Conclusions: The results indicated that, under current	14

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
	2. Exercise training program (ETP) 3. Usual care (UC) Total sample size: A cohort simulation of 100,000 hypothetical patients per treatment group was performed	Willingness to pay threshold: Threshold of both \$50,000 and \$100,000/LY gained Software used: Excel	cost-effectiveness threshold, MMP is cost-effective compared with UC, and ETP is not cost-effective compared with MMP. However, ETP is cost-effective compared with MMP from a healthcare payer's perspective.	
Davis, 2017[41] Country: Canada Design: Randomized controlled trial Study length: 12 months Setting: Community/home Area of rehabilitation: Neurology, cardiorespiratory Specific area: PT Funding: Foundation	Objectives: To estimate the incremental cost per quality-adjusted life years (QALYs) gained of a thrice weekly aerobic exercise intervention compared with usual care. Condition: Vascular cognitive impairment Number of interventions: 2 Comparators: 1. Aerobic training (AT) 2. Usual care Total sample size: Total N=70	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, healthcare cost Perspective: Public health payer Time horizon: 6 months and 12 months Discount rate: No discount; cost within a year of recruitment Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D-3L Model used: Multiple linear regression Willingness to pay threshold: CAD 20,000	Results: Total healthcare costs (i.e., 1,791 +/- 1,369 [2015 CAD] at 6 months) were greater, indicating a greater cost for the thrice weekly AT group compared with the control group. The ICER for thrice weekly AT were cost-effective compared with the control group with a willingness to pay threshold of CAD 20,000/QALY or higher. Conclusions: The incremental cost-utility ratios for thrice weekly AT were cost-effective compared with CON, when using a willingness to pay threshold	20

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
		Software used: STATA	of CAD 20,000/QALY or higher.	
Davis, 2015[42] Country: Canada Design: Randomized controlled trial Study length: 6 Months Setting: NR Area of rehabilitation: Neurology Specific area: PT, other rehab Funding: Foundation, government	Objectives: To determine the incremental cost-effectiveness ratio (ICER) (cost per seconds gained or lost on Stroop Test) of twice weekly resistance training or aerobic training compared with twice weekly balance and tone exercises in terms of changes in executive cognitive function among senior women with probable mild cognitive impairment Condition: Mild cognitive impairment (MCI) Number of interventions: 3 Comparators: 1. Balance and tone (BAT) 2. Aerobic training (AT) 3. Resistance training (RT) Total sample size: Total N=86; 1. BAT n=28; 2. AT n=30; 3. RT n=28	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: Other, incremental cost per incremental Stroop change score Perspective: Public health payer Time horizon: 6 months Discount rate: Discounting was reported as not relevant given the analytic time horizon Outcome for economic evaluation: Incremental cost per incremental Stroop change score Measurement preference-based outcome: NA Model used: Nested imputation and nonparametric bootstrapping to model uncertainty Willingness to pay threshold: NR Software used: STATA v. 11.0	Results: Based on the bootstrapped estimates from our base case analysis, it was found that both the AT and RT interventions were less costly than twice weekly BAT classes. Compared with the BAT group, the RT group had significantly improved performance on the Stroop Test (p=0.04). Conclusions: RT and AT result in healthcare cost saving and are more effective than BAT classes after only 6 months of intervention. RT is a promising strategy to alter the trajectory of cognitive decline in seniors with MCI.	16

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
de Vries, 2016[43] Country: Netherlands Design: Randomized controlled trial Study length: 6 months Setting: Outpatient/clinics Area of rehabilitation: Multisystem Specific area: PT Funding: Industry	Objectives: To test the (cost-) effectiveness of a patient-centred PT strategy (Coach2Move) in which individualized treatment is combined to increase physical activity level and physical fitness and, thereby, to decrease the level of frailty. Condition: Adults 70 years or older who signed up at a PT clinic because of mobility problems Number of interventions: 2 Comparators: 1. Coach2Move 2. Usual Care PT Total sample size: Total N=129; 1. Coach2Move n=64; 2. Usual care PT n=65	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: Net monetary benefit, incremental net monetary benefit Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: Costs, QALYs Measurement preference-based outcome: SF-36 subsequently transformed into SF-6D scores, Numeric Rating Scale-fatigue, and patient-specific complaints questionnaire Model used: Linear mixed models Willingness to pay threshold: In EUR, considered at 2,000, 5,000, 10,000, 20,000, 30,000, and 50,000 Software used: NR	Results: At 6 months, the between-group difference was significant for moderate-intensity physical activity in favour of the Coach2Move group (mean difference: 17.9 min per day; 95% CI 4.0 to 34.9; p=0.012). Compared with usual treatment, the Coach2Move strategy resulted in cost savings (EUR 849.8; 95% CI: 1,607 to 90; p=0.028), an improvement in QALYs, (0.02; 95% CI: 0.00 to 0.03; p=0.03), and a higher NMB at every willingness to pay threshold. Conclusions: Older adults with mobility problems can safely increase physical activity in their own environment and reduce frailty.	17
Dehnbarez, 2015[44] Country: Denmark	Objectives: To evaluate whether a LC method was cost-effective compared with the standard rehabilitation of	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: Net benefit, CEAC	Results: An additional cost of DKK 6,043 (95% CI -5,697 to 17,783) and a QALY gain of 0.005 (95% CI -0.001 to	18

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Design: Randomized controlled trial Study length: 5 months Setting: Inpatient (hospital) Area of rehabilitation: Cardiorespiratory Specific area: PT Funding: Government	patients with ischemic heart disease and heart failure Condition: Ischemic heart disease and heart failure Number of interventions: 2 Comparators: 1. Learning and coping 2. Standard Total sample size: Total N=825; 1. Learning and coping n=413; 2. Standard n=412	Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: SF-6D Model used: NR Willingness to pay threshold: Threshold values considered from DKK 0 to DKK 500,000 Software used: STATA v. 13	0.012) was estimated for LC. The probability that LC would be cost-effective did not exceed 29% for any threshold values of willingness to pay per QALY. Conclusions: The LC was unlikely to be cost-effective within 5 months of follow up from a societal perspective, but longer-term follow up should be evaluated before a definite conclusion is drawn.	
den Hollander, 2018[45] Country: Netherlands Design: Randomized controlled trial Study Length: 6 Months Area of Rehabilitation: Neurology	Objectives: The aim of this study was to evaluate the cost-effectiveness of exposure in vivo (a cognitive-behavioral treatment targeting pain-related fear) in Complex Regional Pain Syndrome Type I (CRPS-I), as compared to pain-contingent physical therapy (PPT). Condition: Complex regional pain syndrome type 1 Number of Interventions: 2	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: 6 Months Discount rate: 6 Months Outcome for economic evaluation: QALY Measurement preference-based outcome: SF-36; SF-6D Model used: Fear avoidance model	Results: EXP resulted in greater improvement in physical health-related quality of life and quality-adjusted life-years than PPT. Despite higher initial treatment costs, EXP showed a tendency to reduce all costs compared with PPT. Furthermore, the cost-effectiveness planes were in favor of EXP. Conclusions: EXP, seems more cost-effective than PPT	CHEE RS Score: 21

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Specific Area: PT Funding: Profileringsfonds; governmental funding for Maastricht University, Belgium; and the Flemish Government	Comparators: 1. Exposure In Vivo (EXP) 2. Pain-Contingent Physical Therapy (PPT) Total sample size: Total N=38; 1. EXP n=19; 2. PPT n=19	Willingness to pay threshold: Treatments resulting in costs between €16,000 (for the lowest disease burden) and €80,000 (for the highest burden) per QALY are considered for reimbursement Software used: IBM SPSS Statistics Version 22	in CRPS patients with pain-related fear. The initial higher costs for EXP are offset by a long-term reduction of costs for healthcare use, and a tendency to lower work absenteeism and reduced societal costs.	
Diddens, 2017[46] Country: Netherlands Design: Decision tree model Study length: 6 months Setting: Outpatient/clinics, community/home Area of rehabilitation: Musculoskeletal	Objectives: To estimate the cost-effectiveness of TheraBite compared to PT. Condition: Acute myogenic temporomandibular disorder (TMD) Number of interventions: 2 Comparators: 1. PT 2. TheraBite (TB) Total sample size: Total N=96; 1. PT n=50; 2. TB n=46	Type of economic evaluation: Other Unit of economic analysis: ICER, CEAC Perspective: Societal Time horizon: 6 weeks Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: Average QoL of each individual patient with data for pain, AMIO and MFIQ was calculated for both health states;	Results: The point estimate for the ICER is –EUR 28,068 (–USD 30,191) per QALY (dominant) for TB versus PT. At the willingness to pay ratio of EUR 20,000 (USD 21,513) per QALY, TB has a 97% probability of being cost-effective compared to PT. Conclusions: TB is expected to be cost-effective compared to PT for the treatment of acute myogenic TMD, offering faster recovery of QoL for patients, at a lower cost to society.	13

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Specific area: PT Funding: Industry		then the average QoL of all patients in each health state was calculated Model used: Deterministic decision tree model was created, allowing an intuitive deterministic complete case analysis Willingness to pay threshold: EUR 20,000 (USD 21,513) Software used: Excel 2010		
Dritsaki, 2016[47] Country: UK Design: Randomized controlled trial Study length: 6 months Setting: Outpatient/clinics Area of rehabilitation: Cardiorespiratory Specific area: PT Funding: Government	Objectives: To undertake a cost-utility analysis of a self-management program of activity, coping, and education (SPACE) for chronic obstructive pulmonary disease. Condition: Chronic obstructive pulmonary disease (COPD) Number of interventions: 2 Comparators: 1. Usual care 2. SPACE FOR COPD Total sample size:	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, incremental net benefit, net monetary benefit, CEAC Perspective: Public health payer Time horizon: 6 months Discount rate: NR Outcome for economic evaluation: Costs, health related QoL (HRQoL; QALYs) Measurement preference-based outcome: EQ-5D-3L Model used: Generalized linear model	Results: The mean difference in costs between usual care and SPACE FOR COPD program was - £27.18 (95% CI - £122.59 to £68.25) while mean difference in QALYs was 0.10 (95% CI 0.17 to 0.02). The results suggest that the intervention is more costly and more effective than usual care. The probability of the intervention being cost-effective was 97% at a threshold of £20,000/QALY gained. Conclusions: The authors conclude that the SPACE FOR COPD program is cost-	16

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
	Total N=184; 1. Usual care n=95; 2. SPACE n=89	Willingness to pay threshold: Cost-effectiveness in the NHS context of £20,000 to £30,000/QALY gained, as applied by NICE Software used: NR	effective compared to usual care.	
Ehlken, 2014[48] Country: Germany Design: Prospective cohort study Study length: 24 +/- 12 months Setting: Inpatient (hospital), community/home Area of rehabilitation: Multisystem Specific area: Other rehab Funding: Industry	Objectives: To analyze the impact of exercise training on healthcare costs in pulmonary hypertension. Condition: Pulmonary hypertension Number of interventions: 2 Comparators: 1. Training group 2. Control group Total sample size: Total N=104; 1. Training group n=58; 2. Control group n=46	Type of economic evaluation: Other Unit of economic analysis: Mean life years, mean utility, mean QALYs Perspective: NR Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D, SF-36 questionnaire Model used: A pharmacoeconomic model (based on a decision tree) was used to analyze and compare the average treatment costs Willingness to pay threshold: NR Software used: SPSS 20	Results: During a follow-up of 24 +/- 12 months, the training group had significantly better survival rates at 1 and 3 years and less worsening events (death, lung transplantation, hospitalization due to PH, new PAH-targeted medication) than the control group (15 vs. 25 events, p=0.05), which also led to lower estimated healthcare costs of EUR 657 within a period of 2 years. Conclusions: Due to less worsening events within 2 years, healthcare costs were lower in patients performing exercise training as add-onto medical therapy than in	12

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
			patients with medical treatment only.	
Essex, 2017[49] Country: UK Design: Randomized controlled trial Study length: 1 year Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: PT Funding: NR	Objectives: To assess the cost-effectiveness of acupuncture and usual care, and Alexander Technique lessons and usual care, compared with usual GP care alone for chronic neck pain patients. Condition: Chronic neck pain Number of interventions: 3 Comparators: 1. Acupuncture 2. Alexander treatment 3. Usual care (GP care) Total sample size: Total N=293; 1. Acupuncture n=104; 2. Alexander treatment n=89; 3. Usual care n=100	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER Perspective: Public health payer, societal Time horizon: 1 year Discount rate: No discount; cost within a year of recruitment Outcome for economic evaluation: QALYs, Northwick Park Neck Pain Questionnaire Measurement preference-based outcome: EQ-5D-3L Model used: Regression model Willingness to pay threshold: £20,000/QALY, £30,000/QALY Software used: STATA	Results: Incremental costs were £451 for acupuncture and £667 for Alexander. Acupuncture was likely to be cost-effective (ICER=£18,767/QALY bootstrapped 95% CI £4,426 to £74,562) and was robust to most sensitivity analyses. Conclusions: Acupuncture was found to be cost-effective when compared with usual care.	15

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Fairhall, 2015[50] Country: Australia Design: Randomized controlled trial Study length: 12 Months Setting: Community/home Area of rehabilitation: Multisystem Specific area: PT Funding: Government	Objectives: To compare the costs and cost-effectiveness of a multifactorial interdisciplinary intervention versus usual care for older people who are frail Condition: Frail elderly Number of interventions: 2 Comparators: 1. Intervention 2. Control Total sample size: Total N=241; 1. Intervention n=120; 2. Control n=121	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, CEAC Perspective: Public health payer Time horizon: Limited to the 12-month trial duration Discount rate: Discounting was not applied Outcome for economic evaluation: QALY, incremental cost per extra patient experiencing transition out of frailty over 12 months and incremental cost per QALY gained over 12 months Measurement preference-based outcome: EQ-5D Model used: NR Willingness to pay threshold: Considered at AUD 50,000, and AUD 25,000 Software used: Stata v. 12	Results: The prevalence of frailty was 14.7% lower in the intervention group compared with the control group at 12 months (95% CI 2.4% to 27.0%; p=0.02). There was no significant between-group difference in the EQ-5D utility scores. The cost for 1 extra person to transition out of frailty was AUD 15,955 (at 2011 prices). Conclusions: For frail older people residing in the community, a 12-month multifactorial intervention provided better value for money than usual care, particularly for the very frail, in whom it has a high probability of being cost saving, as well as effective.	20
Farag, 2016[51] Country: Australia	Objectives: To determine the cost-effectiveness of a 6-month minimally supervised	Type of economic evaluation: Cost-effectiveness analysis	Results: The average cost of the intervention was AUD 1,010 per participant. Incremental cost-effectiveness	16

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Design: Randomized controlled trial Study length: 6 months Setting: Community/home, other Area of rehabilitation: Multisystem Specific area: PT Funding: Government	exercise program for people with Parkinson's Disease. Condition: Parkinson's Disease Number of interventions: 2 Comparators: 1. Intervention group 2. Control group Total sample size: Total N=231; 1. Intervention group n=115; 2. Control group n=116	Unit of economic analysis: ICER, CEAC Perspective: Public health payer Time horizon: NR Discount rate: NR Outcome for economic evaluation: Using natural units of health outcomes, including the incremental cost per fall prevented and cost per extra person avoiding mobility deterioration Measurement preference-based outcome: SF-12v2 converted to the SF-6D Model used: NR Willingness to pay threshold: As the underlying willingness to pay is unknown, the results are presented in a CEAC; cost-effectiveness ratios in the order of USD 50,000 to USD 100,000 per QALY were reported Software used: Stata v. 12	of the program relative to usual care was AUD 574 per fall prevented, AUD 9,570 per extra person avoiding mobility deterioration, and AUD 338,800 per QALY gained. Subgroup analyses for the low-disease-severity group indicate the program to be dominant, that is, less costly and more effective than usual care for all health outcomes. Conclusions: The exercise intervention appeared cost-effective regarding fall prevention in the whole sample and cost saving in the low disease severity group, when compared with usual care.	

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Farag, 2015[52] Country: Australia Design: Randomized controlled trial Study length: 12 months Setting: Community/home Area of rehabilitation: Multisystem Specific Area: PT Funding: Government	Objectives: To examine, from a health and community service provider perspective, the cost-effectiveness of a 12-month home-based exercise program in older people who have been recently discharged from hospital. Condition: Older people recently discharged from hospital Number of interventions: 2 Comparators: 1. Intervention group 2. Control group Total sample size: Total N=340; 1. Intervention mean n=171; Control mean n=169	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, CEAC Perspective: Public health payer Time horizon: NR Discount rate: NR Outcome for economic evaluation: 12-point SPPB, a 3-point self-rated measure of health status, and QoL (QALY) Measurement preference-based outcome: EQ-5D Model used: NR Willingness to pay threshold: As the underlying willingness to pay is unknown, the probability of the intervention being cost-effective is presented as a function of varying willingness to pay in CEACs Software used: NR	Results: The average cost of the intervention was AUD 751 per participant. The incremental cost-effectiveness of the program relative to usual care was AUD 22,958, per extra person showing an improvement in mobility, AUD 19,020 per extra person indicating an improvement in health, and AUD 77,403 per QALY. Conclusions: The exercise intervention appeared to offer reasonable value for money for mobility out-comes and self-reported health status. Value for money for all measures was greater in the higher cognitive status subgroups.	20
Farquhar, 2014[53] Country: UK	Objectives: To identify if Breathlessness Intervention Service (BIS) is more cost-effective than standard care for patients with intractable	Type of economic evaluation: Cost-consequence analysis Unit of economic analysis: Cost-effectiveness planes (likelihood of	Results: BIS reduced patient distress due to breathlessness (primary outcome: -1.29; 95% CI -2.57 to -0.005; p=0.049) significantly more than the	17

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Design: Randomized controlled trial Study length: 5 weeks Setting: Outpatient/clinics, community/home Area of rehabilitation: Cardiorespiratory Specific area: OT Funding: Government	breathlessness from advanced malignant disease and does it reduce patient and carer distress? Condition: Advanced cancer patients troubled by breathlessness despite optimization of underlying illness Number of interventions: 2 Comparators: 1. Intervention arm (Breathlessness Intervention Service; BIS) 2. Control arm Total sample size: Total N=67; 1. Intervention arm n=35; 2. Control arm n=32	higher or lower health/social care costs compared to better or worse outcomes) Perspective: NR Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs, costs, changes in patient distress due to breathlessness, change in mastery of breathlessness, anxiety and depression Measurement preference-based outcome: EQ-5D Model used: NR Willingness to pay threshold: NR Software used: NVivo software (for qualitative analysis)	control group; 94% of respondents reported a positive impact (51/53). BIS reduced fear and worry, and increased confidence in managing breathlessness. BIS had a 66% likelihood of better outcomes in terms of reduced distress due to breathlessness at lower health/social care costs than standard care (81% with informal care costs included). Conclusions: BIS appears to be more effective and cost-effective in advanced cancer than standard care.	
Fatoye, 2016[54] Country: UK Design: Other Study length: 12 weeks Setting: NR	Objectives: To examine the cost-effectiveness of semi-rigid ankle brace to facilitate return to work following first-time acute ankle sprains. Condition: First-time acute ankle sprains	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, net monetary benefit, CEAC, cost-effectiveness acceptability frontier, expected value of perfect information	Results: The cost and quality adjusted life years gained using semi-rigid ankle brace was £184 and 0.72 respectively. However, the cost and QALYs gained following taping was £155	16

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Other	Number of interventions: 2 Comparators: 1. Taping 2. Semi-rigid ankle brace Total sample size: Total N=81; 1. Taping n=40; 2. Semi-rigid ankle brace n=41	Perspective: Public health payer Time horizon: 12 weeks Discount rate: NR Outcome for economic evaluation: Costs, QALYs Measurement preference-based outcome: NA Model used: Decision tree model Willingness to pay Threshold: £20,000/QALY Software used: Excel 2010	and 0.61 respectively. The ICER for the semi-rigid brace was £263 per QALY. Conclusions: Taping is a cheaper intervention compared with ankle brace to facilitate return to work following first-time ankle sprains. However, the ICER observed for ankle brace was less than the NICE threshold and the intervention had a higher net-benefit, suggesting that it is a cost-effective intervention. Decision-makers may be willing to pay £263 for an additional gain in QALY.	
Fernandes, 2017[55] Country: Denmark Design: Randomized controlled trial Study length: 1 Year post surgery	Objectives: To analyze 12-month clinical effect and cost-utility of supervised neuromuscular exercise prior to total hip replacement and total knee replacement surgery Condition: Total hip replacement (THR) and total	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: Net monetary benefit, CEAC Perspective: Public health payer Time horizon: 12 months (61 weeks) Discount rate: NA; less than 1 year	Results: HOOS/KOOS QoL (8.25; 95% CI 0.42 to 16.10) and QALYs (0.04; 95% CI 0.01 to 0.07) were statistically significantly improved. At a threshold of EUR 40,000, preoperative exercise was found to be cost-effective at 84% probability.	17

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Government, foundation	knee replacement (TKR) surgery Number of interventions: 2 Comparators: 1. Replacement surgery plus preoperative exercise program 2. Replacement surgery alone Total sample size: Total N=165; 1. Surgery plus exercise n=84; 2. Surgery alone; n=81	Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D-3L Model used: Multiple regression analysis Willingness to pay threshold: EUR 40,000 Software used: NR	Conclusions: Preoperative supervised neuromuscular exercise for 8 weeks was found to be cost-effective in patients scheduled for THR and TKR surgery at conventional thresholds for willingness to pay. One-year clinical effects were small to moderate and favoured the intervention group, but only statistically significant for quality of life measures.	
Fernandez-de-Las-Penas, 2019[56] Country: Spain Design: Randomized clinical trial Study Length: 1 Year Area of Rehabilitation: Neurology	Objectives: To evaluate differences in cost-effectiveness of manual physical therapy versus surgery in women with Carpal Tunnel Syndrome. Condition: Carpal Tunnel Syndrome Number of Interventions: 2 Comparators: 1. Manual Physical Therapy Group 2. Surgery Group	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-5L Model used: NR Willingness to pay threshold: NR	Results: Incremental quality-adjusted life years showed greater cost-effectiveness in favor of manual physical therapy (difference, 0.135; 95% confidence interval: 0.134, 0.136). Manual therapy was significantly less costly than surgery (mean difference in cost per patient, €2576; P<.001). Conclusions: Manual physical therapy, has been found to be equally effective	CHEERS Score: 18

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Specific Area: PT Funding: Health Institute Carlos III	Total sample size: Total N=120; 1. Manual Therapy n=60; 2. Surgery n=60	Software used: STATA Version 13.1; Excel Version 16.0	but less costly (ie, more cost-effective) than surgery for women with CTS.	
Frederix, 2016[57] Country: Belgium Design: Randomized controlled trial Study length: 1 Year Setting: Outpatient/clinics, community/home Area of rehabilitation: Cardiorespiratory Specific area: Other rehab Funding: Government	Objectives: To evaluate the cost-effectiveness of a comprehensive cardiac telerehabilitation program in Belgium. Condition: Patients requiring cardiac rehabilitation for coronary artery disease for chronic heart failure with a reduced ejection fraction Number of interventions: 2 Comparators: 1. Intervention group 2. Control group Total sample size: Total N=139; 1. Intervention group n=69; 2. Control group n=70	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: Costs, QALYs Measurement preference-based outcome: EQ-5D Model used: Cox regression model Willingness to pay threshold: NR Software used: SPSS v. 22	Results: The total average cost per patient was significantly lower in the intervention group (EUR 2156 +/- EUR 126) than in the control group (EUR 2720 +/- EUR 276) (p=0.01) with an overall incremental cost of EUR – 564.40. Adjusted differential incremental QALYs (0.026 QALYs) yielded an incremental cost-effectiveness ratio of EUR –21,707/QALY. Conclusions: The addition of cardiac telerehabilitation to conventional centre-based cardiac rehabilitation was found to be more effective and efficient than centre-	16

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
			based cardiac rehabilitation alone.	
Freeman, 2019[58] Country: United Kingdom Design: Randomized controlled trial Study Length: 36 Weeks Area of Rehabilitation: Neurology Specific Area: PT Funding: UK National Institute of Health Research	Objectives: To assess whether a home-based standing frame programme was clinically effective and to explore its cost-effectiveness in people with severe, progressive multiple sclerosis. Condition: Progressive multiple sclerosis Number of Interventions: 2 Comparators: 1. Standing frame group 2. Usual care group Total sample size: Total N=140; 1. Standing frame group n=71; 2. Usual care group n=69	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: 36 Week Discount rate: 36 Week Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-5L Model used: Repeated-measures model and Generalised linear regression models (GLM) Willingness to pay threshold: Willingness-to-pay threshold of £20000 and £30000 per QALY Software used: STATA SE (version 14.2)	Results: The use of the standing frame resulted in a significant increase in AMCA score compared with that for usual care alone, with a fully adjusted between-group difference in AMCA score at 36 weeks of 4.7 points (95% CI 1.9–7.5; p=0.0014). The standing frame group had a mean 0.018 (95% CI –0.014 to 0.051) additional quality-adjusted life-years (QALYs) compared with those of the usual care group, and the estimated incremental cost-per-QALY was approximately £14700. Conclusions: The standing frame programme significantly increased motor function in people with severe progressive multiple sclerosis, although not to the degree that	CHEE RS Score: 23

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
			was considered a priori as clinically meaningful.	
Fritz, 2017[59] Country: USA Design: Randomized controlled trial Study length: 1 year Setting: NR Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Government	Objectives: To compare costs and cost-effectiveness of usual primary care management for patients with acute low back pain with or without the addition of early PT. Condition: Acute lower back pain Number of interventions: 2 Comparators: 1. Early PT 2. Usual care Total sample size: Total N=220; 1. Early PT n=107; 2. Usual care n=113	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, CEAC Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: Generalized linear models Willingness to pay threshold: \$50,000-\$100,000/additional QALY Software used: STATA: Release 12	Results: Early PT resulted in higher total 1-year costs (mean difference in adjusted total costs = \$580; 95% CI \$175 to \$984; p=0.005) and better QoL (mean difference in QALYs=0.02; 95% CI 0.005 to 0.35; p=0.008) after 1 year. The incremental cost-effectiveness ratio was \$32,058 (95% CI \$10,629 to \$151,161) per QALY. Conclusions: The results support early PT as cost-effective relative to usual primary care after 1 year for patients with acute, nonspecific lower back pain.	15
Fusco, 2016[60] Country: Italy Design: Other	Objectives: To assess cost-effectiveness and cost utility of telerehabilitation versus standard rehabilitation after total knee replacement.	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, net monetary benefit, CEAC Perspective: Public health payer	Results: TR appears to be cost-effective in the base case and in all of the considered scenarios but is no longer more effective and less	20

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Study length: Modelled for lifetime Setting: Outpatient/ clinics, community/ home Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Other	Condition: Recent total knee replacement (TKR) Number of interventions: 2 Comparators: 1. Standard rehabilitation (SR) 2. Standard rehabilitation + telerehabilitation (SR-TR) Total sample size: NR	Time horizon: Lifetime Discount rate: 0.03 Outcome for economic evaluation: Incremental cost per knee flexion range of motion (ROM) and as incremental cost per QALY Measurement preference-based outcome: NA Model used: Markov model, ordinary least squares, and Tobit models; the Cholesky decomposition method was used to represent uncertainty in the regression models Willingness to pay threshold: NR Software used: Excel 2013, STATA v. 12	expensive if transportation costs are excluded. Comparing SR-TR with SR, the ICER adopting the NHS perspective for the base case was – EUR 117/ROM gained. The cost-effectiveness probability for SR-TR was 0.98 (ceiling ratio: EUR 50/ROM), while the joint probability of being more effective and less expensive was 0.87. Conclusions: The analysis suggested SR-TR to be cost-effective, even less expensive, and more effective if the PCUs provide ambulance transportations. However, the uncertainty related to TR costs, HRQoL and long-term clinical outcomes raise important topics for future research.	
Fusco, 2019[61] Country: United Kingdom	Objectives: To assess the costs, effects, and cost-utility of an accelerated	Type of economic evaluation: Cost-Utility Analysis Unit of economic analysis: ICER	Results: The accelerated physiotherapy programme was less expensive (mean cost	CHEE RS

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Design: Randomized controlled trial Study Length: 52 Weeks Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: National Institute for Health Research	physiotherapy programme versus a standard physiotherapy programme following resurfacing hip arthroplasty. Condition: Hip arthroplasty Number of Interventions: 2 Comparators: 1. Standard 2. Accelerated Total sample size: Total N=80; 1. Standard n=40; 2. Accelerated n=40	Perspective: Public health payer Time horizon: 12 Months Discount rate: 12 Months Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-3L Model used: NR Willingness to pay threshold: £20,000 per quality-adjusted life year Software used: Stata SE v12.0	difference –£200; 95% confidence interval: –£656 to £255) and more effective (mean QALY difference 0.13; 95% confidence interval: 0.05 to 0.21) than standard physiotherapy and had a high probability of being cost-effective. Conclusions: From the National Health Service perspective, an accelerated physiotherapy programme for male patients undergoing revision of total hip arthroplasty (RHA) is very likely to be cost-effective when compared to a standard physiotherapy programme.	Score: 19
Gillespie, 2013[62] Country: Ireland Design: Randomized controlled trial Study length: 8 weeks	Objectives: To assess the cost-effectiveness of a structured education pulmonary rehabilitation program (SEPRP) for chronic obstructive pulmonary disease relative to usual practice in primary care.	Type of economic evaluation: Cost-consequence analysis Unit of economic analysis: ICER, net benefit Perspective: Health care provider Time horizon: 22 weeks	Results: The intervention was associated with an increase of EUR 944 (95% CI 489 to 1,400) in mean healthcare cost and EUR 261 (95% CI 226 to 296) in mean patient cost. The intervention was associated with a mean	18

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Setting: Outpatient/clinics Area of rehabilitation: Cardiorespiratory Specific area: PT Funding: Government, industry	Condition: Chronic obstructive pulmonary disease (COPD) Number of interventions: 2 Comparators: 1. Intervention arm 2. Control arm Total sample size: Total N=350; 1. Intervention n=178; 2. Control n=172	Discount rate: Authors report no discount due to study length Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D 3L Model used: Generalized estimating equations regression model Willingness to pay threshold: EUR 5,000, EUR 15,000, EUR 25,000, EUR 35,000, EUR 45,000 Software used: STATA v. 11, EXCEL statistical packages	improvement of 1.11 (95% CI 0.35 to 1.87) in CRQ Total Score and 0.002 (95% CI - 0.006 to 0.011) in QALYs gained. Conclusions: While analysis suggest that SEPRP was cost-effective if society is willing to pay at least EUR 850 per one-point increase in disease-specific CRQ, no evidence exists when effectiveness was measured in QALYs gained.	
Gordon, 2017[63] Country: Australia Design: Randomized controlled trial Study length: 12 months (post-surgery) Setting: Outpatient/	Objectives: To report on the cost-effectiveness of the Exercise for Health trial, comparing an exercise intervention with usual care during and following treatment for women with breast cancer. Condition: Breast cancer Number of interventions: 3 Comparators:	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER Perspective: Public health payer, private payer, broad government payer Time horizon: 12 months (post-surgery) Discount rate: NA; less than 1 year	Results: There were 69 improvers in the intervention group compared with 21 in the usual care group (odds ratio 2.09; 95% CI 1.08 to 4.01; p=0.033). The incremental cost per improver was AUD 2,282 to AUD 2,644. QALY gain for the intervention group versus the usual care group was 0.009, with incremental cost	15

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
clinics, community/ home Area of rehabilitation: Multisystem Specific area: PT Funding: Government	1. 8-month exercise program 2. Home delivered face-to-face exercise 3. Usual care Total sample size: Total N=194	Outcome for economic evaluation: FACT-B+4, QALYs Measurement preference-based outcome: EQ-5D-3L Model used: Generalized estimating equations models Willingness to pay threshold: AUD 50,000 Software used: TreeAge	per QALY gain for models 1 and 2 being AUD 105,231 and AUD 90,842, respectively. Conclusions: An exercise intervention for women after diagnosis of breast cancer may be cost-effective if society is willing to pay approximately AUD 300 per month for women with breast cancer to have markedly improved QoL.	
Hahne, 2017[64] Country: Australia Design: Randomized controlled trial Study length: 1 year Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal	Objectives: To determine whether individualized PT incorporating advice is cost-effective relative to guideline-based advice alone for people with low back pain and/or referred leg pain. Condition: Lower back pain and/or referred leg pain Number of interventions: 2 Comparators: 1. Advice	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, CEAC Perspective: Public health payer Time horizon: 12 months, with no future projection attempted Discount rate: Discounting was not applied Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D	Results: Total healthcare costs were similar for both groups: mean difference \$27.03 (95% CI 200.29 to 254.35). Health benefits across the 12-month follow up were significantly greater with IPT: incremental QALYs=0.006 (95% CI 0.02 to 0.10). The ICER was \$422 per QALY gained. A saving of \$1,995.51 (95%CI 143.98 to 3,837.03) per worker in income was realized in the	18

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Specific area: PT Funding: Industry	2. Individualized physical therapy (IPT) Total sample size: Total N=300	Model used: Linear mixed model Willingness to pay threshold: USD 62,000/QALY gained Software used: SPSS-V21, Excel	IPT group relative to the advice group. Conclusions: Ten sessions of IPT incorporating advice is cost-effective compared with two sessions of guideline-based advice alone for people with low back disorders.	
Hansen, 2017[65] Country: Denmark Design: Randomized controlled trial Study length: 6 months Setting: Inpatient, community/home Area of rehabilitation: Cardiorespiratory Specific area: PT Funding: Government	Objectives: To investigate the cost-effectiveness of cardiac rehabilitation following heart valve surgery. Condition: Heart valve surgery Number of interventions: 2 Comparators: 1. Exercise training plus psychoeducational intervention 2. Usual care Total sample size: Total N=147; 1. Cardiac rehab (CR) n=72; 2. Usual care n=75	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, CEAC Perspective: Societal Time horizon: 6 months Discount rate: NA; less than 1 year Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D-5L Model used: NR Willingness to pay threshold: NR Software used: NR	Results: No statistically significant differences were found in total societal costs (–EUR 1,609; 95% CI –6,162 to 2942) or in QALYs (–0.000; 95% CI –0.021 to 0.020) between groups. Conclusions: Even though CR following heart valve surgery in these Danish patients did not improve short-term HRQoL, it does hold a high probability of being cost-effective for society due to fewer hospital inpatient admissions and less sick leave, which outweigh the extra costs of CR.	14

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Hautala, 2017[66] Country: Finland Design: Randomized controlled trial Study length: 12 months Setting: Outpatient/clinics Area of rehabilitation: Cardiorespiratory Specific area: PT Funding: Foundation, industry	Objectives: To evaluate the cost-effectiveness of exercise-based cardiac rehabilitation implemented according to guidelines. Condition: Acute coronary disease Number of interventions: 2 Comparators: 1. Exercise-based cardiac rehabilitation (ECR) 2. Usual care (UC) Total sample size: Total=204; 1. ECR n=109; 2. UC n=95	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, CEAC Perspective: NR Time horizon: 1 year Discount rate: NA; less than 1 year Outcome for economic evaluation: QALYs Measurement preference-based outcome: 15D questionnaire Model used: Not clearly reported Willingness to pay threshold: NR Software used: STATA, SPSS	Results: The incremental cost was divided by the baseline adjusted incremental QALYs (0.045), yielding an ICER of €24,511/QALY. Conclusions: The present cost-effectiveness study demonstrated that the addition of 1 year of regular exercise training to UC according to current guidelines was a dominant treatment option (i.e., less costly and more effective) and reduced the occurrence of adverse cardiac events compared with UC alone.	14
Hewitt, 2019[67] Country: Australia Design: Randomized controlled trial Study Length: 12 Months	Objectives: To estimate the cost-effectiveness of a strength and balance exercise programme (SUNBEAM) which has been shown to be clinically effective in reducing the rate of falls in residents of aged care facilities.	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: Health services Time horizon: 12 Months Discount rate: 12 Months Outcome for economic evaluation: Cost per fall avoided	Results: 72 injurious falls occurred in the intervention group versus 157 with usual care. Delivery of the SUNBEAM programme cost \$463 per participant. The incremental cost-effectiveness ratio was \$22 per fall per person avoided with the mean bootstrapped incremental	CHEE RS Score: 16

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: Feros Care and Domain Principal Group; HUR Health and Fitness Equipment	Condition: Residents of aged care setting Number of Interventions: 2 Comparators: 1. Intervention Group 2. Usual Care Group Total sample size: Total N=221; 1. Intervention Group n=113; 2. Usual Care Group n=108	Measurement preference-based outcome: Short Form - 36 (SF-36) Model used: Modeled costs including acute and long-term costs Willingness to pay threshold: NR Software used: STATA 13	cost-effectiveness ratio \$18 per fall avoided (95% CI: -\$380.34 to \$417.85). Conclusions: The SUNBEAM programme can be considered cost-effective, relative to other fall prevention interventions in older adults.	
Hollinghurst, 2013[68] Country: UK Design: Randomized controlled trial Study length: 6 months Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: PT	Objectives: To compare the cost-effectiveness of PhysioDirect with usual PT care for patients with musculoskeletal problems. Condition: Non-urgent musculoskeletal problems Number of interventions: 2 Comparators: 1. PhysioDirect 2. Usual care Total sample size: Total N=2,249; 1. PhysioDirect n=1,056; 2. Usual care n=743	Type of economic evaluation: Cost-consequence analysis Unit of economic analysis: ICER, net monetary benefit, CEAC Perspective: Public health payer Time horizon: NR Discount rate: Discounting was not carried out because the analysis was restricted to costs and outcomes over a period of less than a year Outcome for economic evaluation: QALYs Measurement preference-based outcome: SF-36v2, EQ-5D-3L	Results: There was no evidence of a difference between the two groups in the cost of PT, other NHS services, personal costs, or value of time off work. Outcomes were also similar. Total NHS costs, including the cost of PT were higher in the PhysioDirect group by £19.30 (95% CI -£37.60 to £76.19) and there was a QALY gain of 0.007 (95% CI -0.003 to 0.016). The ICER was £2,889 and the net monetary benefit at	22

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Funding: Government		Model used: Regression model, imputation model Willingness to pay threshold: £20,000 and £30,000/QALY Software used: PhysioDirect assessment software, Excel, Stata v. 12	λ =£20,000 was £117 (95% CI -£86 to £310). Conclusions: PhysioDirect may be a cost-effective alternative to usual PT care, though only with careful management of staff time.	
Hwang, 2019[69] Country: Australia Design: Randomized controlled trial Study Length: 6 Months Area of Rehabilitation: Cardiorespiratory Specific Area: PT Funding: Heart Foundation Health Professional Scholarship	Objectives: To investigate the cost-utility of a home-based telerehabilitation program. Condition: Heart Failure Number of Interventions: 2 Comparators: 1. Telerehabilitation 2. Control Total sample size: Total N=53; 1. Telerehabilitation n=24; 2. Control n=29	Type of economic evaluation: Cost-Utility Analysis Unit of economic analysis: ICER Perspective: Health care Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D Model used: Linear mixed-effects model Willingness to pay threshold: \$50,000 and \$60,000 per QALY Software used: IBM SPSS Statistics 25	Results: Total health care costs per participant were significantly lower in the telerehabilitation group (-\$1,590, 95% CI: -2,822, -359) during the 6 months. No significant differences in quality-adjusted life years (0, 95% CI: -0.06, 0.05) were seen between the two groups. Conclusions: Heart failure telerehabilitation appears to be less costly and as effective for the health care provider as traditional centre-based rehabilitation.	CHEE RS Score: 18

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Jansons, 2018[70] Country: Australia Design: Randomized controlled trial Study length: 12 months Setting: Community/home Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Industry	Objectives: To identify the comparative cost-effectiveness of gym-based maintenance exercise programs versus a home-based maintenance program with telephone support for adults with chronic health conditions whom have previously completed a short-term supervised exercise group program. Condition: Adults with chronic health conditions Number of interventions: 2 Comparators: 1. Home-based intervention 2. Gym-based intervention Total sample size: Total N=100; 1. Home n=49; 2. Gym n=52	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, direct and indirect healthcare costs Perspective: Societal Time horizon: 12 months Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D-3L Model used: Linear regression Willingness to pay threshold: AUD 34,200-51,000 Software used: STATA v. 13	Results: Gym-based follow up would cost an additional AUD 491,572 from a societal perspective to gain 1 QALY compared with the home-based approach. Conclusions: The gym-based approach was more costly than the home-based maintenance intervention with telephone support.	16
Janssen, 2014[71] Country: Netherlands	Objectives: To evaluate the cost-effectiveness of the separate and combined use of bracing and home-based neuromuscular training for the	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER Perspective: Societal	Results: The ICER of the brace group in comparison with the combined group was approximately -USD 3,865. The ICER of the	19

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Design: Randomized controlled trial Study length: 12 months Setting: Community/home Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Industry	prevention of the recurrence of ankle sprains. Condition: Sustained a lateral ankle sprain no longer than 2 months prior Number of interventions: 3 Comparators: 1. Neuromuscular training (NMT) 2. Brace group 3. Combination group Total sample size: Total N=340; 1. NMT group n=107; 2. Brace group n=113; 3. Combination group n=120	Time horizon: 12 months Discount rate: No discount; study length of 1 year Outcome for economic evaluation: Cost differences divided by effect differences using combination group as comparison Measurement preference-based outcome: NA Model used: NR Willingness to pay threshold: NR Software used: Unable to identify	neuromuscular training group in comparison with the combined group was USD 424. Conclusions: Bracing was found to be the dominant secondary preventive intervention over both neuromuscular training and the combination of both measures.	
Jha, 2018[72] Country: United Kingdom Design: Randomized controlled trial Study Length: 6 Months	Objectives: To evaluate the clinical and cost-effectiveness of electric stimulation plus standard pelvic floor muscle training compared to standard pelvic floor muscle training alone in women with urinary incontinence and sexual dysfunction.	Type of economic evaluation: Cost-Utility Analysis Unit of economic analysis: ICER Perspective: Public health payer Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY	Results: The mean PISQ-PF dimension scores at follow-up were 33.1 (SD 5.5) and 32.3 (SD 5.2) for the Intervention and Control groups respectively. After adjusting the mean difference was -1.0 (95% CI: -4.0 to 1.9; P = 0.474). Within this study, the use of electrical stimulation was cost-effective with very	CHEE RS Score: 16

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: National Institute for Health Research	Condition: Urinary incontinence and sexual dysfunction Number of Interventions: 2 Comparators: 1. Standard Pelvic Floor Muscle Training (PFMT) 2. PFMT + Electrical Stimulation Total sample size: Total N=114; 1. Standard PFMT n=57; 2. PFMT + Electrical Stimulation n=57	Measurement preference-based outcome: SF-36; EQ-5D Model used: NR Willingness to pay threshold: NR Software used: STATA	small incremental costs and quality adjusted life years (QALYs). Conclusions: In women presenting with urinary incontinence in conjunction with sexual dysfunction, physiotherapy is beneficial to improve overall sexual function. However no specific form of physiotherapy is beneficial over another.	
Johnsen, 2014[73] Country: Norway Design: Randomized controlled trial Study length: 24 months Setting: Inpatient (hospital), outpatient/clinics	Objectives: To evaluate the cost-effectiveness of total disc replacement versus multidisciplinary rehabilitation in patients with chronic low back pain. Condition: Chronic lower back pain for over 1 year with degenerative changes in lumbosacral intervertebral discs Number of interventions: 2 Comparators:	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, CEAC Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D, SF-6D Model used: NR	Results: The mean QALYs gained using EQ-5D was 1.25 in the TDR group and 0.95 in the MDR group resulting in a significant difference. The mean total cost per patient in the TDR group was GBP 87,622 compared with GBP 74,116 in the MDR group. The ICER for the TDR procedure varied from GBP 39,748 using EQ-5D (TDR	12

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Area of rehabilitation: Musculoskeletal Specific area: PT, OT Funding: Government, foundation	1. Total disc replacement (TDR) 2. Multidisciplinary rehabilitation (MDR) Total sample size: Total N=172; 1. TDR n=86; 2. MDR n=86	Willingness to pay threshold: £74,600 or kr500,000/QALY Software used: Unable to identify	cost-effective) to GBP 128,328 using SF-6D. Conclusions: The TDR was cost-effective compared with MDR after 2 years when using EQ-5D for assessing QALYs gained and a willingness to pay of GBP 74,600. The TDR was not cost-effective when SF-6D was used.	
Johnson, 2015[74] Country: UK Design: Randomized controlled trial Study length: Weeks 1-3 intervention with optional follow up to withdrawal or death Setting: Inpatient (hospital),	Objectives: To assess the effectiveness of two modes of delivery regarding the relief of breathlessness intensity; to test which mode was more effective for other aspects of breathlessness, function, QoL, psychological distress and coping, and cost-effectiveness. Condition: Intra-thoracic malignancy with breathlessness Number of interventions: 2 Comparators:	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: Change in QALYS compared to changes in costs between the interventions Perspective: NR Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: Model of breathlessness as having two	Results: Primary analysis (n=124; 79%), showed no between-arm difference in the AUC: three sessions 22.86 (7.12) vs. single session 22.58 (7.10) (p=0.83; mean difference 0.2; 95% CI -2.31 to 2.7). Complete case analysis showed a non-significant reduction in QALYs with three sessions (mean difference -0.006; 95% CI -0.018 to 0.006). The probability of the single session being cost-effective (threshold value of	14

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
outpatient/clinics, community/home Area of rehabilitation: Cardiorespiratory Specific area: Other rehab Funding: Government	1. Three sessions 2. Single session Total sample size: Total N=156; 1. Three sessions n=52; 2. Single session n=104	recognizable components, namely perception and emotional response Willingness to pay threshold: £20,000/QALY Software used: NR	£20,000/QALY) was over 80%. Conclusions: There was no evidence that three sessions conferred additional benefits, including cost-effectiveness, over one. A single session of breathing training seems appropriate and minimises patient burden.	
Joseph, 2019[75] Country: Sweden Design: Randomized controlled trial Study Length: 10 Weeks Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: Swedish Research Council	Objectives: To determine the cost-effectiveness of the HiBalance training program for managing Parkinson's disease (PD)-related balance and gait disorders. Condition: Parkinsons disease Number of Interventions: 2 Comparators: 1. Intervention Group 2. Control Group Total sample size: Total N=100; 1. Intervention Group n=51; 2. Control Group n=49	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: NR Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: SF-36; SF-6D Model used: NR Willingness to pay threshold: NR Software used: Stata Version 13; Rstudio v 1.1.419	Results: The estimated incremental cost-effectiveness ratios were 314,558SEK (EUR 31,969) for an additional QALY, 6262 SEK (EUR 631) for one point improvement in balance performance, and 1650SEK (EUR 166) for 1cm/second increase in gait velocity. Conclusions: In terms of QALYs, the HiBalance program demonstrated a high probability of cost-effectiveness in the short-term perspective.	CHEERS Score: 16

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Jowett, 2013[76] Country: UK Design: A within-trial cost-effectiveness analysis with patients randomized to interventions Study length: 24 weeks Setting: NR Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Foundation	Objectives: To perform a cost-effectiveness analysis of subacromial corticosteroid injection combined with exercise compared with exercise alone in patients with moderate to severe shoulder pain from subacromial impingement syndrome. Condition: Moderate to severe shoulder pain from subacromial impingement syndrome Number of interventions: 2 Comparators: 1. Injection plus exercise 2. Exercise only Total sample size: Total N=232; 1. Injection plus exercise n=115; 2. Exercise only n=117	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, CEAC Perspective: Public health payer Time horizon: NR Discount rate: Since the follow-up period was less than 1 year, study states discounting was not required Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: NR Willingness to pay threshold: £20,000/additional QALY gained Software used: SPSS for Windows v. 17.0, STATA v. 9, Excel 2007	Results: Mean per patient NHS costs (£255 vs. £297) and overall healthcare costs (£261 vs. £318) were lower in the injection plus exercise arm, but this difference was not statistically significant. Total QALYs gained were very similar in the two trial arms (0.3514 vs. 0.3494 QALYs), although slightly higher in the injection plus exercise arm, indicating that injection plus exercise may be the dominant treatment option. Conclusions: Injection plus exercise delivered by therapists may be a cost-effective use of resources compared with exercise alone and lead to lower healthcare costs and less time off work.	14
Kampshoff, 2018[77] Country: Netherlands	Objectives: To evaluate the long-term effectiveness and cost-effectiveness of high intensity (HI) versus low-to	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: Societal	Results: At longer term, intervention effects on role ($\beta = 5.9$, 95% CI = 0.5; 11.3) and social functioning ($\beta =$	CHEE RS Score: 18

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Design: Randomized controlled trial Study Length: 64 Weeks Area of Rehabilitation: Cardiorespiratory Specific Area: PT Funding: Alpe d'HuZes/KWF Fund; Dutch Cancer Society	moderate intensity (LMI) exercise on physical fitness, fatigue, and health-related quality of life (HRQoL) in cancer survivors. Condition: Cancer Number of Interventions: 2 Comparators: 1. Low-to-Moderate Intensity (LMI) 2. High Intensity (HI) Total sample size: Total N=277; 1. LMI n=138; 2. HI n=139	Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: European Organisation Research and Treatment of Cancer-Quality of Life questionnaire-Core 30 (EORTC-QLQ-C30) Model used: Linear mixed model analysis Willingness to pay threshold: Lower bounds of the Dutch and UK willingness-to pay threshold (i.e., 20,000 and 24,400€/QALY gained) Software used: SPSS v22.0 and STATA v12.0	5.7, 95%CI = 1.7; 9.6) were larger for HI compared to those for LMI exercise. From a societal perspective, the probability that HI was cost-effective compared to LMI exercise was 0.91 at 20,000€/QALY and 0.95 at 52,000€/QALY gained. Conclusions: The intervention was found to have larger effects on role and social functioning for HI than for LMI exercise. Furthermore, HI exercise was cost-effective with regard to QALYs compared to LMI exercise.	
Kang, 2017[78] Country: USA Design: Decision analytic model Study length: Unclear Setting: Inpatient (hospital)	Objectives: To determine the relative cost-effectiveness of 4 treatment strategies for massive irreparable rotator cuff tears using a decision analytic model. Condition: Massive irreparable rotator cuff tears; for 70-year old female	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: NR Discount rate: 0.03 Outcome for economic evaluation: QALYs	Results: RTSA yielded the most QALYs with 7.69, but greater benefits came at higher costs compared with other treatments. Sensitivity analyses showed that PT was the most cost-effective intervention at a health utility	14

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Academic	patients with shoulder pain and 90 degrees of active forward elevation Number of interventions: 4 Comparators: 1. PT 2. Arthroscopic debridement with biceps tenotomy (AD-BT) 3. Reverse total shoulder arthroplasty (RTSA) 4. Hemiarthroplasty (HA) Total sample size: NA	Measurement preference-based outcome: SF-36 Model used: Markov decision analytic model Willingness to pay threshold: USD 50,000/QALY Software used: TreeAge	of 0.75 or greater (QALY 7.35). Conclusions: PT was the most cost-effective treatment option using a willingness to pay threshold of USD 50,000.	
Karnon, 2017[79] Country: Australia Design: Markov model Study length: Annual model cycle, with a maximum client age of 100 years Setting: Other	Objectives: To develop a cost-effectiveness model to predict publicly funded health and aged care costs and QALYs over the remaining lifetime of frail Australians and a model-based cost-utility analysis of a PT-based intervention for frail individuals. Condition: Frailty Number of interventions: 2	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, CEAC, net loss curve Perspective: Public health payer Time horizon: NR Discount rate: 0.05 Outcome for economic evaluation: QALYs Measurement preference-based outcome: NR	Results: The evaluated PT-based frailty intervention has an expected incremental cost per QALY gained of AUD 8,129 compared to usual care, but there is a probability of 0.3 that usual care is more effective and less costly than the intervention. Conclusions: The reported cost-effectiveness model is illustrated through the estimation of all-important	16

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Area of rehabilitation: Multisystem Specific area: PT Funding: Academic	Comparators: 1. Control 2. Intervention Total sample size: Total N=10,377 individuals in the DYNOPTA data set	Model used: Markov model Willingness to pay threshold: \$45,000-\$75,000/QALY Software used: NR	costs and effects of a PT-based frailty intervention, which facilitates comparisons with funding decisions for other new technologies in Australia.	
Khodakarami, 2020[80] Country: USA Design: Decision tree analytic model Study Length: NR Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: None	Objectives: To investigate the cost-effectiveness of chiropractic versus PT in the U.S. using a decision tree analytic model for estimating the economic outcomes. Condition: Low back pain Number of Interventions: 2 Comparators: 1. Chiropractic 2. Physical Therapy Total sample size: NR	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: NR Time horizon: NR Discount rate: NR Outcome for economic evaluation: DALY Measurement preference-based outcome: NA Model used: Decision tree analytic model Willingness to pay threshold: NR Software used: NR	Results: The findings showed that the total average cost in the chiropractic group was \$48.56 lower than the PT group. The findings also showed that the daily adjusted life years (DALY) in the chiropractic group was 0.0043 higher than the PT group. Conclusions: Chiropractic care was shown to be a cost-effective alternative compared with PT for adults with at least three weeks of LBP over six months.	CHEE RS Score: 16
Kidholm, 2016[81]	Objectives: To develop and test an individualized cardiac telerehabilitation (CTR) program designed to increase	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER	Results: The mean total cost per patient was EUR 1,700 higher in the intervention group. The QALY gain was	17

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Country: Denmark Design: Randomized controlled trial Study length: 12 months Setting: Inpatient (hospital), outpatient/clinics, community/home Area of rehabilitation: Cardiorespiratory Specific area: NR Funding: Government, industry, foundation	participation in rehabilitation, improve patient QoL, reduce the number of admissions, and reduce the need for acute care. Condition: Artery sclerosis, coronary artery bypass surgery, valve surgery, heart failure Number of interventions: 2 Comparators: 1. Telerehabilitation group 2. Control group Total sample size: Total N=141; 1. Telerehabilitation group n=72; 2. Control group n=69	Perspective: Public health payer Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs, costs (use of resources to carry out the intervention and the use of rehabilitation and healthcare services in the intervention and control groups) Measurement preference-based outcome: SF-36 transformed to the SF-6D Model used: NR Willingness to pay threshold: NR Software used: EpiData v. 1.4.1, EpiData Manager v. 1.3.2.1, R v. 3.1.2	higher in the intervention group, but the difference was not statistically significant. The incremental CU ratio was more than EUR 400,000 per QALY gained. Conclusions: Even though the rehabilitation activities increased, the program does not appear to be cost-effective. The intervention itself was not costly (less than EUR 500) and increasing the number of patients may show reduced costs of the devices and make the CTR more cost-effective. Telerehabilitation can increase participation, but the intervention, in its current form, does not appear to be cost-effective.	
Kigozi, 2018[82] Country: United Kingdom Design: Randomized controlled trial	Objectives: To investigate the cost-effectiveness of two enhanced physical therapy interventions compared with usual physical therapy care (UC) for adults with knee OA.	Type of economic evaluation: Cost-Utility Analysis Unit of economic analysis: ICER Perspective: UK healthcare Time horizon: NR	Results: The UC group was associated with lower National Health Service (NHS) costs [ITE-UC: £273.30, 95% CI: £62.10 to £562.60; TEA-UC: £141.80,	CHEERS Score: 20

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Study Length: 18 Months Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: National Institute for Health Research	Condition: Knee osteoarthritis Number of Interventions: 3 Comparators: 1. Usual Care (UC) 2. Individually Tailored Exercise (ITE) 3. Targeted Exercise Adherence (TEA) Total sample size: Total N=514; 1. UC n=175; 2. ITE n=176; 3. TEA n=163	Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-3L Model used: NR Willingness to pay threshold: NR Software used: NR	95% CI: £135.60 to £408.10)] and slightly higher QALY gains (ITE-UC: 0.015, 95% CI: 0.057 to 0.026; TEA-UC: 0.003, 95% CI: 0.045 to 0.038). Conclusions: Our findings show that Usual Care is likely to be the most cost-effective option.	
Kloek, 2018[83] Country: Netherlands Design: Randomized controlled trial Study Length: 12 Months Area of Rehabilitation: Musculoskeletal Specific Area: PT	Objectives: To evaluate the cost-effectiveness of a blended physiotherapy intervention (e-Exercise) compared to usual physiotherapy in patients with osteoarthritis of hip and/or knee. Condition: Knee osteoarthritis Number of Interventions: 2 Comparators: 1. e-Exercise	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-3L Model used: Imputation model	Results: The probability of e-Exercise being cost-effective compared to usual physiotherapy was moderate (< 0.82). For QALYs, the probability of e-Exercise being cost-effective compared to usual physiotherapy was 0.68/0.84 at a willingness to pay of 10,000 EUR per gained QALY, from respectively the societal and the healthcare perspective.	CHEE RS Score: 23

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Funding: Royal Dutch Society for Physiotherapy	2. Usual Physiotherapy Total sample size: Total N=208; 1. e-Exercise n=109; 2. Usual PT n=99	Willingness to pay threshold: 10,000 EUR and 80,000 EUR per gained QALY Software used: STATA Corp 13.0; SPSS Statistics 23.0	Conclusions: E-Exercise itself was significantly cheaper compared to usual physiotherapy in patients with hip and/or knee osteoarthritis, but not cost-effective from the societal- as well as healthcare perspective.	
Kraal, 2017[84] Country: Netherlands Design: Randomized controlled trial Study length: 1 Year Setting: Outpatient/clinics, community/home Area of rehabilitation: Cardiorespiratory Specific area: PT, other rehab	Objectives: To identify what the effect of home-based exercise training with telemonitoring guidance compared to regular centre-based exercise training on physical fitness and physical activity levels is in low-to-moderate cardiac risk patients entering cardiac rehabilitation (CR) and identify if same is cost-effective. Condition: Low-to-moderate cardiac risk patients entering CR Number of interventions: 2 Comparators: 1. Centre-based CR	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, CEAC Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: SF-36, MacNew questionnaire Model used: Multivariate regression model for beta-blocker medicated cardiac patients Willingness to pay threshold: EUR 20,000-EUR 40,000	Results: Physical activity levels did not change during the 1-year study period (centre-based p=0.38, home-based p=0.80). Healthcare costs were statistically non-significantly lower in the home-based group (EUR 437 per patient, 95% CI -562 to 1,436; p=0.39). From a societal perspective, a statistically non-significant difference of EUR 3160 per patient in favour of the home-based group was found (95% CI -460 to 6,780; p=0.09). Conclusions: Home-based training with telemonitoring guidance can be used as an alternative to centre-based	20

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Funding: Industry	2. Home-based CR Total sample size: Total N=90; 1. Centre-based CR n=45; 2. Home-based CR n=45	Software used: R v. 3.0.3, SPSS for Windows v. 22.0	training for low-to-moderate cardiac risk patients entering CR.	
Krist, 2013[85] Country: Netherlands Design: Randomized controlled trial Study length: 33 weeks Setting: Community/home Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Industry	Objectives: To identify if an injury prevention program consisting of 10 exercises designed to improve stability, muscle strength, co-ordination, and flexibility of the trunk, hip, and leg muscles is cost-effective in adult male armature soccer players. Condition: Musculoskeletal injury Number of interventions: 2 Comparators: 1. Exposure 2. Control Total sample size: Total N=456; 1. Exposure n=11 teams and 223 participants; 2. Control n=12 teams and 233 participants	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, cost-effectiveness planes Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: All significant costs associated with the injury were considered Measurement preference-based outcome: NA Model used: Poisson model Willingness to pay threshold: NR Software used: NR	Results: No significant differences in the proportion of injured players and injury rate were found between the two groups. Statistically significant costs differences in favour of the intervention group were found per player (mean difference EUR 201; 95% CI 15 to 426) and per injured player (mean difference EUR 350; 95% CI 51 to 733). Conclusions: The exercises failed to significantly reduce the number of injuries in male amateur soccer players within one season but did significantly reduce injury-related costs. The cost savings might be the result of a preventative effect on knee	14

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
			injuries, which often have substantial costs due to lengthy rehabilitation and lost productivity.	
Lamb, 2018[86] Country: England Design: Randomized controlled trial Study Length: 12 Months Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: National Institute for Health Research	Objectives: To estimate the clinical effectiveness and cost-effectiveness of a bespoke exercise programme, in addition to usual care, on the cognitive impairment (primary outcome), function and health-related quality of life (HRQoL) of people with mild to moderate dementia (MMD) and carer burden and HRQoL. Condition: Mild to moderate dementia (MMD) Number of Interventions: 2 Comparators: 1. Usual Care 2. Exercise Group Total sample size: Total N=494; 1. Usual Care n=165; 2. Exercise Group n=329	Type of economic evaluation: Cost-Utility Analysis Unit of economic analysis: ICER Perspective: Public health payer Time horizon: 1 Year Discount rate: 1 Year Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-3L Model used: Cost-effectiveness modeling Willingness to pay threshold: British studies ranges between £20,000 and £30,000 per QALY Software used: SAS® software version 9.4	Results: The mean incremental cost-effectiveness of the exercise intervention was estimated at –£74,227 per QALY gained; associated with a higher net cost and a lower net effect and was dominated in health economic terms. The associated mean incremental net monetary benefits at cost-effectiveness thresholds of £15,000, £20,000 and £30,000 per QALY were –£2158, –£2306 and –£2601, respectively. Conclusions: The data collected in the DAPA trial strongly support a hypothesis that exercise therapy in addition to usual care, when compared with usual care alone, is more expensive and less effective.	CHEE RS Score: 21

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Legget, 2015[87] Country: Canada Design: Markov model Study length: Data collected over 11 years (from January 2002 to January 2013) Setting: Outpatient/clinics Area of rehabilitation: Cardiorespiratory Specific area: Other rehab Funding: Foundation	Objectives: To assess the cost utility of a centre-based outpatient cardiac rehabilitation program compared with no program within patient subgroups based on age, sex, and clinical presentation (acute coronary syndrome [ACS] or non-ACS). Condition: Cardiac catheterization Number of interventions: 3 Comparators: Markov model was stratified by clinical presentation, age, and sex Total sample size: Total N=139,866; 1. With ACS n=91,193 (65.2%); 2. Without ACS n=48,673 (34.8%)	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER Perspective: Public health payer Time horizon: Lifetime horizon Discount rate: 0.05 Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D-3L Model used: Markov modelling Willingness to pay Threshold: NR Software used: STATA v. 12, TreeAge Pro 2012	Results: The incremental cost per adjusted life-year gained for cardiac rehabilitation varies by subgroup, from \$18,101 per QALY gained to \$104,518 per QALY gained. Conclusions: The cost-effectiveness of cardiac rehabilitation varies depending on patient characteristics. This analysis indicates that cardiac rehabilitation is most cost-effective for those with an ACS and those who are at higher risk for subsequent cardiac events.	18
Leininger, 2016[88] Country: USA	Objectives: To estimate the cost-effectiveness of home exercise and advice, spinal manipulative therapy plus home exercise and advice,	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, CEAC Perspective: Societal	Results: Total costs for SMT+HEA were 5% lower than HEA (mean difference: -USD 111; 95% CI -1,354 to 899) and 47% lower than	20

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Design: Randomized controlled trial Study length: 1 year Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Industry	and supervised rehabilitative exercise plus home exercise and advice. Condition: Chronic mechanical neck pain Number of interventions: 3 Comparators: 1. Home exercise and advice (HEA) 2. Spinal manipulative therapy (SMT) + HEA 3. Supervised rehabilitative exercise (SRE) + HEA Total sample size: Total N=241; 1. HEA n=79; 2. SMT+HEA n=80; 3. SRE+HEA n=82	Time horizon: 1 Year Discount rate: No discount applied Outcome for economic evaluation: QALYs Measurement preference-based outcome: SF-36, SF-6D, and EQ-5D-3L used as a sensitivity analysis Model used: Linear mixed effect models Willingness to pay threshold: USD 50,000-200,000/QALY Software used: NR	SRE+HEA (mean difference: -USD 1,932; 95% CI -2,796 to -1,097). SMT+HEA also resulted in a greater reduction of neck pain over the year relative to HEA (0.57; 95% CI 0.23 to 0.92) and SRE+HEA (0.41; 95% CI 0.05 to 0.76). Conclusions: On average, SMT+HEA resulted in better clinical outcomes and lower total societal costs relative to SRE+HEA and HEA alone, with a 0.75 to 0.81 probability of cost-effectiveness for willingness to pay thresholds of USD 50,000 to USD 200,000 per QALY.	
Lewis, 2015[89] Country: UK Design: Randomized controlled trial Study length: 1 year	Objectives: To determine the cost-effectiveness of TENS in addition to usual primary care management for tennis elbow. Condition: Epicondylalgia or tennis elbow Number of interventions: 2 Comparators:	Type of economic evaluation: Cost-effectiveness analysis, cost-utility analysis Unit of economic analysis: ICER, probabilistic CEACs Perspective: Public health payer, private payer, societal Time horizon: NR	Results: Mean cost was higher and QoL lower for PCM + TENS when compared with PCM alone. Conclusions: Adding TENS to PCM of tennis elbow may result in lower costs in respect of a broad societal perspective	13

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Government	1. Primary care management (PCM) 2. PSM + TENS Total sample size: Total N=241; 1. PCM n=NR; 2. PSM + TENS n=NR	Discount rate: NR Outcome for economic evaluation: QALYs, obtained from EQ-5D-3L, SF-6D Measurement preference-based outcome: EQ-5D-3L, SF-6D Model used: NR Willingness to pay threshold: £50,000/QALY Software used: SPSS, STATA	that includes health care costs and indirect costs linked to work productivity losses. It is uncertain whether PCM + TENS is cost-effective when compared with PCM alone from both healthcare and societal health economic perspectives.	
Li, 2015[90] Country: USA Design: Randomized controlled trial Study length: 9 months Setting: Community/home Area of rehabilitation: Neurology Specific area: PT Funding: Government	Objectives: To determine the cost-effectiveness of Tai Ji Quan for reducing falls among patients with mild-to-moderate Parkinson's Disease Condition: Parkinson's Disease Number of interventions: 3 Comparators: 1. Tai Ji Quan 2. Resistance 3. Stretching Total sample size: Total N=176	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, net health benefit Perspective: Societal Time horizon: 9 months Discount rate: 0.03 Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: NR Willingness to pay threshold: \$14,306 and \$21,270 (in 2013)	Results: Tai Ji Quan was more effective than either resistance training or stretching; it had the lowest cost and was the most effective in improving primary and secondary outcomes. Compared with stretching, Tai Ji Quan cost an average of \$175 less for each additional fall prevented and produced a substantial improvement in QALY gained at a lower cost. Conclusions: Tai Ji Quan represents a cost-effective	15

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
		dollars), which represented average Medicare costs per fall Software used: NR	strategy for optimizing spending to prevent falls and maximize health gains in people with Parkinson's Disease.	
Lilje, 2014[91] Country: Sweden Design: Randomized controlled trial Study length: 1 year Setting: NR Area of rehabilitation: Musculoskeletal Specific area: PT, other rehab Funding: Other	Objectives: To compare costs and outcomes from naprapathic manual therapy (NMT) with orthopedic standard care for common, low-prioritized, nonsurgical musculoskeletal disorders, after second-line treatment. Condition: Individuals of working age referred to orthopedic care who were considered "low priority" and not candidates for surgery Number of interventions: 2 Comparators: 1. Control group 2. Index group Total sample size: Total N=78; 1. Control group n=38; 2. Index group n=40	Type of economic evaluation: Cost-consequence analysis Unit of economic analysis: Other, disaggregated information provided Perspective: Public health payer Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: SF-36 converted to SF-6D Model used: NR Willingness to pay threshold: £30,000 Software used: STATA, SPSS, Excel	Results: A 12-month follow up showed significantly larger improvement for NMT than for orthopedic standard care, significantly lower mean cost per patient; SEK 5,427 (95% CI 3,693 to 7,161) compared to SEK 14,298 (95% CI 8,322 to 20,274), and more gains in outcomes in cost per QALY per patient (0.066 compared with 0.026). Conclusions: Suggest possibility of improved outcomes and reasonable cost savings for low-prioritized nonsurgical outpatients would be attainable if NMT were available as an additional standard care option in orthopedic outpatient clinics.	15

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Lodhia, 2016[92] Country: USA Design: Other Study length: Theoretical (Markov) analysis Setting: NR Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Industry	Objectives: To investigate the cost-effectiveness of hip arthroscopic surgery versus structured rehabilitation alone for acetabular labral tears and estimate the rate of symptomatic OA and total hip arthroplasty Condition: Acetabular labral tears Number of interventions: 2 Comparators: 1. Arthroscopic surgery 2. Rehabilitation alone Total sample size: NR	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: Lifetime horizon Discount rate: 0.03 Outcome for economic evaluation: QALYs Measurement preference-based outcome: NA Model used: Markov decision model Willingness to pay threshold: USD 50,000/QALY Software used: TreeAge Pro 2014	Results: Arthroscopic surgery was more costly (additional USD 2,653) but generated more utility (additional 3.94 QALYs) compared with rehabilitation over a lifetime. The mean ICER was USD 754/QALY, well below the conventional willingness to pay threshold of USD 50,000/QALY. Conclusions: Hip arthroscopic surgery is more cost-effective and results in a considerably lower incidence of symptomatic OA than structured rehabilitation alone in treating symptomatic labral tears of patients in the second to seventh decades of life without pre-existing OA.	22
Longacre, 2020[93] Country: USA Design: Randomized controlled trial	Objectives: To determine the cost-effectiveness of a Collaborative Care Model (CCM)-based, centralized telecare approach to delivering rehabilitation	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: NR Time horizon: 6 Months	Results: In the intervention-only model, tele-rehabilitation was found to be the dominant strategy, with an incremental cost-effectiveness ratio (ICER) of \$15 494/QALY. At	CHEE RS Score: 11

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Study Length: 6 Months Area of Rehabilitation: Multisystems Specific Area: PT Funding: National Cancer Institute	services to late-stage cancer patient. Condition: Late-stage cancer Number of Interventions: 3 Comparators: 1. Control (arm A) 2. Tele-rehabilitation (arm B) 3. Tele-rehabilitation + pharmacological pain management (arm C) Total sample size: Total N=515; 1. Arm A n=172; 2. Arm B n=172; 3. Arm C n=172	Discount rate: 6 Months Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-3L Model used: Decision-analytic model Willingness to pay threshold: 50,000 or 100,000 USD per gained QALY Software used: Tree AgePro software (2017)	the \$100,000 willingness-to-pay threshold, this tele-rehabilitation was the cost-effective strategy in 95.4% of simulations. Conclusions: The delivery of a CCM-based, centralized tele-rehabilitation intervention to patients with advanced stage cancer is highly cost-effective.	
Ludvigsson, 2017[94] Country: Sweden Design: Randomized clinical trial Study length: 1 year Setting: Outpatient/	Objectives: To analyze the cost-effectiveness of physiotherapist-led neck-specific exercise without or with a behavioural approach, or prescription of physical activity in chronic whiplash-associated disorders, grade 2 to 3 Condition: Chronic whiplash-associated disorders (WAD)	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: NR Discount rate: Discounting was not applied since the scope of this study was 1 year Outcome for economic evaluation: QALYs	Results: The intervention cost alone per QALY gain in the NSE group was USD 12,067. A trend for higher QALY gains were observed in the NSEB group but the costs were also higher. The ICERs varied depending on questionnaire used, but the addition of a behavioural approach to NSE alone was not cost-effective from a	21

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
clinics, community/home Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Government	Number of interventions: 3 Comparators: 1. Neck-specific exercise (NSE) 2. Neck-specific exercises with a behavioural approach (NSEB) 3. Prescription of physical activity (PPA) Total sample size: Total N=216; 1. NSE n=76; 2. NSEB n=71; 3. PPA n=69	Measurement preference-based outcome: EQ-5D, SF-6D Model used: Linear regression model Willingness to pay threshold: USD 26,000 (£20,000) from a healthcare perspective Software used: SPSS v. 22	societal perspective (ICER primary outcome USD 127,800; 95% CI 37,816 to 711,302). Conclusions: Neck-specific exercises was cost-effective from a societal perspective in the treatment of chronic WAD compared with the other exercise interventions. ICERs varied depending on HRQoL questionnaires used. The prescription of physical activity did not result in any QALY gain and was thus not considered a relevant option.	
Maddison, 2015[95] Country: New Zealand Design: Randomized controlled trial Study length: 24 weeks for intervention and a	Objectives: To determine the effectiveness and cost-effectiveness of a mobile phone intervention to improve exercise capacity and physical activity behaviour in people with ischemic heart disease Condition: Ischemic heart disease Number of interventions: 2 Comparators:	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, CEAC Perspective: Other Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs	Results: No differences in PVO2 between the two groups (difference -0.21ml kg-1min-1; 95% CI -1.1 to 0.7; p=0.65) at 24 weeks. However significant treatment effects were observed for selected secondary outcomes, including leisure time physical activity (difference 110.2 min/week; 95% CI -0.8	18

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
6-month follow up Setting: Outpatient/clinics Area of rehabilitation: Cardiorespiratory Specific area: Other rehab Funding: Government, academic, foundation	1. Control 2. Intervention Total sample size: Total N=171; 1. Control n=86; 2. Intervention n=85	Measurement preference-based outcome: SF-36 v. 2, EQ-5D Model used: Analysis of covariance (ANCOVA) regression model Willingness to pay Threshold: NZD 20,000 (£10,600) Software used: SAS v. 9.3, R v. 2.15	to 221.3; p=0.05) and walking (difference 151.4 min/week; 95% CI 27.6 to 275.2; p=0.02). Conclusions: A mobile phone intervention was not effective at increasing exercise capacity over and above usual care. The intervention was effective and probably cost-effective for increasing physical activity and may have the potential to augment existing cardiac rehabilitation services.	
Manning, 2015[96] Country: UK Design: Randomized controlled trial Study length: 36 weeks Setting: Outpatient/clinics	Objectives: To conduct a cost-utility analysis of the Education, Self-Management and Upper Limb Exercise Training in People with RA (EXTRA) program compared with usual care. Condition: Rheumatoid arthritis Number of interventions: 2 Comparators: 1. EXTRA program	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, CEAC Perspective: Public health payer Time horizon: NR Discount rate: No discount; study states not necessary with a follow-up period of less than 1 year Outcome for economic evaluation: QALYs	Results: Compared with usual care, total QALYs gained were higher in the EXTRA program, leading to an increase of 0.0296 QALYs. The mean NHS costs per participant were slightly higher in the EXTRA program (by £82), resulting in an ICER of £2,770/additional QALY gained. Conclusions: The physiotherapist-led EXTRA	17

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Foundation	2. Usual care Total sample size: Total N=108; 1. EXTRA program n=52; 2. Usual care n=56	Measurement preference-based outcome: EQ-5D-3L Model used: Regression-based Willingness to pay threshold: £20,000-30,000 Software used: Stata v. 12.1	program represents a cost-effective use of resources compared with usual care and leads to lower healthcare costs and work absence.	
Marks, 2016[97] Country: Australia Design: Randomized controlled trial Study length: 12 weeks Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Government	Objectives: To determine whether corticosteroid injection given by a physiotherapist for shoulder pain is as clinically and cost-effective as that from an orthopedic surgeon. Condition: Shoulder pain Number of interventions: 2 Comparators: 1. Physiotherapist-injected corticosteroids 2. Orthopedic surgeon-injected corticosteroids Total sample size: Total N=278	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER Perspective: Public health payer Time horizon: 12 weeks Discount rate: NA Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D-5L Model used: NR Willingness to pay threshold: AUD 50,000/QALY Software used: NR	Results: Non-inferiority of injection by the physiotherapist was declared from total SPADI scores at 6 and 12 weeks (upper limit of the 95% one-sided CI 13.34 and 7.17 at 6 and 12 weeks, respectively). There were no statistically significant differences between groups on any outcome measures at 6 or 12 weeks. Conclusions: Corticosteroid injection for shoulder pain, provided by a suitably qualified physiotherapist is at least as clinically effective, and less expensive, compared with similar care delivered by an orthopedic surgeon.	13

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Marra, 2014[98] Country: Canada Design: Randomized controlled trial Study length: 6 months Setting: NR Area of rehabilitation: Musculoskeletal Specific area: Other rehab Funding: Industry	Objectives: To determine if a pharmacist-initiated multidisciplinary strategy provides value for money compared to usual care in participants with previously undiagnosed knee osteoarthritis. Condition: Undiagnosed knee osteoarthritis Number of interventions: 2 Comparators: 1. Usual care 2. Intervention care Total sample size: NR	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, CEAC Perspective: Public health payer Time horizon: 6 months Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: Health Utilities Index Mark 3 (HUI3), Paper Adaptive Test - 5D (PAT-5D) Model used: Modeling using nested imputation and bootstrapping Willingness to pay threshold: Thresholds of \$2,000 and \$20,000/QALY were considered Software used: SAS software PROC MI procedure	Results: From the Ministry of Health perspective, the average patient in the intervention group generated slightly higher costs compared with usual care. The intervention resulted in ICERs of \$232 (95% CI 1,530 to 2,154) per QALY gained from the Ministry of Health perspective and \$14,395 (95% CI 7,826 to 23,132) per QALY gained, compared with usual care. Conclusions: A pharmacist-initiated, multidisciplinary program was good value for money from both the societal and Ministry of Health perspectives.	19
Marsh, 2016[99] Country: Canada	Objectives: To determine the cost-effectiveness of arthroscopic surgery in addition to non-operative treatments compared with	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, incremental cost-utility ratio, net	Results: The incremental net benefit was negative for all willingness-to-pay values. Uncertainty estimates suggest that even if willing to pay	21

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Design: Randomized controlled trial Study length: 24 months Setting: Inpatient (hospital), outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Government	non-operative treatments alone in patients with knee osteoarthritis. Condition: Knee osteoarthritis (OA) Number of interventions: 2 Comparators: 1. Arthroscopic surgery 2. Non-operative Total sample size: Total N=168; 1. Arthroscopic surgery n=88; 2. Non-operative n=80	benefit regression, cost-effectiveness plane, CEAC Perspective: Public health payer Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: NA Model used: Net benefit regression model Willingness to pay threshold: Modelled thresholds varying between \$0 and \$100,000 Software used: NR	\$400,000 to achieve a clinically important improvement in WOMAC score, or $\geq$ \$50,000 for an additional QALY, there is <20% probability that the addition of arthroscopy is cost-effective compared with nonoperative therapies only. Conclusions: Arthroscopic debridement of degenerative articular cartilage and resection of degenerative meniscal tears in addition to nonoperative treatments for knee OA is not an economically attractive treatment option compared with non-operative treatment only, regardless of willingness to pay value.	
Maru, 2019[100] Country: Australia Design: Randomized controlled trial	Objectives: To assess the 1-year cost-effectiveness of a 24-week ET program added to a post-discharge DMP in patients recently hospitalized with HF.	Type of economic evaluation: Cost-Utility Analysis Unit of economic analysis: Incremental Net Monetary Benefits and Incremental Cost Utility Ratio Perspective: Public health payer	Results: At the AU\$50,000/QALY threshold, ET showed 29.6% and 1.7% probability of being cost-effective in the overall population (INMB AU\$ - 1,472) and patients aged $\geq$ 70	CHEE RS Score: 21

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Study Length: 1 Year Area of Rehabilitation: Cardiorespiratory Specific Area: PT Funding: National Health and Medical Research Council (Australia)	Condition: Heart Failure Number of Interventions: 2 Comparators: 1. Disease Management Program (DMP) 2. DMP + Exercise Training (ET) Total sample size: Total N=278; 1. DMP n=138; 2. DMP + ET n=140	Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: AQoL-4D Model used: NR Willingness to pay threshold: \$50,000 AUD Software used: STATA Version 14 Microsoft Excel	(INMB AU\$ -11,469), respectively. In patients aged <70, ET was potentially cost-effective with 83.6% probability (INMB AU\$4,059). Conclusions: Adding ET to DMP was not cost-effective overall or in patients aged ≥70 but was relatively cost-effective in those aged <70.	
Matchar, 2019[101] Country: Singapore Design: Randomized controlled trial Study Length: 9 Months Area of Rehabilitation: Multisystems Specific Area: PT	Objectives: To perform a cost-effectiveness analysis of a multifactorial, tailored intervention to reduce falls among a heterogeneous group of highrisk elderly people. Condition: High fall risk community-dwelling elderly Number of Interventions: 2 Comparators: 1. Intervention 2. Usual Care Total sample size:	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: Health system Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D Model used: NR Willingness to pay threshold: S\$70,000 (Singapore dollars)	Results: The ICER was \$S 120,667 per QALY gained (\$S 362/0.003 QALYs). However, the intervention was more effective and cost-saving among those with SPPB scores of greater than 6 at baseline, higher cognitive function, better vision and no more than 1 fall in the preceding 6 months. Conclusions: The intervention was, overall, not cost-effective, compared to usual care. However, the	CHEE RS Score: 18

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Funding: Ministry of Health Singapore	Total N=354; 1. Control n=177; 2. Intervention n=177	Software used: STATA Version 14	program was cost-effective among healthier subgroups, and even potentially cost-saving among individuals with sufficient reserve to benefit.	
Mazari, 2013 [102] Country: UK Design: Randomized controlled trial Study length: 12 months post-intervention Setting: Outpatient/clinics Area of rehabilitation: Cardiorespiratory Specific area: PT Funding: Other	Objectives: To compare costs and utilities of percutaneous transluminal angioplasty, a supervised exercise program, and combined treatment in patients with intermittent claudication to establish the most cost-effective treatment. Condition: Intermittent claudication (IC) due to femoropopliteal arterial disease Number of interventions: 3 Comparators: 1. Percutaneous transluminal angioplasty (PTA) 2. Supervised exercise program (SEP) 3. PTA + SEP Total sample size:	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER Perspective: Other Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: SF-6D, calculated from SF-36 Model used: Decision tree was used for the index case Willingness to pay threshold: EUR 25,000-35,000/QALY Software used: STATA 11.0 SE	Results: All treatments resulted in significant improvement in the SF-6D index ($p<0.001$). There was no significant difference between treatments in mean QALYs gained (PTA: 0.620, 95% CI 0.588 to 0.652; SEP: 0.629, 0.597 to 0.660; PTA + SEP: 0.649, 0.622 to 0.675). The adjusted mean cost per procedure was significantly higher for PTA (EUR 7,301.74) compared with SEP (EUR 3,866.49) and PTA + SEP (EUR 6,911.68) ($p<0.001$). Conclusions: Supervised exercise is the most cost-effective first-line treatment for IC, and when combined	12

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
	Total N=178; 1. PTA n=60; 2. SEP n=60; 3. PTA + SEP n=58		with PTA is more cost-effective than PTA alone.	
McLean, 2015[103] Country: Australia Design: Other Study length: 18 months Setting: Community/home Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Government, foundation	Objectives: To undertake a cost-utility analysis and secondary cost-effectiveness analysis from a healthcare system perspective of a group-based exercise program compared to routine care for falls prevention in an older community-dwelling population. Condition: Community dwelling residents over the age of 70 Number of interventions: 2 Comparators: 1. Exercise program 2. Routine care Total sample size: Total N=1,107; 1. Exercise program n=541; 2. Routine care n=549	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER; CEAC Perspective: Public health payer Time horizon: 18 months Discount rate: 0.03 Outcome for economic evaluation: QALY Measurement preference-based outcome: Utility Value of Health State Model used: Decision tree model was used in the decision analysis to establish pathways of participation; a negative binomial regression model was used to calculate the rate of falls in each group and determine the rate of injury Willingness to pay threshold: GBP £20,00 to £30,00/QALY	Results: The ICER of GBP 51,483/QALY for the base case analysis was well above the accepted cost-effectiveness threshold of GBP 20,000 to 30,000/QALY, but in a sensitivity analysis with minimized program implementation the incremental cost reached GBP 25,678/QALY. Males had a 44% lower injury rate if they fell, compared to females resulting in a more favourable ICER for the women-only analysis. Conclusions: This exercise program is cost-effective for women only. There is no evidence to support its cost-effectiveness in a group of mixed sex unless the costs of	22

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
		Software used: PASW Statistics 18, Excel 2007, Risk Solver Platform v. 10.0	program implementation are minimal.	
Milte, 2016[104] Country: Australia Design: Randomized controlled trial Study length: 6 months Setting: Inpatient (hospital), community/home Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Academic, industry	Objectives: To undertake a cost-utility analysis of individual nutrition and exercise therapy programs for rehabilitation following hip fracture. Condition: Community-residing individuals 70 years of age or older following hip fracture Number of interventions: 2 Comparators: 1. Intervention 2. Control Total sample size: Total N=175; 1. Intervention n=86; 2. Control n=89	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, CEAC Perspective: Public health payer Time horizon: Less than 1 year Discount rate: Discounting of costs was not undertaken, as the time horizon of the study was less than 1 year Outcome for economic evaluation: QALYs Measurement preference-based outcome: AQoL-4D Model used: NR Willingness to pay threshold: AUD 50,000 as per Pharmaceutical Benefits Advisory Committee Software used: IBM SPSS Statistics v. 19.0	Results: There were minimal differences in mean costs between the intervention (AUD 45,764; SD: 23,012) and the control group (AUD 44,764; SD: 23,012) but a slightly higher mean gain in QALYs in the intervention group (0.155, SD: 0.132) compared with the control group (0.139, SD: 0.149). The ICER was AUD 28,350/QALY gained. Conclusions: A comprehensive 6-month program of therapy from dietitians and physical therapists could be provided at a relatively low additional cost in this group of frail older adults, and the incremental cost-effectiveness, although there was a very high level of uncertainty in the findings.	17

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Miyamoto, 2018[105] Country: Brazil Design: Randomized controlled trial Study Length: 12 Months Area of Rehabilitation: Multisystems Specific Area: PT Funding: Sao Paulo Research Foundation	Objectives: To evaluate the effectiveness and cost-utility of the addition of different doses of Pilates to an advice for non-specific chronic low back pain (NSCLBP) from a societal perspective. Condition: Non-specific chronic low back pain (NSCLBP) Number of Interventions: 4 Comparators: Pilates Groups (PG) 1. PG1 2. PG2 3. PG3 4. Booklet Group (BG) Total sample size: Total N = 296; 1. PG1 n=74; 2. PG2 n=74; 3. PG3 n=74; 4. BG n=74	Type of economic evaluation: Cost-Utility Analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: SF-6D Model used: Linear mixed models Willingness to pay threshold: £20 000 per QALY gained, and £30 000 per QALY gained Software used: SPSS V.24; STATA V.14	Results: Compared with the BG, all Pilates groups showed significant improvements in pain (PG1, mean difference (MD)=-1.2, 95%CI -2.2 to -0.3; PG2, MD=-2.3, 95%CI -3.2 to -1.4; PG3, MD=-2.1, 95%CI -3.0 to -1.1) and disability (PG1, MD=-1.9, 95%CI -3.6 to -0.1; PG2, MD=-4.7, 95%CI -6.4 to -3.0; PG3, MD=-3.3, 95%CI -5.0 to -1.6). Conclusions: Adding two sessions of Pilates exercises to advice provided better outcomes in pain and disability than advice alone for patients with NSCLBP. The cost-utility analysis showed that Pilates three times a week was the preferred option.	CHEE RS Score: 20
Mortimer, 2019[106] Country: Australia	Objectives: To evaluate the cost-effectiveness of structured activities of daily living (ADL) retraining	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: Public health payer	Results: Structured ADL retraining during PTA significantly increased functional independence at	CHEE RS Score: 18

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Design: Randomized controlled trial Study Length: Days average 71 (+/-72 days) Area of Rehabilitation: Neurology Specific Area: OT Funding: Transport Accident Commission; Epworth Research Institute Grant; & William Buckland Foundation Grant	during posttraumatic amnesia (PTA) plus treatment as usual (TAU) vs TAU alone for inpatient rehabilitation following severe traumatic brain injury (TBI). Condition: Severe Traumatic Brain Injury Number of Interventions: 2 Comparators: 1. Control 2. Intervention Group Total sample size: Total N=104; 1. Control n=55; 2. Intervention n=49	Time horizon: Coincides with the final scheduled follow-up for the trial (2mo post discharge) Discount rate: Coincides with the final follow-up (2mo post discharge) Outcome for economic evaluation: Cost per amount of care provided in hospital Measurement preference-based outcome: NA Model used: Generalized linear model with a log link function Willingness to pay threshold: NR Software used: NR	PTA emergence (mean difference: 4.90, SE: 1.4, 95% confidence interval [CI]: 1.5, 8.3). Even in our most pessimistic scenario, structured ADL retraining was cost-saving as compared to TAU (mean: -\$7762; 95% CI: -\$8105, -\$7419). Conclusions: Structured ADL retraining during PTA yields net cost-savings to the health system and offers a cost-effective means of increasing functional independence at PTA emergence and hospital discharge.	
Nagayama, 2016[107] Country: Japan Design: Randomized controlled trial	Objectives: To evaluate if interventions based on occupation-based goal setting could focus on meaningful activities to improve QoL and independent activities of daily living, with greater cost-	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, total care costs Perspective: NR Time horizon: NR	Results: The ADOC group had a significantly greater change in the BI score, with improved scores (p=0.027; 95% CI 0.41 to 6.87; intraclass correlation coefficient = 0.14). No other	18

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Study length: 4 months Setting: Other Area of rehabilitation: Multisystem Specific area: OT Funding: Foundation, other	effectiveness than an impairment-based approach. Condition: Residents of geriatric health facilities Number of interventions: 2 Comparators: 1. Experimental (ADOC) group 2. Control group Total sample size: Total N=54; 1. ADOC group n=28, from 6 facilities; 2. Control group n=26, from 6 facilities	Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: SF-36, which was then converted to the SF-6D Model used: Mixed effects multilevel regression analysis Willingness to pay threshold: NR Software used: STATA v. 13	outcome was significantly different. The ICER, calculated using the change in BI score, was \$63.1. Conclusions: The results suggest that occupational therapy using the ADOC for older residents might be effective and cost-effective. Conducting a randomized controlled trial in the occupational therapy setting is feasible.	
Neilson, 2019[108] Country: United Kingdom Design: Randomized controlled trial Study Length: 26 Weeks	Objectives: To assess the cost-effectiveness of advice to remain active (AA) versus advice to rest (AR); and immediate physiotherapy (IP) versus usual care (waiting list) physiotherapy (UCP). Condition: Distal arm pain Number of Interventions: 3 Comparators:	Type of economic evaluation: Cost-Utility Analysis Unit of economic analysis: ICER Perspective: Public health payer Time horizon: 26 Weeks Discount rate: 26 Weeks Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-3L	Results: Baseline-adjusted cost differences were GBP 88 [95% confidence interval (CI): -14, 201) AA versus AR; -£14 (95% CI: -87, 66) IP versus UCP. Baseline-adjusted QALY differences were 0.0095 (95% CI: -0.0140, 0.0344) AA versus AR; 0.0143 (95% CI: -0.0077, 0.0354) IP versus UCP.	CHEERS Score: 19

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Area of Rehabilitation: Multisystems Specific Area: PT Funding: Arthritis Research UK	1. Immediate physiotherapy (IP) 2. Usual Care (wait list) with Advice to remain Active (AA) 3. Usual care (waiting list) physiotherapy with Advice advocating Rest (AR) Total sample size: Total N= 538	Model used: Generalized linear model Willingness to pay threshold: £20000–£30000 per QALY Software used: STATA 14.0 and Microsoft Excel	Conclusions: The difference in mean costs and mean QALYs between the competing strategies was small and not statistically significant. AA is preferable to one that encourages AR, as it is more effective and more likely to be cost-effective than AR.	
Nicolian, 2019[109] Country: France Design: Randomized controlled trial Study Length: From inclusion in study until delivery Area of Rehabilitation: Musculoskeletal Specific Area: PT	Objectives: To assess the cost-effectiveness of acupuncture for pelvic girdle and low back pain (PGLBP) during pregnancy. Condition: Pelvic girdle and low back pain (PGLBP) during pregnancy Number of Interventions: 2 Comparators: 1. Acupuncture 2. Control Total sample size: Total N=199; 1. Acupuncture n=96; 2. Control n=103	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: Time horizon was until the delivery Discount rate: Time horizon was until the delivery Outcome for economic evaluation: Change in cost per change in number of days with pain NRS $\leq$ 4/10 when comparing acupuncture and standard treatment groups Measurement preference-based outcome: NA	Results: The proportion of days with NRS $\leq$ 4/10 was greater in the acupuncture group than in the standard care group (61% vs 48%, $p = 0.007$). Average total costs were higher in the control group (EUR 2947) than in the acupuncture group (EUR 2635, $\Delta = -\text{EUR } 312$, 95% CI: -966 to +325). Acupuncture was a dominant strategy when both healthcare and non-healthcare costs were included. Conclusions: Acupuncture was a dominant strategy when	CHEE RS Score: 19

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Funding: Delegation a la Recherche Clinique d'Ile de France		Model used: Generalized linear mixed-effects model Willingness to pay threshold: NR Software used: R version 3.3.1	accounting for employer costs. A 100% probability of cost-effectiveness was obtained for a willingness to pay of EUR 100 per days with pain NRS ≤ 4 .	
Oestergaard, 2013[110] Country: Denmark Design: Randomized controlled trial Study length: 1 year Setting: Inpatient (hospital), community/home Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Other	Objectives: To examine the cost-effectiveness and cost-utility of initiating rehabilitation 6 weeks after surgery as opposed to 12 weeks after surgery from a societal perspective. Condition: Instrumented lumbar spinal fusion due to degenerative disc disease or spondylolisthesis grade 1 or 2 Number of interventions: 2 Comparators: 1. 6-week group 2. 12-week group Total sample size: Total N=82; 1. 6-week group n=41; 2. 12-week group n=41	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, net benefit, CEAC Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: Model for multiple imputation using linear regression Willingness to pay threshold: NR Software used: NR	Results: The fast-track strategy tended to be costlier by EUR 6,869 (95% CI -4,640 to 18,378) while at the same time leading to significantly poorer outcomes of functional disability by -9 points (95% CI -18 to -3) and a tendency for reduced gain in QALYs by -0.04 (95% CI -0.13 to 0.01). Conclusions: Initiating rehabilitation at 6 weeks as opposed to 12 weeks after surgery is on average more costly and less effective. The uncertainty of this result did not seem to be sensitive to methodological issues.	18

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Oosterhuis, 2017[111] Country: Netherlands Design: Randomized controlled trial Study length: 26 weeks Setting: Inpatient (hospital), outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Government	Objectives: To determine whether referral for early rehabilitation after lumbar disc surgery is effective and cost-effective compared to no referral. Condition: Herniated lumbar disc, low back pain Number of interventions: 2 Comparators: 1. Referral for early rehab 2. Usual care Total sample size: Total N=173; 1. Referral for early rehab n=92; 2. Usual care n=77	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, CEAC Perspective: Societal Time horizon: 26 weeks Discount rate: No discount; cost within a year of recruitment (26 weeks) Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D-3L Model used: Multivariate imputation by chained equations with predictive mean matching Willingness to pay threshold: EUR 32,000 Software used: STATA	Results: The maximum probability for the intervention to be cost-effective was 0.75 at a willingness to pay of EUR 32,000/QALY. The ICER was –EUR 85,394, indicating that the intervention saved EUR 85,394/QALY gained. High level of uncertainty around the estimates. Conclusions: Early rehabilitation after lumbar disc surgery was neither more effective nor more cost-effective than no referral	19
Oppong, 2015[112] Country: UK Design: Randomized controlled trial	Objectives: To assess the cost-effectiveness of joint protection and hand exercises for the management of hand osteoarthritis.	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER Perspective: Public health payer Time horizon: 12 months	Results: Mean costs were GBP 58.46 (SD 0.662) for leaflet and advice, GBP 92.12 (SD 0.659) for joint protection, GBP 64.51 (SD 0.681) for hand exercises and GBP 112.38 (SD 0.658) for	15

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Study length: 12 months Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: PT, OT Funding: Government, foundation	Condition: Hand osteoarthritis (OA) Number of interventions: 4 Comparators: 1. Leaflet and advice 2. Joint protection only 3. Hand exercises only 4. Joint protection + hand exercises Total sample size: Total N=257	Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: Regression models Willingness to pay threshold: GBP 20,000 Software used: STATA	joint protection plus hand exercises. In the base case, hand exercises were the cost-effective option, with an ICER of GBP 318/QALY gained. Conclusions: Hand exercises were the most cost-effective option to manage hand OA.	
Panman, 2016[113] Country: Netherlands Design: Randomized controlled trial Study length: 2 years Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal	Objectives: To evaluate the effectiveness of pessary treatment compared with pelvic floor muscle training in women with pelvic organ prolapse over a 2-year period. Condition: Women 55 years old or older presenting with symptomatic pelvic organ prolapse Number of interventions: 2 Comparators: 1. Pelvic floor muscle training (PFMT)	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, incremental cost utility ratio Perspective: NR Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D-3L	Results: There was a nonsignificant difference in the primary outcome between pessary treatment and PFMT with a mean difference of -3.7 points (95% CI -12.8 to 5.3; p=0.42) in favour of pessary treatment. A significantly greater improvement in the prolapse symptoms score was, however, seen with pessary treatment (mean difference -3.2 points; 95% CI -6.2 to -0.0; p=0.05).	19

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Specific area: PT Funding: Foundation	2. Pessary treatment Total sample size: Total N=162; 1. PFMT n=80; 2. Pessary n=82	Model used: MLwiN 2.29 for multilevel analysis to produce hierarchical models Willingness to pay threshold: NR Software used: MLwiN 2.29	Conclusions: In older women with symptomatic prolapse, there was no significant difference between pessary treatment and PFMT in reducing pelvic floor symptoms, but specific prolapse-related symptoms did improve more with pessary treatment. Pessary treatment was preferable in the cost-effectiveness analysis.	
Patil, 2015[114] Country: Finland Design: Randomized controlled trial Study length: 2 years Setting: Community/home Area of rehabilitation: Musculoskeletal Specific area: PT	Objectives: To evaluate the fall-related healthcare costs over a 2-year intervention period from a societal perspective for the interventions of exercise and vitamin D. Condition: Have fallen at least once during the previous year and aged 70-80 years old Number of interventions: 4 Comparators: 1. No exercise + placebo (D-Ex-)	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, CEAC Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: DRS points Measurement preference-based outcome: NA Model used: NR	Results: The incidence rate ratios (95% CI) for medically attended injurious falls were lower in both exercise groups compared with no vitamin D and no exercise. At a willingness to pay of EUR 3,000/injurious fall prevented, there was an 85.6% chance of the exercise intervention being cost-effective in this population. Conclusions: Exercise was effective in reducing fall-	15

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Funding: Other	2. No exercise + vitamin D (D+Ex-) 3. Exercise + placebo (D-Ex+): Exercise and no vitamin D 4. Exercise and vitamin D (D+Ex+) Total sample size: Total N=407; 1. D-Ex- n=102; 2. D+Ex- n=102; 3. D-Ex+ n=103; 4. D+Ex+ n=102	Willingness to pay threshold: EUR 3,000/injurious fall Software used: Stata statistics software v. 12.1	related injuries among community-dwelling older women at a moderate cost. Vitamin D supplementation had marginal additional benefit. The results provide a firm basis for initiating feasible and cost-effective exercise interventions in this population.	
Paulsen, 2020[115] Country: Denmark Design: Randomized controlled trial Study Length: 24 Months Area of Rehabilitation: Musculoskeletal Specific Area: PT	Objectives: The aim of this study was to examine whether routine referral to municipal postoperative rehabilitation is cost-effective in comparison to no referral after surgery for lumbar disc herniation (LDH). Condition: Lumbar disc herniation Number of Interventions: 2 Comparators: 1. HOME 2. REHAB Total sample size:	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D Model used: NR Willingness to pay threshold: GBP 22,000 and GBP 33,000 per QALY	Results: The main cost-effectiveness analysis showed a small, insignificant incremental QALY of 0.021 and an incremental cost of EUR 211.8 for the REHAB group compared to the HOME group, resulting in an ICER of EUR 10,085. Conclusions: Routine referral to municipal physical rehabilitation in patients recovering from LDH surgery was not cost-effective compared to no referral.	CHEE RS Score: 20

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Funding: Research Council of Southern Denmark and Lillebaelt Hospital	Total N=146; 1. REHAB n=73; 2. HOME n=73	Software used: STATA Version 15.1		
Pinto, 2013[116] Country: New Zealand Design: Randomized controlled trial Study length: 1 year Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Government, academic	Objectives: To evaluate the cost-effectiveness of manual PT, exercise PT, and a combination of these therapies for patients with osteoarthritis of the hip or knee Condition: Osteoarthritis of the hip or knee Number of interventions: 4 Comparators: 1. Usual care control 2. Manual therapy alone 3. Exercise therapy alone 4. Combined manual and exercise therapy Total sample size: Total N=206; 1. Usual care n=51; 2. Manual therapy	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: Incremental cost utility ratios Perspective: Public health payer Time horizon: 1 year Discount rate: No discount used, as it was considered unnecessary Outcome for economic evaluation: QALYs Measurement preference-based outcome: Medical Outcomes Study-SF-12v2, SF-6D Model used: Generalized linear models Willingness to pay threshold: NZD 29,149 (1XGDP), NZD 58,298 (2XGDP) and NZD 87,447 (3XGDP) Software used: SAS IVEware	Results: All three treatment programs resulted in incremental QALY gains relative to usual care. From the perspective of the New Zealand health system, exercise therapy was the only treatment to result in an incremental cost utility ration under one-time GDP per capita at NZD 26,400 (-34,081 to 103,899). From the societal perspective manual therapy was cost saving relative to usual care for most scenarios studied. Conclusions: Exercise therapy and manual therapy were more cost-effective than usual care at policy relevant values of willingness to pay	24

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
	n=54; 3. Exercise therapy n=51; 4. Combined n=50		from both the perspective of the health system and society.	
Retel, 2016[117] Country: Netherlands Design: Markov model Study length: Modelled to 2 years Setting: NR Area of rehabilitation: Musculoskeletal Specific area: PT, other rehab Funding: Other	Objectives: To compare the TheraBite device versus speech language pathology (SLP) sessions alone in the preventive setting of advanced head and neck cancer patients treated with concomitant chemo-radiotherapy Condition: Advanced (Stage 3 or 4) functional or anatomical inoperable head and neck cancer receiving concomitant chemo-radiotherapy combined with radiotherapy and comparable intensive supportive care Number of interventions: 2 Comparators: 1. Usual care 2. TheraBite Jaw Motion Rehabilitation System Total sample size:	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER Perspective: Public health payer Time horizon: 2 years Discount rate: Future costs and effects were discounted to their present value by a rate of 4 and 1.5% per year, respectively Outcome for economic evaluation: QALYs Measurement preference-based outcome: Utility Value of Health State Model used: Markov decision model Willingness to pay threshold: EUR 20,000/QALY Software used: Excel	Results: The total healthcare costs per patient were estimated to amount to EUR 5,129 for the TheraBite strategy and EUR 6,915 for the SLP strategy. Based on the current data, the TheraBite strategy yielded more QALYs (1.28) compared to the SLP strategy (1.24). Thus, the TheraBite strategy seems more effective and less costly than the SLP only strategy. Conclusions: TheraBite is expected to be cost-effective compared to SLP in a preventive exercise program for concomitant chemo-radiotherapy for advanced head and neck cancer patients.	18

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
	Total N=29; 1. SLP n=14; 2. TheraBite n=15			
Reynolds, 2014[118] Country: USA Design: Randomized controlled trial Study length: 18 months Setting: Inpatient (hospital), outpatient/clinics, community/home Area of rehabilitation: Cardiorespiratory Specific area: PT Funding: Industry, foundation	Objectives: To better define the relative cost-effectiveness of supervised exercise and stenting for improving functional status, symptoms, and QoL compared with optical medical care Condition: Moderate to severe claudication due to aortoiliac disease Number of interventions: 3 Comparators: 1. Optimal medical care (OMC) 2. Supervised exercise (SE) 3. Iliac stenting (ST) Total sample size: Total N=98; 1. OMC n=20; 2. SE n=37; 3. ST n=41	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, CEAC Perspective: Societal Time horizon: 5 years Discount rate: 3% per year in accordance with US methodological standards Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: Markov model Willingness to pay threshold: A range of thresholds including under USD 20,000, USD 30,000-80,000, and over USD 120,000 were used Software used: TreeAge Pro Software	Results: Through 18 months, mean healthcare costs were USD 5,178, USD 9,804, and USD 14,590 per patient for OMC, SE, and ST respectively. Measured QALYs through 18 months were 1.04, 1.16, and 1.20. The ICERs were USD 24,070 per QALY gained for SE versus OMC, USD 41,376 for ST versus OMC, and USD 122,600 for ST versus SE. Conclusions: Both SE and ST are economically attractive by US standards relative to OMC for the treatment of claudication in patients with aortoiliac disease. ST is more expensive than SE, with uncertain incremental benefit.	22
Richardson, 2014[119] Country: USA	Objectives: To determine whether conservative or surgical therapy is more cost-	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER	Results: Compared to PFMT, initial treatment of SUI with MUS was the more cost-	16

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Design: Decision tree model Study length: 1 year Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Other	effective for the initial treatment of stress urinary incontinence Condition: Stress urinary incontinence (SUI) Number of interventions: 3 Comparators: 1. Continence pessary 2. Behavioural treatment with PFMT 3. Surgical therapy with MUS Total sample size: NR	Perspective: Third-party payer Time horizon: 1 year Discount rate: As the time horizon for this model was 1 year, a discount rate/year was not used Outcome for economic evaluation: QALYs, costs Measurement preference-based outcome: NA Model used: Decision tree model Willingness to pay threshold: A threshold of <\$50,000/QALY was considered cost-effective Software used: NR	effective strategy with an ICER of \$32,132/QALY. Initial treatment with PFMT was also acceptable as long as subjective cure was >35%. In 3-way sensitivity analysis, subjective cure would need to be >40.5% for PFMT and 43.5% for a continence pessary for the MUS scenario to not be the preferred strategy. Conclusions: At 1 year, MUS is more cost-effective than a continence pessary or PFMT for the initial treatment of SUI.	
Rincon, 2016[120] Country: Colombia Design: Markov model Study length: Modelled for 5 years	Objectives: To provide the information necessary to support healthcare resource allocation decisions regarding cardiac rehabilitation in patients with chronic heart failure Condition: Chronic heart failure (CHF) Number of interventions: 2	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER Perspective: Other Time horizon: 5 years Discount rate: Annual discount rate of 3%	Results: For an exercise-based CR program of 12-week duration (36 sessions), costs ranged from USD 265 to USD 369 per patient. Monthly costs associated with ambulatory care of CHF averaged USD 128 +/- USD 321 per patient, and hospitalization costs were	21

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Setting: NR Area of rehabilitation: Cardiorespiratory Specific area: PT Funding: Government	Comparators: 1. Usual care 2. Cardiac rehabilitation (CR) Total sample size: NR	Outcome for economic evaluation: Costs per QALY gained and per LYG Measurement preference-based outcome: Utilities range Model used: Markov model Willingness to pay threshold: Average threshold of USD 21 000 (COP 36 million) Software used: Excel 2010	USD 3,621 +/- USD 5,444 per event. The incremental cost of CR would be USD 998 per additional QALY. Conclusions: Cardiac rehabilitation in patients with CHF in settings such as Colombia can be a cost-effective strategy, with minimal incremental costs and better QoL.	
Rodgers, 2019[121] Country: United Kingdom Design: Randomized controlled trial Study Length: 24 Months Area of Rehabilitation: Neurology Specific Area: Other Rehab	Objectives: To assess the clinical effectiveness and cost-effectiveness of an extended stroke rehabilitation service (EXTRAS) provided following early supported discharge. Condition: Stroke Number of Interventions: 2 Comparators: 1. Intervention 2. Control Total sample size: Total N=573; 1. Intervention n=285; 2. Control n=288	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: Total health and social care costs Perspective: Health and social care provider Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-5L Model used: General linear model	Results: Over 24 months, the mean cost of resource utilization was lower in the intervention group: -£311 (-\$450 [95% CI, -£3292 to £2787; -\$4764 to \$4033]). EXTRAS provided more Quality Adjusted Life Years (0.07 [95% CI, 0.01 to 0.12]). Conclusions: EXTRAS did not significantly improve stroke survivors' performance in extended activities of daily living. However, given the impact on costs and Quality Adjusted Life Years,	CHEERS Score: 14

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Funding: National Institute for Health Research		Willingness to pay threshold: NHS standard of willingness to pay £20 000 (\$28 940 USD) per QALY Software used: NR	EXTRAS may be an affordable addition to improve stroke care.	
Rome, 2017[122] Country: New Zealand Design: Randomized controlled trial Study length: 16 weeks Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: Other rehab Funding: Foundation	Objectives: To evaluate the clinical and cost-effectiveness of two types of foot orthoses in people with established RA Condition: Rheumatoid arthritis Number of interventions: 2 Comparators: 1. Custom-made foot orthosis (CMFO) 2. Simple insert (SI) Total sample size: Total N=41; 1. CMFO n=20; 2. SI n=21	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: Other, HRQoL Perspective: Public health payer Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: Modelling was unable to be undertaken Willingness to pay Threshold: GBP 20,000 Software used: SPSS v. 22.0, Excel 2010, R and Statistical Analysis Software (SAS)	Results: After 16 weeks foot pain improved in both the CMFOs and the SIs. However, disability scores improved for CMFOs but not for SIs. The cost-effectiveness results demonstrated no difference in cost between the arms, with the CMFOs being less effective in terms of cost per QALY gain. Conclusions: In people with established RA, semi-rigid customized foot orthoses can improve pain and disability scores in comparison to simple insoles. From a cost-effectiveness perspective, the customized foot orthoses were far more expensive to manufacture, with no significant cost per QALY gain.	13

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Saha, 2019[123] Country: Sweden Design: Randomized controlled trial Study Length: 12 Months Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: Blekinge county council, Kronoberg and Skåne regional councils and the Vårdal Foundation.	Objectives: The aim of this study was to identify if the WorkUp trial which facilitates participants to stay at work or in case of sick leave, return-to-work, is cost-effective. Condition: Acute/subacute neck/or back pain Number of Interventions: 2 Comparators: 1. Intervention group 2. Reference group Total sample size: Total N=352; 1. Intervention n=146; 2. Reference n=206	Type of economic evaluation: Cost-Utility Analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D Model used: NR Willingness to pay threshold: Swedish National Board of Health and Welfare consider interventions costing < 500,000 SEK (€57,803) per QALY gained as cost-effective Software used: STATA 14	Results: From the healthcare perspective, the ICER was €23,606 (2013 price year) per QALY gain. From the societal perspective the intervention was dominating, i.e. less costly and more effective than reference care. Conclusions: Structured evidence-based physiotherapeutic care together with workplace dialogue is a cost-effective alternative from both a societal and a healthcare perspective for acute/subacute neck and/or back pain patients.	CHEERS Score: 20
Salisbury, 2013[124] Country: UK	Objectives: To investigate whether PhysioDirect is equally as clinically effective as and more cost-effective than usual care for patients	Type of economic evaluation: Cost-effectiveness analysis, cost-utility analysis, cost-consequence analysis Unit of economic analysis: ICER	Results: NHS costs (PT plus other relevant NHS costs) per patient were similar in the two arms (PhysioDirect £198.98 vs. usual care £179.68;	21

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Design: Randomized controlled trial Study length: 6 months Setting: Community/home, other Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Government	with musculoskeletal problems in primary care Condition: Musculoskeletal conditions Number of interventions: 2 Comparators: 1. PhysioDirect 2. Usual care Total sample size: Total N=2,256; 1. PhysioDirect n=1,513; 2. Usual care n=743	Perspective: Public health payer, societal, other Time horizon: 6 months Discount rate: Reported not necessary since the trials lasted only 6 months Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: NR Willingness to pay threshold: £20,000 Software used: NR	difference in means £19.30; 95% CI –£37.60 to £76.19), while QALYs gained were also similar (difference in means 0.007; 95% CI –0.003 to 0.016). Incremental cost per QALY gained was £2,889. Conclusions: Providing PT via PhysioDirect is equally clinically effective compared with usual waiting list-based care, provides faster access to treatment, appears to be safe, and is broadly acceptable to patients.	
Stanmore, 2019[125] Country: United Kingdom Design: Randomized controlled trial Study Length: 12 Weeks	Objectives: To determine the effectiveness of a tailored OTAGO/FaME-based strength and balance Exergame programme for improving balance, maintaining function and reducing falls risk in older people.	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: Public health payer Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-5L	Results: The change in fall rates significantly favoured the intervention (incident rate ratio 0.31 (95% CI 0.16 to 0.62, p = 0.001)). The point estimate of the incremental cost-effectiveness ratio (ICER) was £15,209.80 per quality-adjusted life year (QALY). There was a 61% probability of Exergames	CHEE RS Score: 17

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: Innovate UK through, andMRC Skills Development Fellowship	Condition: Individuals aged 55 years or older residing in assisted living Number of Interventions: 2 Comparators: 1. Control 'usual care' 2. Intervention 'Exergames' Total sample size: Total N=106; 1. Control n=50; 2. Intervention n=56	Model used: Linear regression model and lindear mixed effects model Willingness to pay threshold: NICE threshold of £20,000 per QALY Software used: STATA 14	being cost-effective, rising to 73% at the upper bound of £30,000 per QALY. Conclusions: Exergames improved balance, pain and fear of falling and are a cost-effective fall prevention strategy in assisted living facilities for people aged 55 years or older.	
Stewart, 2017[126] Country: USA Design: Markov model Study length: NR Setting: NR Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Other	Objectives: To evaluate the cost-effectiveness of the treatment of acute anterior cruciate ligament tears with either initial surgical reconstruction or PT in competitive athletes Condition: Athletes with anterior cruciate ligament (ACL) tears Number of interventions: 2 Comparators: 1. Anterior cruciate ligament reconstruction (ACLR)	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: 6 years Discount rate: 3% annually Outcome for economic evaluation: QALYs Measurement preference-based outcome: Health status measured using SF-36 from published studies of National Collegiate Athletic Association athletes; SF-36 score	Results: The ICER of ACL reconstruction compared with PT was USD 22,702/QALY gained. The ICER was most sensitive to the QoL of returning to play or not returning to play, costs, and duration of follow up but not relatively insensitive to the rates and costs of complications, probabilities of return to play for both operative and nonoperative treatments, and discount rate.	20

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
	2. PT Total sample size: 1. Reconstruction n=23 studies used with 2,719 patients; 2. Nonoperative ACL treatment n=4 studies used with 147 patients	was then converted to an EQ-5D value using a published algorithm Model used: Markov model Willingness to pay threshold: USD 50,000/QALY Software used: NR	Conclusions: ACL reconstruction is a cost-effective strategy for competitive athletes with an ACL injury.	
Sturkenboom, 2015[127] Country: Netherlands Design: Randomized controlled trial Study length: 6 months Setting: Community/home Area of rehabilitation: Multisystem Specific area: OT Funding: Foundation	Objectives: To evaluate the cost-effectiveness of a large randomized clinical trial (the Occupational Therapy in Parkinson's Disease [OTiP] study). Condition: Parkinson's Disease (PD) Number of interventions: 2 Comparators: 1. Intervention group 2. Control group Total sample size: Total N=191; 1. Intervention group n=124; 2. Control group n=67	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: Net monetary benefit Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: Linear mixed models Willingness to pay threshold: EUR 40,000 used as a reference value Software used: NR	Results: The estimated mean total costs for the intervention group compared with controls were EUR 125 lower for patients, EUR 29 lower for caregivers, and EUR 122 higher for patient–caregiver pairs (differences not significant). At a value of EUR 40,000 per QALY gained (reported threshold for PD), the net monetary benefit of the intervention per patient was EUR 305 (p=0.74), per caregiver EUR 866 (p=0.01) and per patient–caregiver pair EUR 845 (p=0.24). Conclusions: OT did not significantly impact on total	20

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
			costs compared with usual care.	
Suni, 2018[128] Country: Finland Design: Randomized controlled trial Study Length: 12 Months Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: The Social Insurance Institution of Finland	Objectives: To study the effectiveness of a 6-month intervention of combined neuromuscular exercise and back care counseling or either intervention alone against a non-treatment control-arm for reducing pain and fear of pain in female healthcare workers with recurrent non-specific LBP. Condition: Recurrent non-specific low back pain Number of Interventions: 4 Comparators: 1. Exercise 2. Counselling 3. Combined 4. Control Total sample size: Total N=219; 1. Combined n=53; 2. Exercise Only n=57; 3. Counselling Only n=55; 4. Control n=54	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: NR Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: SF-6D derived from the original SF-36 data Model used: Generalized linear mixed model (GLMM) Willingness to pay threshold: NR Software used: SPSS version 22 & STATA version 12.1	Results: The Combined-arm showed reduced intensity of LBP ($p = 0.006$; effect size 0.70, confidence interval 0.23 to 1.17) and pain interfering with work ($p = 0.011$) compared with the Control-arm. During the study period (0–12 months) mean total costs were lowest in the Combined-arm (€476 vs. €1062–€1992, $p < 0.001$). There was 85% probability of exercise-arm being cost-effective if willing to pay €3550 for QALY gained. Conclusions: Exercise once a week for 6 months combined with five sessions of back care counseling after working hours in real-life settings effectively reduced the intensity of LBP, work interference due to LBP, and	CHEERS Score: 12

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
			fear of pain, but was not cost-effective.	
Tan, 2016[129] Country: Netherlands Design: Randomized controlled trial Study length: 52 weeks Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Foundation	Objectives: To determine the cost-effectiveness of exercise therapy compared to general practitioner care in patients with hip osteoarthritis in primary care Condition: Hip osteoarthritis Number of interventions: 2 Comparators: 1. Intervention group 2. Usual care control group Total sample size: Total N=203; 1. Intervention group n=101; 2. Control group n=102	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, incremental cost difference Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: Saturated linear model with correlated errors and an unstructured covariance matrix Willingness to pay threshold: NR Software used: SPSS for Windows V21.0, STATA v. 12.1	Results: The annual direct costs per patient were significantly lower for the intervention group (EUR 1,233) compared to the control group (EUR 1,331). Productivity costs were higher than direct medical costs. There was a very small adjusted difference in QoL of 0.006 in favour of the control group (95% CI -0.04 to 0.02). Conclusions: Exercise therapy is probably cost saving, without the risk of note-worthy negative health effects.	21
Taraldsen, 2019[130] Country: Norway	Objectives: The aim of this trial was to evaluate the clinical effectiveness and cost-effectiveness of a home-based exercise program delivered four months	Type of economic evaluation: Cost-Utility Analysis Unit of economic analysis: ICER Perspective: Broad health care Time horizon: NR	Results: Estimated between group difference in gait speed was 0.09 m/sec (95% CI: 0.04 to 0.14, p<0.001) at posttest and 0.07 m/sec (95% CI: 0.02 to 0.12, p = 0.009) post	CHEE RS Score: 20

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Design: Randomized controlled trial Study Length: 8 Months Area of Rehabilitation: Musculoskeletal Specific Area: PT Funding: Norwegian Women's Health Association, the Norwegian Extra Foundation for Health and Rehabilitation	following hip-fracture surgery. Condition: Hip fracture Number of Interventions: 2 Comparators: 1. Control 2. Intervention Total sample size: Total N=143; 1. Intervention n=70; 2. Control n=73	Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-3L Model used: Linear mixed models (LMM) Willingness to pay threshold: NR Software used: IBM Statistics SPSS 23 software and the R statistical package	surgery. The mean between-group QALY difference was -0.009 (95% CI: -0.061 to 0.038). The mean between-group total cost difference was +242.9 EUR (95% CI: -8397 to 8584). Conclusions: Findings suggest that gait recovery after hip fracture can be improved by introducing a home-based balance and gait exercise program four months post surgery, without increasing total health care costs.	
Theodore, 2015[131] Country: USA Design: Prospective cohort study Study length: Functional	Objectives: To investigate the cost-effectiveness of early interdisciplinary functional restoration for chronic disabling occupational musculoskeletal disorders (CDOMD), once a normal healing period has passed.	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER; average cost-effectiveness ratio Perspective: Societal Time horizon: NR Discount rate: NR	Results: At 1 year following functional restoration rehabilitation, all groups were comparable on return to work (overall 88%), work retention (overall 80%), and additional healthcare utilization. Early Rehabilitation resulted in estimated cost savings of up	17

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
restoration program + 1 year follow-up call Setting: NR Area of rehabilitation: Musculoskeletal Specific area: PT, OT Funding: Other	Condition: Experienced a workplace related injury which has resulted in symptoms past 4 months and where surgery has been not been fully effective or injury was inoperative, and individual remains unable to return to work Number of interventions: 3 Comparators: 1. Early rehabilitation 2. Intermediate duration 3. Delayed rehabilitation Total sample size: Total N=1,119; 1. Early rehabilitation n=373; 2. Intermediate rehabilitation n=373; 3. Delayed rehabilitation n=373	Outcome for economic evaluation: Estimated cost of illness over the entire duration of disability includes the sum of the estimated medical, disability benefits, and productivity losses Measurement preference-based outcome: NR Model used: Logistic regression analysis Willingness to pay threshold: NR Software used: NR	to 72% (or almost \$170,000 per claim). Conclusions: Duration of disability does not negatively impact objective work or healthcare utilization outcomes following interdisciplinary FR. However, early rehabilitation is more likely to be a cost-effective solution compared to cases that progress >8 months and receiving FR as a treatment of "last resort".	
Tosh, 2014[132] Country: UK Design: Randomized controlled trial	Objectives: To assess the cost-effectiveness of a pragmatic exercise intervention in conjunction with usual care compared to usual care only in people with	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, net monetary benefit Perspective: Public health payer	Results: The incremental cost per QALY of the intervention was £10,137/QALY gained compared to usual care. The probability of being cost-effective at a £20,000/QALY	22

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Study length: 9 months Setting: Community/home, other Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Foundation	mild to moderate multiple sclerosis. Condition: Multiple sclerosis (MS) Number of interventions: 2 Comparators: 1. Usual care 2. EXIMS Total sample size: Total N=120; 1. Usual care n=60; 2. EXMIS n=60	Time horizon: 9 months Discount rate: No discount; study states not necessary with a 9-month time horizon Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D and SF-6D utilities by extracting from the Multiple Sclerosis Quality of Life - 54 Model used: Ordinary least squares regression Willingness to pay threshold: £20,000/QALY Software used: STATA 12, Excel 2010	threshold was 0.75, rising to 0.78 at a £30,000/QALY threshold. Conclusions: The pragmatic exercise intervention is highly likely to be cost-effective at current established thresholds, and there is scope for it to be tailored to subgroups of patients or services to reduce its cost impact.	
Treacy, 2018[133] Country: Australia Design: Randomized controlled trial Study length: 3 months	Objectives: To determine if people admitted for inpatient rehabilitation can be more cost-effective with the addition of standing balance circuit classes compared to usual care.	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER Perspective: Other Time horizon: NR Discount rate: NR Outcome for economic evaluation: Expense differences	Results: The median cost savings for the intervention group was AUD 4,741 (95% CI 137 to 9,372) per participant; 94% of bootstraps showed that the intervention was both effective and cost-saving.	17

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Setting: Inpatient (hospital) Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Foundation	Condition: Admitted to the general rehabilitation hospital in Sydney, Australia Number of interventions: 2 Comparators: 1. Intervention 2. Control Total sample size: Total N=162 1. Intervention n=81; 2. Control n=81	for the hospital between the control and intervention group Measurement preference-based outcome: NR Model used: NR Willingness to pay threshold: NR Software used: STATA v. 13	Conclusions: Two weeks of additional standing balance circuit classes delivered in addition to usual therapy resulted in decreased healthcare costs at 3 months in hospital inpatients admitted for rehabilitation. There is a high probability that this intervention is both cost saving and effective.	
van de Graff, 2020[134] Country: Netherlands Design: Randomized controlled trial Study Length: 24 Months Area of Rehabilitation: Musculoskeletal Specific Area: PT	Objectives: To examine whether physical therapy (PT) is cost-effective compared with arthroscopic partial meniscectomy (APM) in patients with a non-obstructive meniscal tear, we performed a full trial-based economic evaluation from a societal perspective. Condition: Non-obstructive meniscal tear Number of Interventions: 2 Comparators: 1. PT Group	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: EQ-5D-5L Model used: Model-based economic evaluation	Results: PT was associated with significantly lower costs after 24 months compared with APM (–EUR 1803; 95% CI –EUR 3008 to –EUR 838). The probability of PT being cost-effective compared with APM was 1.00 at a willingness to pay of EUR 0/unit of effect for the IKDC (knee function) and QALYs (quality of life) and decreased with increasing values of willingness to pay. Conclusions: The probability of PT being cost-effective	CHEE RS Score: 20

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Funding: The Netherlands Organization for Health Research and Development	2. Arthroscopic Partial Meniscectomy (APM) Group Total sample size: Total N=319; 1. APM Group n=158; 2. PT Group n=161	Willingness to pay threshold: Between EUR 10,000 and EUR 80,000 per QALY Software used: STATA V.14	compared with APM was relatively high at reasonable values of willingness to pay for the IKDC and QALYs. Also, PT had a relatively high probability of being non-inferior to APM for both outcomes.	
van den Houten, 2016[135] Country: Netherlands Design: Markov model Study length: Modeled for 5 years Setting: Inpatient (hospital), outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Academic	Objectives: To incorporate current evidence on the costs and effectiveness of supervised exercise therapy (SET) and endovascular revascularization (ER) into a clinical decision model, and to evaluate the cost-effectiveness of a SET-first strategy (with ER in the event of SET failure) compared with an ER-first strategy for the management of intermittent claudication Condition: Intermittent claudication Number of interventions: 2 Comparators:	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, incremental cost-effectiveness plane, CEAC Perspective: Public health payer Time horizon: 5 years Discount rate: Future costs and outcomes were discounted at a rate of 4% and 1.5% respectively Outcome for economic evaluation: QALYs, total costs (reported in EUR), ICER Measurement preference-based outcome: EQ-5D Model used: Markov model Willingness to pay threshold: EUR 40,000/QALY was used as	Results: Considering a 5-year time horizon, probabilistic sensitivity analysis revealed that SET was associated with cost savings compared with ER (–EUR 6,412, 95% credibility interval (CrI) – 11,874 to –1,939). The mean difference in effectiveness was –0.07 (95% CrI –0.27 to 0.16) QALYs. ER was associated with an additional EUR 91,600/QALY gained compared with SET. One-way sensitivity analysis indicated more favourable cost-effectiveness for ER in subsets of patients with low QoL scores at baseline.	21

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
	1. Supervised Exercise Therapy (SET) 2. Endovascular Revascularization (ER) Total sample size: NR	this is close to the commonly used threshold of EUR 50,000/QALY Software used: Excel 2010	Conclusions: SET is a more cost-effective primary treatment for intermittent claudication than ER.	
van Dongen, 2016[136] Country: Netherlands Design: Randomized controlled trial Study length: 52 weeks Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Industry	Objectives: To evaluate the societal cost-effectiveness of manual therapy according to the Utrecht School (MTU) in comparison with PT in sub-acute and chronic non-specific neck pain patients. Condition: Adults (18-70 years) who had neck pain Number of interventions: 2 Comparators: 1. MTU group (manual therapy) 2. PT group Total sample size: Total N=181; 1. MTU group n=90; 2. PT group n=91	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, QALY Perspective: Societal Time horizon: NR Discount rate: No discount; deemed not necessary due to the 52-week follow-up Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D, SF-6D Model used: Linear regression analysis Willingness to pay threshold: NR Software used: STATA v. 12	Results: An additional recovered patient in the MTU group compared to the PT group was associated with a societal cost saving of EUR 1,024. For 1 additional point improvement on the NDI-DV was associated with a societal cost saving of EUR 92. For one QALY lost it was associated with a societal cost saving of EUR 14,561. Conclusions: MTU was not cost-effective compared with PT among sub-acute and chronic non-specific neck pain patients for perceived recovery, functional status, and QALYs.	17

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
van Eeden, 2015[137] Country: Netherlands Design: Randomized controlled trial Study length: 12 months Setting: Outpatient/clinics Area of rehabilitation: Neurology Specific area: OT Funding: Academic	Objectives: To report on a cost-effectiveness and cost-utility evaluation of a cognitive behavioural therapy (CBT) augmented with occupational and movement therapy to support patients with a stroke with depressive symptoms in goal setting and goal attainment in comparison with a computerized cognitive training program (CogniPlus) as a control intervention Condition: Stroke with depressive symptoms Number of interventions: 2 Comparators: 1. Augmented CBT intervention 2. Control group Total sample size: Total N=61; 1. Augmented CBT n=31; 2. CogniPlus n=30	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER; cost-effectiveness, cost-effectiveness planes and a CEAC Perspective: Societal Time horizon: 12 months Discount rate: Discounting was reported not necessary since the follow-up period of the current study did not exceed 1 year Outcome for economic evaluation: Hospital Anxiety and Depression Score, QALYs to measure change in HRQoL Measurement preference-based outcome: EQ-5D-3L Model used: Multiple imputation Willingness to pay threshold: EUR 40,000/QALY Software used: SPSS v. 21, Excel	Results: The average total societal costs were not significantly different between the control group (EUR 9,998.3) and the augmented CBT group (EUR 8,063.7) (95% CI -5,284 to 1,796). The cost-effectiveness and cost-utility analyses provided greater effects and fewer costs for the augmented CBT group, and fewer effects and costs for the HADS. Conclusions: The stroke-specific augmented CBT intervention did not show convincing cost-effectiveness results. However, as the study showed a 76% chance of being cost-effective for one outcome measure (QALY) and did not provide convincing cost-effectiveness results on the HADS.	20

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Van Waart, 2017[138] Country: Netherlands Design: Randomized controlled trial Study length: 6 months Setting: Outpatient/clinics Area of rehabilitation: Multisystem Specific area: PT Funding: Government, foundation, industry	Objectives: To evaluate the cost-utility and cost-effectiveness of Onco-Move and OnTrack for breast cancer patients. Condition: Breast cancer Number of interventions: 3 Comparators: 1. OnTrack intervention 2. Onco-Move 3. Usual care (UC) Total sample size: 1. OnTrack n=76; 2. Onco-Move n=77; 3. UC n=77	Type of economic evaluation: Cost-effectiveness analysis, cost-utility analysis Unit of economic analysis: ICER, CEAC Perspective: Societal Time horizon: 6 months Discount rate: NA; less than 1 year Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D-3L Model used: Linear regression Willingness to pay threshold: EUR 20,000-80,000 Software used: STATA	Results: ICERs for OnTrack compared to UC were EUR 26,916/QALY, EUR 788/1-point decrease in general fatigue, and EUR 1,402/1-point decrease in physical fatigue. The probability of OnTrack being cost-effective ranged from 31% at a willingness to pay of EUR 0, 79% at EUR 80,000/QALY, 97% at EUR 15,000/1-point decrease in general fatigue, and 86% at EUR 24,000/1-point decrease in physical fatigue. Conclusions: Onco-Move is not likely to be cost-effective. Depending on the decision-makers' willingness to pay, OnTrack could be considered cost-effective in comparison with UC.	14
Vavrek, 2014[139] Country: USA	Objectives: To report the incremental costs and benefits of different doses of spinal manipulative therapy (SMT)	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: Other, direct and indirect healthcare costs	Results: Cost of treatment and lost productivity ranged from \$3,398 for 12 SMT sessions to \$3,815 for 0 SMT	14

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Design: Randomized controlled trial Study length: 52 weeks Setting: NR Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Other	in patients with chronic low back pain (LBP). Condition: Current episode of chronic LBP Number of interventions: 4 Comparators: 1. SMT none 2. SMT 6 3. SMT 12 4. SMT 18 Total sample size: Total N=390; 1. SMT none n=95; 2. SMT 6 n=99; 3. SMT 12 n=96; 4. SMT 18 n=100	Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: Multiple linear regression and log-transformation Willingness to pay threshold: NR Software used: STATA v. 11, SAS 9.2	sessions with no statistically significant differences between groups. No statistically significant group differences in QALYs were noted. An incremental benefit of 23 PFDs and 19 DFDs from 12 spinal manipulation treatments relative to a no manipulation control. Conclusions: A dose of 12 SMT sessions yielded a modest benefit in pain-free and disability free days.	
Von Bargaen, 2015[140] Country: USA Design: Markov model Study length: Modelled for lifetime Setting: NR	Objectives: To investigate the cost utility of nonsurgical versus surgical treatments for stress urinary incontinence. Condition: Stress urinary incontinence (SUI) Number of interventions: 5 Comparators: 1. Pelvic floor muscle training (PFMT)	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: Other, incremental society cost and cost acceptability curve Perspective: Societal Time horizon: Lifetime Discount rate: 0.03 Outcome for economic evaluation: QALYs, initial health	Results: Incontinence pessary was the most cost-effective treatment option with a cost of USD 11,411 for 18.9 QALYs. At a willingness to pay (WTP) threshold of USD 50,000, incontinence pessary remained the most cost-effective treatment option. At a WTP threshold of USD 60,000 surgery became	12

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Other	2. PFMT with electrical stimulation 3. Pessary use 4. Surgical options 5. Expectant management Total sample size: NR	plan cost, initial patient cost, and Initial society cost Measurement preference-based outcome: NA Model used: Markov model Willingness to pay threshold: Both USD 50,000 and USD 60,000 were considered Software used: TreeAgePro 2008	the most cost-effective treatment option. Conclusions: Surgical correction is likely the most cost-effective treatment option for young health women with SUI. Results are driven by the high success rate of minimally invasive slings.	
Vos, 2018[141] Country: Netherlands Design: Randomized controlled trial Study length: 26 weeks Setting: Inpatient (hospital) Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Other	Objectives: To determine the cost-effectiveness and cost utility of arthrocentesis as an initial treatment for temporomandibular joint (TMJ) arthralgia compared to usual care. Condition: Diagnosed with arthralgia and persistent pain after 2 weeks of medication Number of interventions: 2 Comparators: 1. Arthrocentesis 2. Usual care Total sample size:	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: ICER, QALY Perspective: Societal Time horizon: NR Discount rate: NR Outcome for economic evaluation: A questionnaire on costs that focused on healthcare consumption during the previous 3, 9, and 14 weeks; also used QALYs Measurement preference-based outcome: EQ-5D	Results: TMJ pain declined more quickly in the arthrocentesis group than in the usual care group (regression coefficient B=-10.76; 95% CI -17.75 to -3.77; p=0.003). The estimated mean total (i.e., societal) cost over 26 weeks was EUR 589 (USD 795) in the arthrocentesis group and EUR 1,680 (USD 2,266) in the usual care group. Conclusions: From an economic perspective, arthrocentesis may be superior to usual care for the	20

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
	Total N=80; 1. Arthrocentesis n=40; 2. Usual care n=40	Model used: Generalized estimated equation multivariate models were assessed Willingness to pay threshold: NR Software used: STATA v. 11, SPSS v. 18.0, R 2005	initial treatment of TMJ pain, as arthrocentesis as an initial treatment seems to have better health outcomes and lower costs than the usual treatment strategy.	
Wales, 2018[142] Country: Australia Design: Randomized controlled trial Study Length: 3 Months Area of Rehabilitation: Multisystems Specific Area: OT Funding: National Health and Medical Research Council	Objectives: To compare the cost effectiveness of two occupational therapy–led discharge planning interventions from the HOME trial. Condition: Older adults hospitalized with an acute condition Number of Interventions: 2 Comparators: 1. Intervention group / Enhanced home program 2. Control / In-hospital consultation Total sample size: Total N=400; 1. Intervention n=170 ; 2. Control n=170	Type of economic evaluation: Cost-Effectiveness Analysis Unit of economic analysis: ICER Perspective: Health system Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALY Measurement preference-based outcome: S-12V2 transformed into SF-6D Model used: NA Willingness to pay threshold: NR Software used: SPSS version 19 and STATA 14.2	Results: The cost of the enhanced program was higher than that of the in-hospital consultation. However, a higher proportion of patients showed improvement in activities of daily living in the enhanced program with an incremental cost-effectiveness ratio of \$61,906.00 per person with clinically meaningful improvement. Conclusions: Health services would not save money by implementing the enhanced program as a routine intervention in medical and acute care wards.	CHEE RS Score: 14

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Werner, 2016[143] Country: Norway Design: Randomized controlled trial Study length: 12 months Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal Specific area: PT Funding: Industry	Objectives: To estimate the clinical effectiveness and cost-effectiveness of a cognitive-based education program on patients with subacute or chronic low backpain in primary care, compared to usual treatment, provided by general practitioners (GPs) and physiotherapists. Condition: Patients with subacute or chronic low back pain (LBP) Number of interventions: 2 Comparators: 1. Intervention 2. Control Total sample size: Total N=216; 1. GP with intervention n=44; 2. CP with control n=25; 3. Physiotherapist with intervention n=66; 4. Physiotherapist with control n=81	Type of economic evaluation: Cost-effectiveness analysis Unit of economic analysis: Other; probability of cost-effectiveness compared to cost-effectiveness threshold (\$/QALY) Perspective: NR Time horizon: NR Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: Mixed model analysis Willingness to pay threshold: NR Software used: NR	Results: There was a substantial improvement in function, pain, and sick leave in both groups. After 12 months the intervention group scored 0.66 RMDQ points higher than the control group (beta 0.66; 95% CI 0.56 to 1.88). There was no significant difference in QALYs in the two treatment groups; the estimated difference was 0.005 (0.016 to 0.027) in favour of the intervention. Conclusions: This study showed no clinical or health economic benefits as a result of adding a cognitive education program to usual treatment for patients with subacute and chronic LBP.	11

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEE RS score
Williams, 2015[144] Country: England Design: Randomized controlled trial Study length: 12 months Setting: Outpatient/clinics Area of rehabilitation: Musculoskeletal Specific Area: PT, OT, other rehab Funding: Government	Objectives: To estimate the clinical effectiveness and cost-effectiveness of adding an optimised exercise program for hands and upper limbs to standard care for patients with rheumatoid arthritis and to qualitatively describe the experience of participants in the trial. Condition: Rheumatoid arthritis (RA) Number of interventions: 2 Comparators: 1. Usual care 2. Usual care plus an individualized exercise program Total sample size: Total N=490; 1. Usual care n=244; 2. Usual care plus exercise program n=246	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: ICER, incremental net benefit, Expected Value of Perfect Information Perspective: Public health payer Time horizon: 1 Year Discount rate: No discounting applied as time horizon was 1 year Outcome for economic evaluation: QALYs, costs Measurement preference-based outcome: EQ-5D-3L, SF-12 Model used: Generalized linear model, Seemingly Unrelated Model Willingness to pay threshold: £30,000/QALY Software used: NR	Results: There was a statistically significant difference in favour of the exercise program for the primary outcome at 4 and 12 months (mean difference 4.6 points, 95% CI 2.2 to 7.0 points; mean difference 4.4 points, 95% CI 1.6 to 7.1 points, respectively). The estimated difference in mean QALYs accrued over 12 months was 0.01 greater (95% CI -0.03 to 0.05) in the exercise program group. Imputed analysis produced ICER estimates of £17,941 (0.59 probability of cost-effectiveness at willingness to pay threshold of £30,000/QALY). Conclusions: The results of the Strengthening And stretching for Rheumatoid Arthritis of the Hand trial suggest that the addition of an exercise program for RA hands/wrists to usual care is	21

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
			clinically effective and cost-effective when compared with usual care alone.	
Zingmark, 2017[145] Country: Sweden Design: Prospective cohort study Study length: Cycle in the Markov model was 1 year Setting: Community/home Area of rehabilitation: Musculoskeletal Specific area: OT, other rehab Funding: Industry	Objectives: To evaluate long-term cost-effectiveness of an intervention targeting bathing disability among older people. Condition: Dependency in bathing Number of interventions: 5 Comparators: 1. Mild dependency 2. Moderate dependency 3. Severe dependency 4. Total dependency 5. Death Total sample size: NA	Type of economic evaluation: Cost-utility analysis Unit of economic analysis: Total estimated annual costs for each state in the Markov model Perspective: Societal Time horizon: 8 years Discount rate: 3% at each year after the first year Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D, Health Utility Index Model used: Markov model Willingness to pay threshold: ≤EUR 11,000, ≤EUR 55,000, and a cost of >EUR 55,000 Software used: Excel 2007	Results: Over the full follow-up period, the intervention resulted in QALY gains and reduced societal cost. After 8 years, the intervention resulted in 0.052 QALYs gained and reduced societal costs by EUR 2,410 per person. Conclusions: An intervention targeting bathing disability among older people presents a cost-effective use of resources and leads to both QALY gains and reduced societal costs over 8 years.	21
Zwerink, 2016[146]	Objectives: To identify if a community-based exercise program (the COPE-active	Type of economic evaluation: Cost-effectiveness analysis	Results: The number of QALYs was not statistically significantly different	19

Study information	Objectives, interventions, sample characteristics	Economical evaluation details	Results and conclusions	CHEERS score
Country: Netherlands Design: Randomized controlled trial Study length: 24 months Setting: Community/home Area of rehabilitation: Cardiorespiratory Specific area: PT Funding: Foundation	program) is a cost-effective component of a self-management program after 2 years of follow up. Condition: Adults between 40 and 75 years with a clinical diagnosis of COPD Number of interventions: 2 Comparators: 1. COPE-active 2. Control (self-management program only) Total sample size: Total N=153; 1. COPE-active n=77; 2. Control n=76	Unit of economic analysis: ICER Perspective: Public health payer Time horizon: Analysis for both 12 months and 24 months Discount rate: NR Outcome for economic evaluation: QALYs Measurement preference-based outcome: EQ-5D Model used: Decision analytic model Willingness to pay Threshold: EUR 48,000-50,000 for the Netherlands Software used: NR	between the COPE-active and control group. The small between-group difference in QALYs led to relatively high additional costs (EUR 10,950) for each QALY gained. Conclusions: Although the COPE-active program is effective in achieving a sustained behavioural change toward physical activity, the long-term effect on exercise capacity is small and not distinguishable from chance. In combination with higher costs, the community-based exercise program cannot be considered cost-effective.	

Appendix 3. CHEERS evaluation

	Total Items: Yes	Item 24 Conflict Interest	Item 23 Source Funding	Item 22 Discussion Findings	Item 21 Heterogeneity	Item 20b Uncertainty Model Based	Item 20a Uncertainty Single Study	Item 19 Incremental Cost Outcomes	Item18 Study Parameters	Item 17 Analytic Methods	Item 16 Assumptions	Item 15 Choice Model	Item 14 Currency Price Conversion	Item 13b Model Based Econ. Evaluation	Item13a Single Study based Econ. Evaluation	Item 12 Measurement Preference	Item 11b Synthesis Base estimates	Item 11a Single Study Base Estimates	Item 10 Choice Health Outcomes	Item 9 Discount Rate	Item 8 Time Horizon	Item 7 Comparators	Item 6 Perspective	Item 5 Setting	Item 4 Target Population	Item 3 Objectives	Item2 Abstract	Item1Title	Author, Year
	22	Y	Y	Y	Y	NA	Y	Y	Y	Y	NA	Y	Y	NA	Y	Y	NA	Y	Y	Y	P	Y	Y	Y	Y	Y	Y	Y	Abbott, 2019 [18]
	11	Y	P	P	NA	NA	P	Y	P	N	N	N	P	NA	Y	Y	NA	P	P	Y	Y	N	Y	P	Y	Y	P	Y	Aboagye, 2015 [19]
	17	N	Y	Y	NA	Y	NA	Y	Y	Y	Y	P	P	Y	NA	Y	Y	NA	Y	Y	N	P	Y	P	Y	Y	Y	Y	Ademi, 2016 [20]
	8	Y	Y	P	N	NA	Y	P	P	P	N	N	P	NA	P	Y	NA	P	P	Y	N	Y	N	Y	P	P	P	Y	Adie, 2017 [21]
	17	Y	P	Y	NA	Y	Y	P	Y	Y	Y	P	P	Y	Y	Y	NA	Y	P	Y	N	Y	N	Y	Y	Y	Y	Y	Albert, 2016 [22]
	19	Y	Y	Y	NA	Y	NA	Y	Y	Y	Y	P	N	Y	NA	Y	P	P	Y	Y	P	Y	Y	Y	Y	Y	Y	Y	Allen, 2018 [23]
	14	Y	Y	Y	NA	NA	P	Y	Y	P	N	P	P	NA	Y	NA	NA	P	P	Y	Y	Y	Y	Y	Y	Y	P	Y	Andelic, 2014 [24]
	18	Y	Y	Y	NA	NA	Y	Y	Y	Y	NA	N	N	NA	Y	Y	NA	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Arias-Buria, 2018 [25]
	21	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	NA	Y	Y	NA	Y	Y	Y	P	Y	Y	Y	Y	Y	P	Y	Barker, 2020 [26]
	16	Y	Y	Y	NA	NA	P	P	Y	Y	N	Y	Y	N	Y	Y	NA	P	P	Y	N	Y	N	Y	Y	Y	Y	Y	Barnhoorn, 2018 [27]
	21	Y	Y	Y	NA	NA	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	NA	P	P	Y	Y	Y	Y	Y	Y	Y	P	P	Beaupre, 2020 [28]
	19	Y	Y	Y	NA	NA	Y	Y	Y	P	NA	NA	NA	NA	Y	Y	NA	NA	Y	Y	Y	Y	Y	Y	P	Y	Y	Y	Bornhoft, 2019 [29]

Bove, 2017 [30]	Y	Y	Y	Y	Y	Y	Y	P	Y	Y	NA	Y	Y	NA	Y	N	Y	Y	Y	Y	Y	NA	Y	Y	Y	Y	Y	22
Brodin, 2015 [31]	Y	P	Y	Y	P	Y	Y	N	N	Y	P	NA	Y	Y	NA	Y	N	N	N	P	Y	N	NA	Y	Y	Y	Y	14
Brusco, 2015 [32]	Y	P	Y	N, UC	Y	Y	Y	UC	N	Y	P	NA	Y	Y	NA	Y	N	N	N	P	Y	P	NA	NA	Y	Y	Y	13
Burge, 2020 [33]	Y	P	Y	P	Y	Y	Y	P	Y	Y	Y	NA	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	NA	Y	P	Y	Y	19
Burns, 2016 [34]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	Y	Y	Y	NA	NA	Y	Y	Y	23
Canaway, 2018 [35]	Y	Y	Y	Y	Y	Y	Y	P	Y	Y	Y	NA	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	NA	Y	Y	P	Y	21
Cheng, 2016 [36]	Y	P	Y	P	Y	Y	Y	Y	Y	Y	NA	P	Y	NA	Y	P	Y	Y	Y	Y	Y	NA	Y	NA	Y	P	Y	18
Coombes, 2016 [37]	Y	Y	Y	Y	Y	Y	Y	P	Y	Y	P	NA	Y	Y	NA	Y	P	N	N	Y	Y	P	NA	NA	Y	Y	Y	17
Cuperus, 2016 [38]	Y	Y	Y	Y	Y	Y	Y	P	Y	Y	Y	NA	Y	Y	NA	Y	P	N	Y	Y	Y	Y	NA	NA	Y	N	N	19
D'Amico, 2016 [39]	Y	Y	Y	Y	P	Y	Y	N	Y	P	P	NA	Y	Y	NA	P	Y	Y	Y	Y	Y	Y	NA	NA	Y	Y	Y	18
Dang, 2017 [40]	Y	Y	Y	N	N	Y	Y	Y	P	P	NA	N	NA	NA	P	P	Y	Y	Y	Y	Y	NA	Y	NA	Y	N	Y	14
Davis, 2017 [41]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	NA	Y	P	N	Y	P	Y	P	NA	NA	Y	Y	Y	20
Davis, 2015 [42]	Y	P	Y	Y	P	Y	Y	Y	Y	Y	Y	NA	NA	Y	NA	Y	Y	N	P	Y	Y	Y	NA	NA	Y	Y	Y	18
De Vries, 2016 [43]	Y	Y	Y	Y	Y	Y	Y	N	N	Y	P	NA	Y	Y	NA	P	Y	P	Y	Y	Y	Y	NA	NA	Y	P	Y	17
Dehbaraz, 2015 [44]	Y	Y	Y	Y	Y	Y	Y	N	N	P	Y	NA	Y	Y	NA	Y	N	Y	Y	P	Y	Y	NA	NA	Y	Y	Y	18
Den Hollander, 2018 [45]	Y	Y	Y	Y	Y	Y	Y	P	N	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	N	Y	21
Diddens, 2017 [46]	Y	Y	Y	P	Y	Y	Y	P	N	Y	NA	N	P	NA	Y	P	P	Y	Y	Y	P	NA	Y	NA	Y	P	N	13
Dritsaki, 2016 [47]	Y	Y	Y	Y	P	P	Y	P	N	Y	Y	NA	Y	Y	NA	Y	Y	N	Y	P	Y	Y	NA	NA	Y	P	Y	16
Ehlken, 2014 [48]	Y	P	Y	Y	Y	N	Y	N	N	Y	NA	P	Y	NA	Y	N	Y	N	N	Y	Y	NA	N	NA	Y	P	UC	12

Essex, 2017 [49]	Y	P	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	NA	Y	N	N	P	P	Y	P	NA	NA	Y	UC	UC	1 5
Fairhall, 2015 [50]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	NA	Y	N	N	P	Y	Y	Y	NA	Y	Y	Y	P	2 0
Farg, 2016 [51]	Y	P	Y	Y	P	Y	Y	N	N	Y	Y	NA	Y	Y	NA	P	N	N	Y	Y	Y	Y	NA	Y	Y	P	Y	1 6
Farg, 2015 [52]	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	NA	Y	Y	NA	Y	N	N	Y	Y	Y	Y	NA	Y	Y	Y	Y	2 0
Farquhar , 2014 [53]	Y	P	Y	Y	P	N	Y	N	N	Y	Y	NA	Y	Y	NA	Y	Y	N	Y	Y	Y	Y	NA	NA	Y	Y	Y	1 7
Fatoye, 2016 [54]	Y	P	Y	Y	P	Y	Y	Y	N	P	NA	N	Y	NA	Y	P	Y	Y	Y	Y	Y	NA	Y	NA	Y	Y	UC	1 6
Fernande s, 2017 [55]	Y	Y	Y	Y	P	Y	Y	Y	Y	Y	P	NA	Y	Y	NA	Y	N	N	P	P	Y	P	NA	Y	Y	Y	Y	1 7
Fernande z, 2019 [56]	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	NA	Y	Y	NA	N	NA	NA	Y	Y	Y	Y	NA	NA	Y	Y	Y	1 8
Frederix, 2016 [57]	Y	P	Y	Y	Y	P	Y	N	N	Y	Y	NA	Y	Y	NA	P	P	Y	Y	Y	Y	P	NA	NA	Y	Y	Y	1 6
Freeman, 2019 [58]	Y	Y	Y	Y	Y	Y	Y	P	Y	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	Y	Y	2 3
Fritz, 2017 [59]	Y	P	Y	Y	P	Y	Y	N	N	Y	P	NA	Y	Y	NA	Y	P	Y	Y	Y	Y	Y	NA	NA	Y	P	N	1 5
Fusco, 2016 [60]	Y	Y	Y	Y	Y	Y	Y	Y	P	Y	NA	P	Y	NA	Y	Y	Y	Y	Y	Y	Y	NA	Y	NA	Y	Y	UC	2 0
Fusco, 2019 [61]	Y	Y	P	Y	Y	Y	Y	Y	N	P	Y	NA	Y	Y	NA	Y	NA	Y	Y	Y	Y	Y	NA	NA	Y	Y	Y	1 9
Gillespie, 2013 [62]	Y	Y	Y	N	Y	Y	Y	P	Y	Y	Y	NA	P	Y	NA	P	Y	Y	Y	Y	Y	Y	NA	NA	Y	Y	P	1 8
Gordon, 2017 [63]	Y	Y	Y	Y	P	Y	P	P	N	Y	P	NA	Y	Y	NA	Y	P	N	N	Y	Y	P	NA	Y	Y	Y	Y	1 5
Hahne, 2017 [64]	Y	Y	Y	P	Y	Y	Y	P	P	Y	Y	NA	Y	Y	NA	Y	Y	N	Y	Y	Y	Y	NA	Y	Y	P	N	1 8
Hansen, 2017 [65]	Y	Y	Y	P	N	Y	Y	Y	Y	Y	P	NA	Y	Y	NA	Y	N	N	N	N	Y	P	NA	NA	Y	P	Y	1 4
Hautala, 2017 [66]	Y	P	Y	Y	P	N	Y	Y	Y	Y	Y	NA	Y	Y	NA	Y	N	N	N	N	Y	P	NA	N	Y	P	Y	1 4
Hewitt, 2019 [67]	Y	Y	Y	Y	Y	Y	P	Y	Y	P	Y	NA	P	Y	NA	Y	P	P	P	P	Y	Y	NA	NA	Y	Y	Y	1 6

Hollinghurst, 2013 [68]	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	NA	Y	Y	N	Y	Y	Y	Y	NA	Y	Y	Y	Y	22
Hwang, 2019 [69]	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	NA	Y	Y	NA	Y	Y	NA	Y	P	Y	Y	NA	NA	P	Y	Y	18
Jansons, 2018 [70]	Y	Y	Y	Y	Y	Y	Y	P	N	Y	P	NA	Y	Y	NA	P	P	N	Y	Y	P	Y	NA	NA	Y	Y	Y	16
Janssen, 2014 [71]	Y	P	Y	Y	Y	Y	Y	Y	Y	Y	P	NA	NA	Y	NA	Y	P	Y	Y	Y	Y	Y	NA	NA	Y	Y	Y	19
Jha, 2018 [72]	N	Y	Y	Y	Y	Y	P	N	N	Y	Y	NA	Y	Y	NA	P	NA	NA	Y	Y	P	Y	NA	Y	Y	Y	Y	16
Johnsen, 2014 [73]	Y	P	Y	P	N	Y	Y	N	N	Y	P	NA	Y	Y	NA	P	N	N	Y	Y	Y	Y	NA	NA	Y	P	N	12
Johnson, 2015 [74]	N	Y	Y	Y	Y	N	Y	N	N	Y	Y	NA	Y	N	NA	N	Y	N	Y	Y	N	N	NA	Y	P	Y	Y	14
Joseph, 2019 [75]	Y	P	Y	Y	P	N	Y	N	N	Y	Y	NA	Y	Y	NA	Y	NA	NA	Y	Y	Y	Y	NA	NA	Y	Y	Y	16
Jowett, 2013 [76]	Y	P	Y	Y	P	P	P	N	Y	Y	P	NA	P	Y	NA	Y	N	Y	Y	Y	P	Y	NA	Y	Y	P	Y	14
Kampshoff, 2018 [77]	Y	Y	Y	Y	P	P	Y	N	P	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	P	Y	Y	NA	NA	Y	Y	Y	18
Kang, 2017 [78]	Y	N	Y	P	P	P	Y	N	Y	Y	NA	Y	Y	NA	Y	P	Y	P	P	P	Y	NA	Y	Y	Y	P	Y	14
Karnon, 2017 [79]	Y	P	Y	P	Y	Y	N	P	Y	Y	NA	P	NA	NA	N	Y	Y	Y	Y	Y	Y	NA	Y	Y	Y	P	Y	16
Khodakarami, 2020 [80]	N	P	Y	Y	P	N	Y	N	P	Y	NA	Y	Y	NA	Y	Y	P	Y	Y	Y	Y	NA	Y	NA	Y	Y	Y	16
Kidholm, 2016 [81]	Y	Y	Y	Y	Y	Y	P	N	N	Y	Y	NA	Y	Y	NA	Y	N	N	Y	Y	Y	Y	NA	Y	Y	P	UC	17
Kigozi, 2018 [82]	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	NA	Y	NA	NA	Y	Y	Y	Y	NA	NA	Y	Y	Y	20
Kloek, 2018 [83]	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	Y	Y	23
Kraal, 2017 [84]	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	NA	Y	Y	NA	Y	Y	N	Y	Y	Y	Y	NA	NA	Y	Y	Y	20
Krist, 2013 [85]	N	P	Y	Y	Y	Y	Y	N	N	Y	P	NA	Y	Y	NA	P	Y	P	Y	Y	P	Y	NA	NA	Y	Y	Y	18
Lamb, 2018 [86]	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	NA	Y	NA	NA	Y	Y	Y	Y	NA	Y	Y	Y	Y	21
Legget, 2015 [87]	Y	Y	Y	Y	Y	Y	P	P	P	Y	NA	P	Y	NA	Y	Y	P	Y	Y	Y	Y	NA	Y	Y	Y	Y	N	18

Leininger, 2016 [88]	Y	Y	Y	Y	Y	Y	Y	Y	P	Y	Y	NA	Y	Y	NA	Y	Y	N	Y	Y	Y	Y	NA	NA	Y	Y	N	20
Lewis, 2015 [89]	Y	P	P	Y	Y	Y	Y	N	N	Y	P	NA	Y	Y	NA	Y	N	N	P	P	Y	P	NA	NA	Y	Y	Y	13
Li, 2015 [90]	Y	Y	Y	P	P	Y	Y	Y	Y	Y	P	NA	Y	P	NA	Y	N	N	N	N	Y	N	NA	Y	Y	Y	Y	15
Lilje, 2014 [91]	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	NA	Y	Y	NA	P	N	Y	P	P	Y	N	NA	NA	Y	N	Y	15
Lodhia, 2016 [92]	Y	Y	Y	Y	Y	P	P	Y	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	Y	Y	Y	22
Longacre, 2020 [93]	Y	P	Y	P	Y	N	Y	P	N	Y	NA	P	Y	NA	Y	P	P	Y	Y	N	Y	NA	Y	NA	P	P	N	11
Ludvigsson, 2017 [94]	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	NA	P	Y	Y	Y	Y	Y	Y	NA	NA	Y	Y	Y	21
Maddison, 2015 [95]	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	NA	Y	Y	Y	Y	Y	N	Y	Y	Y	P	NA	NA	Y	Y	N	18
Manning, 2015 [96]	Y	Y	Y	P	Y	Y	P	N	Y	Y	Y	NA	Y	Y	NA	P	N	Y	Y	Y	Y	Y	NA	Y	Y	P	N	17
Marks, 2016 [97]	Y	N	Y	Y	Y	Y	Y	Y	N	Y	P	NA	Y	N	NA	P	N	N	N	N	Y	P	NA	NA	Y	Y	Y	13
Marra, 2014 [98]	Y	Y	Y	Y	P	Y	Y	Y	N	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	Y	Y	Y	NA	NA	Y	N	UC	19
Marsh, 2016 [99]	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	NA	P	Y	NA	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	Y	Y	21
Maru, 2019 [100]	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	NA	Y	NA	Y	Y	P	Y	Y	NA	Y	Y	Y	Y	21
Matchar, 2019 [101]	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	NA	P	NA	NA	Y	P	Y	Y	NA	Y	Y	Y	N	18
Mazari, 2013 [102]	Y	P	Y	N	N	Y	N	N	N	Y	P	NA	P	Y	NA	Y	P	Y	Y	Y	Y	P	NA	NA	Y	N	Y	12
McLean, 2015 [103]	Y	Y	Y	Y	Y	Y	Y	P	Y	Y	NA	Y	Y	NA	Y	P	Y	Y	Y	Y	Y	NA	Y	Y	Y	Y	Y	22

Milte, 2016 [104]	Y	Y	Y	Y	Y	Y	Y	P	Y	Y	Y	NA	Y	Y	NA	Y	N	P	P	Y	Y	Y	NA	NA	Y	P	N	19
Miyamoto, 2018 [105]	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	NA	Y	Y	NA	Y	P	Y	Y	NA	NA	Y	Y	Y	20
Mortimer, 2019 [106]	Y	Y	Y	Y	Y	Y	Y	P	Y	Y	Y	NA	NA	Y	NA	Y	Y	Y	P	Y	P	Y	NA	NA	Y	Y	N	18
Nagayama, 2016 [107]	Y	Y	Y	Y	Y	N	Y	N	N	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	Y	Y	N	NA	NA	Y	Y	N	18
Neilson, 2019 [108]	Y	Y	Y	Y	Y	Y	Y	P	Y	P	Y	NA	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	NA	NA	Y	Y	N	19
Nicolian, 2019 [109]	Y	Y	Y	Y	Y	Y	Y	P	Y	Y	Y	NA	NA	Y	NA	Y	NA	NA	Y	P	Y	Y	NA	Y	Y	Y	Y	19
Oestergaard, 2013 [110]	Y	Y	Y	Y	Y	Y	P	N	N	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	Y	Y	Y	NA	NA	Y	N	N	18
Oosterhuis, 2017 [111]	Y	P	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	NA	Y	P	N	P	Y	Y	Y	NA	NA	Y	Y	Y	19
Oppong, 2015 [112]	Y	Y	Y	Y	P	Y	Y	P	N	Y	P	NA	Y	Y	NA	Y	Y	P	P	P	Y	P	NA	NA	Y	Y	Y	15
Panman 2016 [113]	Y	Y	Y	Y	Y	N	Y	N	N	Y	Y	NA	Y	P	NA	Y	Y	Y	Y	Y	Y	P	NA	NA	Y	Y	Y	19
Patil, 2015 [114]	Y	Y	Y	P	Y	Y	Y	N	N	Y	Y	NA	NA	Y	NA	P	N	Y	Y	Y	Y	Y	NA	NA	Y	N	N	15
Paulsen, 2020 [115]	Y	Y	Y	Y	Y	Y	Y	N	P	Y	Y	NA	Y	Y	NA	Y	NA	Y	Y	Y	Y	Y	NA	NA	Y	Y	Y	20
Pinto, 2013 [116]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	Y	Y	24
Retel, 2016 [117]	Y	Y	Y	Y	Y	Y	P	P	Y	Y	NA	P	Y	NA	Y	P	Y	Y	Y	Y	Y	NA	Y	NA	Y	N	Y	18

Reynolds , 2014 [118]	Y	P	Y	P	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	22
Richards on, 2014 [119]	Y	P	Y	Y	Y	Y	Y	P	Y	Y	NA	P	Y	NA	P	P	Y	Y	Y	Y	P	NA	Y	NA	Y	N	Y	16
Rincon, 2016 [120]	Y	Y	Y	Y	Y	Y	Y	Y	P	P	NA	Y	Y	NA	Y	Y	Y	Y	Y	Y	Y	NA	Y	NA	Y	Y	Y	21
Rodgers, 2019 [121]	Y	Y	Y	Y	Y	P	Y	N	P	P	Y	NA	Y	P	NA	Y	Y	NA	P	P	P	Y	NA	NA	Y	Y	Y	14
Rome, 2017 [122]	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	NA	P	Y	NA	Y	NA	N	Y	Y	P	P	NA	NA	P	P	N	13
Saha, 2019 [123]	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	NA	Y	Y	NA	Y	NA	NA	Y	P	Y	Y	NA	Y	Y	Y	Y	20
Salisbury , 2013 [124]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	NA	Y	NA	NA	P	Y	Y	Y	NA	Y	Y	Y	Y	21
Stanmor e, 2019 [125]	Y	Y	Y	Y	Y	P	Y	N	N	Y	Y	NA	Y	N	NA	Y	Y	NA	Y	N	Y	Y	NA	NA	Y	Y	Y	17
Stewart, 2017 [126]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	NA	Y	Y	P	Y	Y	Y	Y	NA	Y	NA	Y	N	N	20
Sturkenb oom, 2015 [127]	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	NA	Y	Y	NA	P	Y	N	Y	Y	Y	Y	NA	Y	Y	Y	Y	20
Suni, 2018 [128]	Y	P	Y	Y	P	N	P	N	N	Y	Y	NA	Y	Y	NA	P	P	NA	P	P	Y	P	NA	Y	Y	Y	Y	12
Tan, 2016 [129]	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	Y	Y	Y	NA	NA	Y	Y	Y	21
Taraldse n, 2019 [130]	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	NA	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	NA	NA	Y	Y	Y	20
Theodor e, 2015 [131]	Y	P	Y	Y	Y	Y	Y	Y	N	Y	P	NA	NA	Y	NA	Y	Y	Y	Y	Y	Y	Y	NA	NA	Y	N	N	17

Tosh, 2014 [132]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	NA	P	Y	Y	Y	Y	Y	Y	NA	Y	Y	Y	UC	2 2
Treacy, 2018 [133]	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	NA	P	Y	NA	Y	N	Y	P	Y	P	Y	NA	NA	Y	Y	Y	1 7
Van de Graff, 2020 [134]	Y	Y	Y	Y	Y	P	Y	N	P	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	P	Y	Y	NA	Y	Y	Y	Y	2 0
Van den Houten, 2016 [135]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	P	Y	NA	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	NA	Y	Y	2 2
Van Dongen, 2016 [136]	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	P	NA	Y	Y	NA	Y	N	N	Y	Y	Y	Y	NA	Y	Y	Y	Y	1 7
Van Eeden, 2015 [137]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	NA	Y	P	Y	Y	Y	Y	P	NA	NA	Y	Y	Y	2 2
Van Waart, 2017 [138]	Y	Y	Y	P	P	Y	Y	P	Y	Y	P	NA	Y	Y	NA	Y	N	N	P	P	Y	Y	NA	Y	Y	P	Y	1 4
Vavrek, 2014 [139]	Y	Y	Y	Y	P	Y	Y	Y	Y	Y	P	NA	Y	Y	NA	P	Y	P	Y	Y	Y	P	NA	NA	Y	UC	UC	1 4
Von Bergen, 2015 [140]	Y	Y	Y	Y	N	P	P	P	P	Y	NA	Y	P	NA	P	Y	Y	N	N	Y	N	NA	N	NA	P	N	Y	1 0
Vos, 2018 [141]	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	NA	Y	Y	NA	Y	Y	Y	Y	Y	Y	Y	NA	NA	Y	N	Y	2 0
Wales, 2018 [142]	Y	P	Y	P	Y	Y	Y	N	Y	P	Y	NA	Y	Y	NA	Y	NA	NA	Y	P	Y	P	NA	NA	Y	P	Y	1 4
Werner, 2016 [143]	Y	P	Y	Y	Y	N	Y	N	N	P	P	NA	UC	Y	NA	P	P	P	Y	Y	Y	P	NA	NA	Y	Y	UC	1 1

Williams, 2015 [144]	Y	Y	Y	Y	Y	Y	Y	P	Y	Y	Y	NA	Y	Y	NA	N	Y	Y	Y	Y	Y	Y	NA	Y	Y	Y	N	21
Zingmark, 2017 [145]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	Y	NA	Y	P	Y	Y	Y	Y	Y	NA	Y	NA	Y	Y	UC	21
Zwerink, 2016 [146]	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	P	NA	Y	Y	NA	Y	Y	N	P	Y	Y	Y	NA	NA	Y	Y	Y	19
Total of items accomplished by studies/average	122	93	126	108	100	104	114	39	61	118	75/106	10/23	110/120	99/106	21/26	87/129	65/114	58/106	97	97	114	77/106	22/24	43/45	121/129	89	95	
% Yes	94.6%	72.1%	97.7%	83.7%	77.5%	80.6%	88.4%	30.2%	47.3%	91.5%	70.8%	43.5%	91.7%	93.4%	80.8%	67.4%	57.0%	54.7%	75.2%	75.2%	88.4%	72.6%	91.7%	95.6%	93.8%	69.0%	73.6%	

Appendix 4. Search strategy

Data Base	Date Searched	Search Terms
Medline Ovid MEDLINE(R) ALL 1946 to Feb 11, 2020	Date last searched: February 12, 2020 Results: 1123	1. exp Home Care Services/ 2. (home-support or home-care or home-health-care or home-healthcare or home-professional-service* or home-rehab* or home-nursing or home-based-care or home-based-nursing or home-based-rehab* or home-based-physical-therapy or home-based-physiotherap* or home-based-occupational-therapy).mp. 3. 1 or 2 4. exp Independent Living/ 5. (community or ((independent or family) adj3 (living or dwelling)) or "at home" or "in their own home*" or home-dwelling or ("live* with" adj3 famil*) or home-based or (home adj3 exercis*) or ((age or aging or ageing) adj3 (place or home))).mp. 6. 4 or 5 7. Geriatrics/ or Health Services for the Aged/ 8. exp aged/ 9. (retired or sarcopeni* or elder* or old* old or old age or centenarian* or nonagenarian* or octogenarian* or septuagenarian* or aging or (senior* not ((high school or university or college) adj3 senior*)) or gerontolog* or geriatric* or (mature not "mature student*") or aged adult* or aged patient* or aged individual* or aged population* or (older adj2 (client* or people or

		person* or adult* or patient* or individual* or population* or women or men))).mp. 10. 7 or 8 or 9 11. "costs and cost analysis"/ or cost-benefit analysis/ or "cost control"/ or "cost savings"/ or "cost of illness"/ or health care costs/ or health expenditures/ 12. exp models, economic/ 13. (economic adj1 (evaluat* or analys* or study or studies or assess* or consequence* or model*))).mp. 14. (cost-benefit or benefit-cost or cost utility).mp. 15. (cost consequence* or cost offset*).mp. 16. ((cost or costs) adj2 analys*).mp. 17. "cost of illness".mp. 18. (cost or costs or costing or economic* or expenditures or price or fiscal or financial or efficiency or pay or valuation or spending).ti. 19. (value adj2 (money or monetary)).mp. 20. cost effectiv*.ab. /freq=2 21. or/11-20 22. 3 and 6 and 10 and 21
Embase 1974 to 2018 February 11, 2020	Date last searched: February 12, 2020 Results: 1391	1. exp home care/ 2. (home-support or home-care or home-health-care or home-healthcare or home-professional-service* or home-rehab* or home-nursing or home-based-care or home-based-nursing or home-based-rehab* or home-based-physical-therapy or home-based-

		physiotherap* or home-based-occupational-therapy).mp. 3. 1 or 2 4. independent living/ 5. (community or ((independent or family) adj3 (living or dwelling)) or "at home" or "in their own home*" or home-dwelling or ("live* with" adj3 famil*) or home-based or (home adj3 exercis*) or ((age or aging or ageing) adj3 (place or home))).mp. 6. 4 or 5 7. elderly care/ 8. exp geriatric care/ 9. geriatrics/ 10. exp aged/ 11. (retired or sarcopeni* or elder* or old* old or old age or centenarian* or nonagenarian* or octogenarian* or septuagenarian* or aging or (senior* not ((high school or university or college) adj3 senior*)) or gerontolog* or geriatric* or (mature not "mature student*") or aged adult* or aged patient* or aged individual* or aged population* or (older adj2 (client* or people or person* or adult* or patient* or individual* or population* or women or men))).mp. 12. or/7-11 13. health economics/ 14. exp economic evaluation/ 15. "health care cost"/ 16. economic model/
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		17. (economic adj1 (evaluat* or analys* or study or studies or assess* or consequence* or model*)).mp. 18. (cost-benefit or benefit-cost or cost utility).mp. 19. (cost consequence* or cost offset*).mp. 20. ((cost or costs) adj2 analys*).mp. 21. "cost of illness".mp. 22. (cost or costs or costing or economic* or expenditures or price or fiscal or financial or efficiency or pay or valuation or spending).ti. 23. (value adj2 (money or monetary)).mp. 24. cost effectiv*.ab. /freq=2 25. or/13-24 26. 3 and 6 and 12 and 25
CINAHL Plus with Full Text (EBSCOhost interface)	Date last searched: February 12, 2020 Results 1280	Search mode: Boolean Phrase S1: (MH "Home Health Care+") OR (MH "Home Nursing") OR home-support or home-care or home-health-care or home-healthcare or home-professional-service* or home-rehab* or home-nursing or home-based-care or home-based-nursing or home-based-rehab* or home-based-physical-therapy or home-based-physiotherap* or home-based-occupational-therapy S2: (MH "Community Living") OR (community or (independent n3 (living or dwelling)) or "at home" or home-dwelling or "in their own home*" or ("liv* with" n3 famil*) or home-based or (home n3

		exercis*) or ((age or aging or ageing) n3 (place or home))) S3: (MH "Aged+") OR (MH "Geriatrics") OR (MH "Gerontologic Care") OR (retired or sarcopeni* or elder* or old* old or old age or centenarian* or nonagenarian* or octogenarian* or septuagenarian* or aging or (senior* not ((high school or university or college) N3 senior*)) or gerontolog* or geriatric* or (mature not "mature student*") or aged adult* or aged patient* or aged individual* or aged population* or (older N2 (client* or people or person* or adult* or patient* or individual* or population* or women or men))) S4:(MH "Costs and Cost Analysis") OR (MH "Cost Benefit Analysis") OR (MH "Cost Control+") OR (MH "Health Care Costs") OR (MH "Economic Aspects of Illness") OR (MH "Economic Value of Life") S5:(economic N1 (evaluat* or analys* or study or studies or assess* or consequence* or model*)) OR (cost-benefit or benefit-cost or cost utility or cost consequence* or cost offset* or "cost of illness" or ((cost or costs) N2 analys*) or (value N2 (money or monetary)) S6: TI(cost or costs or costing or economic* or expenditures or price or fiscal or financial or efficiency or pay or valuation or spending) S7: S4 OR S5 OR S6 S8: S1 AND S2 AND S3 AND S7
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Abstracts in Social Gerontology	Date last searched: February 12, 2020 Search results: 216	Search mode: Boolean Phrase S1: home-support or home-care or home-health-care or home-healthcare or home-professional-service* or home-rehab* or home-nursing or home-based-care or home-based-nursing or home-based-rehab* or home-based-physical-therapy or home-based-physiotherap* or home-based-occupational-therapy S2: (community or (independent n3 (living or dwelling)) or at-home or home-dwelling or in-their-own-home* or (liv*-with n3 famil*) or home-based or (home n3 exercis*) or ((age or aging or ageing) n3 (place or home))) S3: (retired or sarcopeni* or elder* or old* old or old age or centenarian* or nonagenarian* or octogenarian* or septuagenarian* or aging or (senior* not ((high school or university or college) N3 senior*)) or gerontolog* or geriatric* or (mature not "mature student*") or aged adult* or aged patient* or aged individual* or aged population* or (older N2 (client* or people or person* or adult* or patient* or individual* or population* or women or men))) S4:(economic N1 (evaluat* or analys* or study or studies or assess* or consequence* or model*)) OR (cost-benefit or benefit-cost or cost utility or cost consequence* or cost offset* or "cost of illness" or ((cost or costs) N2 analys*) or (value N2 (money or monetary))
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		S5: TI(cost or costs or costing or economic* or expenditures or price or fiscal or financial or efficiency or pay or valuation or spending) S6: S1 AND S2 AND S3 AND (S4 OR S5)
SCOPUS	Date last searched: February 12, 2020 Results: 1091	TITLE-ABS-KEY (home-support OR home-care OR home-health-care OR home-healthcare OR home-professional-service* OR home-rehab* OR home-nursing OR home-based-care OR home-based-nursing OR home-based-rehab* OR home-based-physical-therapy OR home-based-physiotherap* OR home-based-occupational-therapy) AND TITLE-ABS-KEY (community OR (independent W/3 (living OR dwelling)) OR at-home OR home-dwelling OR in-their-own-home* OR (liv*-with W/3 famil*) OR home-based OR (home W/3 exercis*) OR ((age OR aging OR ageing) W/3 (place OR home))) AND TITLE-ABS-KEY (retired OR sarcopeni* OR elder* OR old*-old OR old-age OR centenarian* OR nonagenarian* OR octogenarian* OR septuagenarian* OR aging OR gerontolog* OR geriatric* OR (mature AND NOT mature-student*) OR aged-adult* OR aged-patient* OR aged-individual* OR aged-population* OR (older W/2 (client* OR people OR person* OR adult* OR patient* OR individual* OR population* OR women OR men))) AND (TITLE-ABS-KEY (economic W/1 (evaluat* OR analys* OR study OR studies OR assess* OR

		consequence* OR model*)) OR cost-benefit OR benefit-cost OR cost-utility OR cost-consequence* OR cost-offset* OR cost-of-illness OR ((cost OR costs) W/2 analys*) OR (value W/2 (money OR monetary)) OR TITLE (cost OR costs OR costing OR economic* OR expenditures OR price OR fiscal OR financial OR efficiency OR pay OR valuation OR spending))
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Appendix 5. Assessment measures

Function (Mobility, Falls, ADL, IADL)	Health Related Quality of Life	Health Services Use	Physical Health	Mood & Mental Health	Cognition
-Walking tolerance -Index of Independence in Activities of Daily Living -Sickness Impact Profile (SIP) -OASIS -Number of falls -Number of falls resulting in severe and moderate injuries -Falls Surveillance Report -Performance Orientated Mobility Assessment (POMA) -Modified Falls Efficacy Scale (MFES) -Short Falls Efficacy Scale – International (Short FES-I)	-Short Form Health Survey – 36 Items -VCM1 -Short Form 12 Item Health Survey -EQ-5D -Nottingham Health Profile (NHP) -Community days	-Health and Social Services Utilization Inventory (HSSUI) -Personal Assistance Use -Rehospitalization -Number of Emergency Department visits -Number of admissions to hospital -Home Health Care (HHC) use -Measured health services -Amount of professional services use -Number of outpatient services used -Number of days hospitalized	-Survival -Pulmonary function -Seniors in the Community: Risk Evaluation for Eating and Nutrition V2 -Mortality -Number of strokes experienced -Mid-upper arm circumference (MUAC) -Body weight -Grip strength -Short Physical Performance Battery (SPPB)	-General Wellbeing Schedule (GWS) -Centre for Epidemiological Studies in Depression Scale (CES-D) -Personal Resource Questionnaire (PRQ85) – Part Two -Kessler-10 -Client and care giver satisfaction	-Standardized Mini-Mental State Examination (SMMSE) -Short Portable Mental Status Questionnaire (SPMSQ)

-Stroke Impact Scale -16 (SIS-16) -Reintegration to Normal Living Index (RNLI) -Omaha Problem Rating Scale -Canadian Occupational performance Measure – Performance (COPM-P) -Canadian Occupational Performance Measure – satisfaction (COPM-S) -Barthel Index -Gait speed		-Amount of inpatient services utilized -Transfer to a higher level of care -Number of home visits -Duration time of home visits			
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Appendix 6. Data extraction summary for economic evaluations within home care

Study Information	Intervention details	Economic Information	Results and conclusions
First Author: Bergner[1] Year Published: 1988 Country of Study: United States Study Design: Randomized Controlled Trial Study Objective: 1. What is the efficacy and cost of health care for patients receiving sustained home care (RHC and SHC) as compared to patients receiving office care? Condition: COPD	Intervention 1. Office Care (OC): Physicians whos patients were assigned to the office care program agreed not to order home nursing services for their patients during the study year. Length of Delivery: 1 Year Intervention 2. Standard Home Care program (SHC): Patients assigned to the home nursing programs were seen as frequently as the nurse considered necessary, but at least once a month. Length of Delivery: 1 Year Intervention 3. Specilized Respiratory Home Care Program (RHC): Patients were seen as frequently as the nurse considered necessary, but at least once a month. Nurses in the respiratory home care program had special training in the respiratory disease. Length of Delivery: 1 Year	Type of economic evaluation: Cost-Consequence Analysis (CCA) Perspective: Societal Time Horizon: Not reported Discount Rate: Not reported Outcome for Economic Evaluation: Cost per intervention Health Outcome Measures: Walking tolerance, IADL, SIP, survival, pulmonary function, GWS CHEERS Components Completed: 12 Risk of Bias: High risk	Results: No improve in every-day performance of daily activities, sense of general well-being, or pulmonary function. Sustained care increased the total cost of care for the patients studied. Patients in the specialized home care program, Respiratory Home Care, consistently incurred the highest medical care costs in the study though these costs were not necessarily statistically significantly different from those in the Standard Home Care Conclusions: In general, the provision of home care services to unselected patients does not seem to improve the health outcomes of those patients nor does it reduce their health care costs.
First Author: Campbell[2]	Intervention 1. Home safety: OT identified hazards, and discussed with the participant any items,	Type of economic evaluation: Cost-Effectiveness Analysis (CEA)	Results: Fewer falls occurred in people randomised to the home safety programme but not in

Year Published: 2005 Country of Study: New Zealand Study Design: Randomized Controlled Trial Study Objective: To assess the efficacy and cost-effectiveness of a home safety programme and a home exercise programme to reduce falls and injuries in older people with low vision. Condition: Individuals who are ≥ 75 with severe visual impairment	behaviour, or lack of equipment that could lead to falls. The OT facilitated provision of equipment and evaluated adherence to the home safety programme Length of Delivery: 6 Month Intervention 2. Exercise only: Otago exercise programme modified for those with severe visual acuity loss plus with vitamin D supplementation. Length of Delivery: 1 Year Intervention 3. Exercise and home safety: Following both the treatments for the Exercise and Home safety programs Length of Delivery: Following both the time lines in the Exercise and Home safety programs Intervention 4. Social visits: Intervention not reported Length of Delivery: Two visits lasting an hour during the first 6 months of the trial	Perspective: Societal Time Horizon: Not reported Discount Rate: Not reported Outcome for Economic Evaluation: Cost per fall Health Outcome Measures: Number of falls, number of falls resulting in severe and moderate injuries CHEERS Components Completed: 10 Risk of Bias: High risk	those randomised to the exercise programme (incidence rate ratios 0.59 (95% confidence interval 0.42 to 0.83) and 1.15 (0.82 to 1.61), respectively). A conservative analysis showed neither intervention was effective in reducing injuries from falls. Delivering the home safety programme cost \$NZ650 (?234; \$432; 344) (at 2004 prices) per fall prevented. Conclusions: The home safety programme reduced falls and was more cost effective than an exercise programme in this group of elderly people with poor vision. The Otago exercise programme with vitamin D supplementation was not effective in reducing falls or injuries in this group, possibly due to low levels of adherence.
First Author: Finkelstein[3] Year Published:	Intervention 1. Control: Standard Home Health Care (HHC) as determined by their underlying condition	Type of economic evaluation: Cost-Effectiveness Analysis (CEA) Perspective: Not reported	Results: Rates of discharge to a higher level of care (hospital, nursing home) within 6 months of study participation was 42% for C

2006 Country of Study: United States Study Design: Randomized Controlled Trial Study Objective: To identify and document the benefits of telemedicine compared to standard care after an acute hospitalization for a long-term condition. Condition: Congestive heart failure, chronic wound care or chronic obstructive pulmonary disease	Length of Delivery: Not Reported Intervention 2. Video Group (V): Received standard HHC plus two supplemental virtual visits (VVs) each week and Internet access. Length of Delivery: Not Reported Intervention 3. Monitoring Group (M): Received standard HHC, the two weekly VVs, and Internet access, plus home-based physiologic monitoring and an electronic diary for monitored measurements and symptom. Length of Delivery: Not Reported	Time Horizon: Not reported Discount Rate: Not reported Outcome for Economic Evaluation: Cost per service area Health Outcome Measures: Omaha problem rating scale, transfer rate to a higher level of care, client and care giver satisfaction, mortality CHEERS Components Completed: 13 Risk of Bias: High risk	subjects, 21% for V subjects, and 15% for M subjects. The average visit costs were \$48.27 for face-to-face home visits, \$22.11 for average virtual visits (video group), and \$32.06 and \$38.62 for average monitoring group visits for CHF and COPD, respectively. Conclusions: This study has demonstrated that virtual visits can improve patient outcome at lower cost than traditional skilled face-to-face home healthcare visits.
First Author: Hammar[4] Year Published: 2009 Country of Study: Finland Study Design: Cluster Randomized Trial	Intervention 1. Integrated Home Care and Discharge Practices: A home nurse and a home aid/helper pairing were assigned to patients to plan and integrate home care services, and participated in planning the patients discharge from hospital to home in co-operation with hospital staff. Length of Delivery: Not Reported	Type of economic evaluation: Cost-Utility Analysis (CUA) Perspective: Not reported Time Horizon: Not reported Discount Rate: Discounting was not utilized as follow up time was 6 months	Results: Patients in the trail group used less home care, doctor and laboratory services than patients in the non-trail group. Similar differences between groups were found regarding costs. According to the NHP instrument, the IHCaD-practice showed higher cost-effectiveness compared to the old practice. No evidence for cost-

Study Objective: To evaluate the effects of integrated home care and discharge practice (IHCaD-practice) on the use of services and cost-effectiveness. Condition: Clients returning from hospital into home care	Intervention 2. Usual Care: Had previously only part of the patient chain of treatment described in writing. Length of Delivery: Not Reported	Outcome for Economic Evaluation: Incremental Cost-Effectiveness Ratio (ICER) and Cost-Effectiveness Acceptability Curve (CEAC) Health Outcome Measures: EQ-5D, NHP, amount of professional health service used, admission to hospital, readmission to hospital, mortality CHEERS Components Completed: 16 EPHPP: Strong reporting	effectiveness was found with the EQ-5D instrument. Conclusions: The study suggests that the IHCaD-practice may be a cost-effective alternative to usual care.
First Author: Hopp[5] Year Published: 2015 Country of Study: United States Study Design: Retrospective analysis to examine pre/post differences Study Objective: Identify the use and cost of services associated with a	Intervention 1. Plan A: Focused more broadly on both cancer and noncancer diagnoses, with the majority of patients older than 65 years of age. Followed the Chronic Care Model. Length of Delivery: 6 Months post entry Intervention 2. Plan B: Focused on a younger population primarily with advanced stage cancer. Care intervention followed the Chronic Care Model. Length of Delivery: 6 Months post entry	Type of economic evaluation: Cost-Benefit Analysis (CBA) Perspective: Not reported Time Horizon: Not reported Discount Rate: Not reported Outcome for Economic Evaluation: Costs per service area Health Outcome Measures: Number of visits to the emergency department, amount of outpatient services, number of days	Results: Average 6-month costs per month significantly declined for patients older than 65 years of age from 1 HMO (US\$9300-US\$5900, $P = .001$). Evaluation of the second HMO showed that patients less than 65 years of age with lower preentry costs (<70 000) had a nonsignificant decline in total costs (US\$18 787-US\$13 781, $P = .08$). Conclusions: Study findings suggest @Home Support is associated with reductions in the use and cost for most health services over time.

comprehensive advanced illness management program. Condition: Advanced cancer, chronic obstructive pulmonary disease, congestive heart failure or persons disabled by multiple conditions.		hospitalized, amount of inpatient services CHEERS Components Completed: 17 EPHPP: Strong reporting	
First Author: Isaranuwatthai[6] Year Published: 2017 Country of Study: Canada Study Design: Secondary data analysis Study Objective: Identify the cost-effectiveness of a multifactorial fall prevention intervention for community-dwelling adults ≥ 75 years Condition: Older adults who are accessing home care services	Intervention 1. Usual care: Received home care services arranged by the CCA care coordinator, which included arranging professional and non-professional services, providing information and monitoring. Length of Delivery: Not reported Intervention 2. Intervention Group: Received usual care, plus monthly in-home visits by an interprofessional team with specialized training in the area of fall prevention. Length of Delivery: Not reported	Type of economic evaluation: Cost-Effectiveness Analysis (CEA) Perspective: Societal Time Horizon: Not reported Discount Rate: Not reported Outcome for Economic Evaluation: Incremental Net Benefit and Cost-Effectiveness Acceptability Curve Health Outcome Measures: Number of falls, Falls Surveillance Report, HSSUI CHEERS Components Completed: 20 EPHPP: Weak reporting	Results: For the total sample, the intervention was not economically attractive. However, the intervention was cost-effective at higher willingness-to-pay (WTP) ($\geq$ \$25,000) for adults 75–84 years and at lower WTP ($<$ \$5,000) for adults 85+ years. Conclusions: The cost-effectiveness of the intervention depends on age and decision makers' WTP to prevent falls. Understanding the influence of age on the cost-effectiveness of an intervention may help to target resources to those who benefit most.

First Author: Kjerstad[7] Year Published: 2016 Country of Study: Norway Study Design: Randomized Controlled Trial Study Objective: To provide an economic evaluation of reablement through an analysis of the cost-effectiveness of the intervention Condition: Disability in older adults	Intervention 1. Reablement: is a form of home-based rehabilitation, which focuses on improving independent functioning. The intervention is time-limited, person-centered and delivered by integrated teams. This was in addition to usual care. Length of Delivery: Offered for a maximum of three months. Intervention 2. Usual care: Often comprises of compensating help and its content is delivered according to the needs described by the participants. Length of Delivery: The provision was not limited to 3 months.	Type of economic evaluation: Cost-Effectiveness Analysis (CEA) Perspective: Not reported Time Horizon: Not reported Discount Rate: Not reported Outcome for Economic Evaluation: Incremental Cost-Effectiveness Ratio (ICER) and Cost-Effectiveness Acceptability Curve (CEAC) Health Outcome Measures: COPM-P, COPM-S, number of home visits, duration of home visits CHEERS Components Completed: 15 Risk of Bias: Some Concerns	Results: The assessments of performance and satisfaction regarding daily activities were significantly higher in the reablement group compared with the control group and this was achieved at lower cost. The intervention group requested significantly fewer home visits which were, on average, of significantly shorter duration compared with the control group. Conclusions: Reablement is a more cost-effective intervention compared with usual care. Reablement has a potentially large effect on the demand for compensating home-based care services
First Author: Lewin[8] Year Published: 2014 Country of Study: Australia Study Design:	Intervention 1. Home Independence Program (HIP): Is a short-term individualised service which is goal-oriented and promotes active engagement in daily living activities using task analysis and redesign, work simplification and assistive technology.	Type of economic evaluation: Cost-Consequence Analysis (CCA) Perspective: Not reported Time Horizon: Not reported Discount Rate: Not reported	Results: Restorative clients used fewer home-care hours (mean [SD], 117.3 [129.4] vs. 191.2 [230.4]), had lower total home-care costs (AU\$5570 vs. AU\$8541) and were less likely to be approved for a higher level of aged care (N[%], 171 [55.2] vs. 249[63.0]) during follow-up. They were also less likely to have

Randomized Controlled Trial Study Objective: To report on the comparison of the health and aged care service use and costs of older home-care clients who were randomly assigned to receive either a restorative or conventional home-care service. Condition: Individuals 65 years of age or older who are assessed as eligible for HACC-funded (home care provider).	Length of Delivery: The service usually has a 12-week time limit. Intervention 2. HACC (Usual home care): Assessment from a Care Co-ordinator who completed a care plan and scheduled the care. Length of Delivery: Not Reported	Outcome for Economic Evaluation: Cost per service area Health Outcome Measures: Number of home care hours provided, transfer rate to a higher level of care, number of visits to the emergency department, number of hospital admissions CHEERS Components Completed: 16 Risk of Bias: Some concerns	presented at an emergency department or have had an unplanned hospital admission. Conclusions: The incorporation of intensive restorative services could result in very substantial savings, with careful targeting to maximise the cost-effectiveness, and warrants further investigation.
First Author: Markle-Reid[9] Year Published: 2010 Country of Study: Canada Study Design: Randomized Controlled Trial Study Objective:	Intervention 1. Usual Home Care Services: Assessing, arranging and coordinating professional and nonprofessional home support services, providing information, referrals to community agencies with monitoring and evaluating the plan of care. Length of Delivery: Not reported Intervention 2. Multifactorial and Interdisciplinary Team Approach: Standard home care, plus home visitation by a dedicated team of	Type of economic evaluation: Cost-Effectiveness Analysis (CEA) Perspective: Societal Time Horizon: Not reported Discount Rate: Not reported Outcome for Economic Evaluation: Cost per service area Health Outcome Measures: Number of falls, POMA, MFES, Falls	Results: No difference in the mean number of falls between groups. Subgroup analyses showed that the intervention effectively reduced falls in men (75–84 years old) with a fear of falling or negative fall history. Number of slips and trips was greatly reduced. Conclusions: A multifactorial, interdisciplinary team approach is more effective and no more expensive than usual home care

Determine if a 6 month multifactorial, interdisciplinary team approach to falls prevention is effective in reducing the number of falls compared with usual home care services and costs associated with it Condition: Older adults (aged 75 years or older) at risk for falls	professionals a minimum of once per month for six months to identify known risk factors for falls and other factors influencing health. Also to managing modifiable fall risk factors, provide intensive client support, and educate. Length of Delivery: Six months	Surveillance Report, SF-36, HSSUI, Seniors in the Community: Risk Evaluation for Eating and Nutrition V2, CES-D, SMMSE CHEERS Components Completed: 16 Risk of Bias: Low risk	in improving quality of life, reducing the incidence of slips and trips, and reducing falls among older males (≥ 75-84 years), with a fear of falling and a negative fall history.
First Author: Markle-Reid[10] Year Published: 2011 Country of Study: Canada Study Design: Randomized Controlled Trial Study Objective: To compare a specialized interprofessional team approach to community-based stroke rehabilitation with usual home care for	Intervention 1. Usual Home Care Services: Focus on assessing the eligibility, arranging and coordinating and non-professional home support services, providing information and referral to community agencies, and monitoring and evaluating the plan of care on an ongoing basis. Length of Delivery: Not reported Intervention 2. Specialized Interprofessional Team Approach: Standard home care plus additional home visitation by a dedicated interprofessional team of healthcare providers to	Type of economic evaluation: Cost-Consequence Analysis (CCA) Perspective: Societal Time Horizon: Not reported Discount Rate: Not reported Outcome for Economic Evaluation: Costs per service area Health Outcome Measures: SIS-16, RNLI, SF-36, HSSUI, number of strokes, CES-D, PRQ-85 Part 2, Kessler-10, SPMSQ	Results: Stroke survivors in the intervention group showed clinically important (although not statistically significant) improvements from baseline in mean SF-36 physical functioning score (5.87, 95% CI -3.98 to 15.7; $p=0.24$) and social functioning score (9.03, CI -7.50 to 25.6; $p=0.28$). There was a higher total per-person costs of use of health services in the intervention group. Conclusions: A 12-month specialized, interprofessional team is a feasible and acceptable approach to community-based

stroke survivors using home care services. Condition: Stroke	provide a comprehensive, collaborative, and evidence-based approach to stroke rehabilitation. Length of Delivery: 12 Months	CHEERS Components Completed: 18 Risk of Bias: Low risk	stroke rehabilitation that produced greater improvements in quality of life compared to usual home care.
First Author: Markle-Reid[11] Year Published: 2003 Country of Study: Canada Study Design: Randomized Controlled Trial Study Objective: 1. Develop, implement and evaluate a new model for delivering services to frail seniors, focussing on health promotion and preventive RN care; 2. Provide information on the health outcomes and costs. Condition: Frail seniors	Intervention 1. Usual Care: Case management services consisted of intake, eligibility assessments, and regular ongoing eligibility assessments by the CCAC case manager. Length of Delivery: Not reported Intervention 2. RN Health Promotion and Preventive Care: Received standard case plus regular in-home or telephone contacts by a Registered Nurse. The goal of the intervention was early identification of unrecognized problems and risk factors for functional decline. Length of Delivery: A minimum of one contact per month by a RN over a 6-month period	Type of economic evaluation: Cost-Consequence Analysis (CCA) Perspective: Societal Time Horizon: Not reported Discount Rate: Not reported Outcome for Economic Evaluation: Cost per service area Health Outcome Measures: SF-36, HSSUI, CES-D, PRQ-85 Part 2 CHEERS Components Completed: 17 Risk of Bias: Some concerns	Results: Clinically and statistically significant improvements in physical and mental health functioning at no additional expense from a societal perspective. There was a difference in the use of acute hospitalization in the intervention group which translates into an annual cost saving of \$200,879 within 1 year for every 100 elderly home care clients. Conclusions: Under the current home care delivery system, this study demonstrates that it is more effective and no more expensive to provide proactive RN health promotion to a general population of frail seniors.
First Author: Meng[12]	Intervention 1. Nurse Intervention: Included patient education, individualized health	Type of economic evaluation: Cost-Effectiveness Analysis (CEA)	Results: The nurse intervention indicated lower probability of PA use, but this effect was not

Year Published: 2010 Country of Study: United States Study Design: Randomized Controlled Trial Study Objective: Tested the hypothesis that the disease management health promotion nurse intervention may reduce total PA use/expenditures. Condition: Clients who were 65 years of age and older, enrolled in Medicare and had recent significant health care utilization	promotion coaching, medication management, and physician care management. Length of Delivery: Not reported Intervention 2. Control Group: Participants received their usual care via their Medicare benefits. available to the Control group. Length of Delivery: Not reported	Perspective: Not reported Time Horizon: Not reported Discount Rate: Not reported Outcome for Economic Evaluation: Proportion of personal assistance (PA) users and average annual PA expenditures Health Outcome Measures: Amount of personal assistant use CHEERS Components Completed: 10 Risk of Bias: High risk	statistically significant ($p = .68$). PA users in the nurse group had significantly lower PA expenditures than did users in the control group ($p = .04$). We detected a reduction in average PA expenditures per person in the intervention group of \$1,464 or 28.9%(95% Confidence Interval, -\$3,044, -\$158) as compared to the control group. Conclusions: A multi-component primary care affiliated disease management health promotion nurse intervention has reduced PA expenditures among elderly persons with disabilities over a 2-year period.
First Author: Popejoy[13] Year Published: 2015 Country of Study: United States Study Design:	Intervention 1. Aging in Place (AIP): Consisted of nurse care coordinators working with an advanced practice registered nurse (APRN) expert to manage a comprehensive care plan that coordinated physicians, nurses, and other professionals' interventions to improve or support older adults' medical	Type of economic evaluation: Cost-Effectiveness Analysis (CEA) Perspective: Public health payer Time Horizon: Not reported Discount Rate: Not reported	Results: The AIP program revealed a small, but statistically significant, reduction in rehospitalizations (0.44 events per year, $p=0.047$) and ED visits (0.2 visits per year, $p=0.015$). In all outcomes, except for inpatient rehabilitation, AIP reduced use of services. In the AIP group, the costs of care per person were

A Quasi-experimental time series with non-equivalent control group Study Objective: To assess the impact of care coordination on utilization and cost outcomes through Aging in Place (AIP) or routine care through home health care (HHC). Condition: Older community dwelling adults	conditions, physical functioning, medication management, and supervision of health and social services. Length of Delivery: Participants were seen by a nurse care coordinator at least monthly, and more frequently as needed. Intervention 2. Home Health Care: The services focused on resolution of post-hospitalization health problems which are of a shorter duration and not focused on extending the time patients can live independently in the community. Length of Delivery: Not reported	Outcome for Economic Evaluation: Cost per service area Health Outcome Measures: OASIS, number of hospitalizations, number of rehospitalizations, number of visits to the emergency department, amount of home health care provided CHEERS Components Completed: 14 EPHH: Weak rating	reduced an average of \$77 per month over the 12 months ($p < 0.001$). Conclusions: Considering other costs of the program, AIP costs were still lower than HHC. This study supports that long-term care coordination supplied by nurses outside of a primary medical home can positively influence functional, cognitive, and health care utilization for frail older people.
First Author: Valluru[14] Year Published: 2019 Country of Study: United States Study Design: Case-cohort study Study Objective:	Intervention 1. IAH-Q: HBPC: Provides needed medical and social services through a mobile team to deliver primary care in the patient's home and coordinate social supports. Length of Delivery: Not reported Intervention 2. IAH-Q: HBPC & LTSS (MAC sites): Integrated care coordination with community supports based on availability of resources and local relationships. Length of Delivery: Not reported	Type of economic evaluation: Cost-Effectiveness Analysis (CEA) Perspective: Not reported Time Horizon: Not reported Discount Rate: Not reported Outcome for Economic Evaluation: Expected cost per Minnesota Case Mix Classification	Results: The LTI rate in the three HBPC programs (8%) was less than that of both concurrent comparison groups (IAH-Q beneficiaries not receiving HBPC, 16%; patients receiving HBPC but not in the IAH demonstration practices, 18%). Costs of home- and community-based services (HCBS) were nonsignificantly lower among integrated care patients (\$2151/mo; observed-to-expected ratio = .88 [.68-1.09]). LTI-free survival in the IAH HBPC

To determine the effect of home-based primary care (HBPC) for frail older adults, operating under Independence at Home (IAH) incentive alignment on longterm institutionalization (LTI) Condition: Frail, medically complex Medicare beneficiaries	Intervention 3. IAH-Q: No HBPS: Individuals who would qualify for the Independence at Home program but are not receiving Home Based Primary Care Length of Delivery: Not reported	Health Outcome Measures: Number of days remaining in the community, mortality CHEERS Components Completed: 15 EPHPP: Moderate rating	group was 85% at 36 months, extending average community residence by 12.8 months compared with IAH-q participants in NHATS. Conclusions: BPC integrated with long-term support services delays LTI in without increasing HCBS costs.
First Author: van der Pols-Vijlbreif[15] Year Published: 2017 Country of Study: Netherlands Study Design: Randomized Controlled Trial Study Objective: To evaluate the cost-effectiveness of a multifactorial personalized intervention focused on eliminating or managing the underlying causes of undernutrition	Intervention 1. Usual Care: Received usual care and did not receive any specific advice. The control group received a standard brochure of the Netherlands Nutrition Centre with general information about a healthy diet after the baseline examination was performed. Length of Delivery: Not reported Intervention 2. Intervention Group: A personalized action plan to manage underlying causes of undernutrition was discussed and developed together with the participant. Also received the standard brochure of the Netherlands Nutrition Centre. Length of Delivery: 6 Months	Type of economic evaluation: Cost-Effectiveness Analysis (CEA) Perspective: Societal Time Horizon: Not reported Discount Rate: Discounting was not necessary because costs were collected over 6 months Outcome for Economic Evaluation: Incremental Cost-Effectiveness Ratio (ICER) Health Outcome Measures: Barthel Index, gait speed, SF-12, MUAC, body weight, grip strength, SPPB	Results: This intervention showed no statistically significant effects on body weight, mid-upper arm circumference, grip strength, and gait speed. Cost-effectiveness acceptability curves showed that the probability of cost-effectiveness was 0.72 at a willingness-to-pay of 1000 EUR/kg weight gain. Conclusions: This multifactorial personalized intervention showed a statistically non-significant effect and was not cost-effective on body-weight compared to usual care.

Condition: With or at risk of undernutrition		CHEERS Components Completed: 21 Risk of Bias: High risk	
First Author: Waterman[16] Year Published: 2016 Country of Study: United Kingdom Study Design: Randomized Controlled Trial Study Objective: The aim of this feasibility study is to optimise the design and investigation of home safety (HS) and home exercise (HE) programmes to prevent falls. Condition: Sight impairment (SI) in individuals who are 65 years of age and older	Intervention 1. Usual care plus social visits: Received usual care from the NHS, but in addition received three social visits and two telephone calls by lay visitors. Length of Delivery: 6 Months Intervention 2. Home safety only: The Westmead Home Safety Assessment was used to discuss with participants the physical and environmental hazards present in their homes. This resulted in a jointly agreed action plan incorporating participant needs and views. Length of Delivery: 6 Months Intervention 3. Home safety + Home exercise: As well as the HS intervention described above, participants in this group received a shortened version of the Otago Exercise Programme (OEP) to perform. Length of Delivery: 6 Months	Type of economic evaluation: Cost-Effectiveness Analysis (CEA) Perspective: Not reported Time Horizon: Not reported Discount Rate: Not Reported Outcome for Economic Evaluation: Cost per intervention Health Outcome Measures: Number of falls, Short FES-I, VCM1, SF-12, CHEERS Components Completed: 17 Risk of Bias: Some concerns	Results: The interventions were implemented over 6 months by an OT at a cost per person (pounds sterling, 2011) of £249 (HS) and £674 (HS+HE). Although self-reported physical activity increased, instrumented monitoring showed a decrease in walking activity. There were no statistically significant differences in falls between the groups; however, the study was not powered to detect a difference. Conclusions: It is feasible and acceptable for an occupational therapist to deliver HS and HE falls prevention programmes to people with SI living independently in the community.

First Author: Williams[17] Year Published: 2016 Country of Study: United States Study Design: Case control matched Study Objective: 1. Can remote monitoring provide the same level of care (or better) with fewer resources? 2.What is the cost per outcome as compared to the standard of care group? Condition: Heart Failure	Intervention 1. Usual Care: This group received standard of care services, with only face-to-face visits from home health nurses. Length of Delivery: Not reported Intervention 2. Intervention: Remote monitoring service included: real-time transmissions of physiological data, and telephone follow-up—if needed from a central nursing station. Nursing phone calls were related to abnormalities in remote monitoring data. If the abnormality was not resolved, the home health agency was contacted and a nurse performed a face-to-face physiological assessment, provided patient education, and encouraged adherence to the plan of care. Length of Delivery: Not reported	Type of economic evaluation: Cost-Benefit Analysis (CBA) Perspective: Agency perspective Time Horizon: Not reported Discount Rate: Not reported Outcome for Economic Evaluation: Cost benefits of the program to the agency (which refer to the monies gained/lost per patient in each program) Health Outcome Measures: Number of hospital readmissions CHEERS Components Completed: 11 EPHPP: Moderate rating	Results: HF-related hospital readmissions rates were 33.3 and 36%, standard care and remote monitoring, respectively. The chi-square test for independence suggests that there was no significant association between the intervention and HF-related hospital readmissions, $\chi^2 = (1, n=210, p\text{-value}=.71, \phi = .71)$. Conclusions: The data suggest that remote monitoring was able to offer the same level of care without mitigating costs. The cost of care resulted in increased service utilization without offsetting the agency's investment into technology and therefore did not support remote monitoring as a financially viable option.
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Appendix 7. Comorbidities included in the Comorbidity Index (CI) computation

No	Comorbidities	Coding (assigned score)
	Comorbidities in the original CI	
1	Myocardial infarction	
2	Congestive heart failure	No = 0, Yes = 1
3	Peripheral vascular disease	No = 0, Yes = 1
4	CVA (Cerebrovascular accident) or TIA (Transient ischemic attack)	No = 0, Yes = 1
5	Chronic cognitive deficit (Dementia/Alzheimers)	No = 0, Yes = 1
6	COPD (Chronic obstructive pulmonary disease)	No = 0, Yes = 1
7	Diabetes mellitus	No = 0, Yes = 2
8	Hemiplegia or paraplegia	No = 0, Yes = 2
9	Moderate to severe chronic kidney disease (or Renal disease)	No = 0, Yes = 2
10	Any malignancy	No = 0, Yes = 2
11	AIDS/HIV	No = 0, Yes = 6
	Comorbidities added from the RAI-HC data	
12	HIP fracture	No = 0, Yes = 1
13	Multiple Sclerosis	No = 0, Yes = 1
14	Parkinsons	No = 0, Yes = 1

15	Pneumonia	No = 0, Yes = 1
16	Arthritis	No = 0, Yes = 1
17	Fracture	No = 0, Yes = 1
18	Head Trauma	No = 0, Yes = 1
19	Urinary tract disease	No = 0, Yes = 1
20	Psychiatric disease	No = 0, Yes = 1

Appendix 8. Comparison of factors for individuals who had and did not have Pampalon Deprivation Index scores provided

	Pampalon Deprivation Index Not Provided = 0 N (%)	Pampalon Deprivation Index Reported = 1-5 N (%)	P-value
Pearson Chi Squared			
Gender			<0.001*
Female	2519 (43.08)	3328 (56.92)	
Male	1134 (39.16)	1762 (60.84)	
Age			<0.001**
65-74 Yrs	520 (33.06)	1053 (66.94)	
75-78 Yrs	1120 (38.33)	1802 (61.67)	
>=85 Yrs	2013 (47.39)	2235 (52.61)	
T-Test			
Comorbidity Index	3,653	5,090	0.8174
Mean	4.816589	4.828487	
Standard Deviation	2.356	2.390	
95% Confidence Interval	4.740 - 4.893	4.763 - 4.894	
HUI3 Utility Score	3,653	5,090	0.0839
Mean	0.3751256	0.3862301	
Standard Deviation	0.294	0.298	
95 % Confidence Interval	0.366 - 0.385	0.378 - 0.394	

* X^2 (N = 8743) = 12.263, $p < 0.001$; Cramer's V = -0.0375, indicating a small effect size

** X^2 (N = 8743) = 118.398, $p < 0.001$; Cramer's V = 0.1164, indicating a small effect size

Appendix 9. Characteristics of the cohort (n=8743) at baseline

Variable	Baseline Count	Baseline HUI3 Score
	Frequency (%)	
Total Sample	8743 (100)	0.382 (0.296)
Gender		
Male	2896 (33.12)	0.392 (0.294)
Female	5847 (66.88)	0.382 (0.296)
Age group		
65-74 years	1573 (17.99)	0.393 (0.294)
75-84 years	2922 (33.42)	0.393 (0.298)
>=85 years	4248 (48.59)	0.370 (0.296)
CCI score		
0-1	1785 (20.42)	0.457 (0.284)
2	1844 (21.09)	0.385 (0.295)
3	1735 (19.84)	0.387 (0.303)
4	1416 (16.2)	0.361 (0.286)
5	892 (10.2)	0.327 (0.296)
6	547 (6.26)	0.353 (0.290)
>=7	524 (5.99)	0.272 (0.293)
PAMPALON index score		
1 (least deprived)	1500 (17.16)	0.385 (0.305)
2	799 (9.14)	0.378 (0.299)
3	1131 (12.94)	0.381 (0.293)
4	881 (10.08)	0.392 (0.297)
5 (most deprived)	778 (8.9)	0.399 (0.293)
PAMPALON (unknown)	3653 (41.78)	0.375 (0.294)

Health care services		
Clinical Specialties		
Support ~		
0 hour/week	6067 (69.39)	0.409 (0.292)
>0 and <1 h/week	567 (6.49)	0.355 (0.298)
1 to <2 h/week	872 (9.97)	0.362 (0.291)
2 to <3 h/week	459 (5.25)	0.316 (0.296)
>=3 h/week	778 (8.9)	0.248 (0.291)
Non-Regulated		
Support °		
0 hour/week	1891 (21.63)	0.384 (0.306)
>0-4.9 hours/week	3094 (35.39)	0.486 (0.270)
5-9.9 hours/week	1815 (20.76)	0.356 (0.276)
>=10 hours/week	1943 (22.22)	0.237 (0.278)

Appendix 10. Frequency distribution (n (%)) of HUI3 change group by covariates: Cohort two, n = 7860

Variables	Increased HUI3	HUI3 stable	Decreased HUI3	P-value
Total sample	2067 (26.30)	1398 (17.79)	4395 (55.92)	
Gender				0.070
Male	629 (24.67)	458 (17.96)	1463 (57.37)	
Female	1438 (27.08)	940 (17.70)	2932 (55.22)	
Age group (baseline)				<0.001
65-74 years	462 (31.73)	323 (22.18)	671 (46.09)	
75-84 years	701 (26.56)	426 (16.14)	1512 (57.29)	
>=85 years	904 (24.01)	649 (17.24)	2212 (58.75)	
PAMPALON index score				0.012
1 (least deprived)	378 (27.43)	231 (16.76)	769 (55.81)	
2	201 (25.22)	152 (19.07)	444 (55.71)	
3	317 (27.81)	220 (19.3)	603 (52.89)	
4	219 (27.00)	152 (18.74)	440 (54.25)	
5 (most deprived)	215 (28.86)	145 (19.46)	385 (51.68)	
IPAMPALON (unknown)	737 (24.66)	498 (16.66)	1754 (58.68)	
CI change group (follow-up score minus baseline score)				<0.001
CI decreased and no change	1487 (29.36)	1076 (21.25)	2501 (49.39)	
CI increased = 1	301 (22.72)	174 (13.13)	850 (64.15)	
CI increased ≥ 2	279 (18.97)	148 (10.06)	1044 (70.97)	
Specialized care change (follow-up hours minus baseline hours)				<0.001
No change and decreased	1604 (27.87)	1158 (20.12)	2993 (52.01)	
Increased	463 (22)	240 (11.4)	1402 (66.6)	

Non-Specialized care change (follow-up hours minus baseline hours)				<0.001
No change and decreased	1058 (25.63)	826 (20.01)	2244 (54.36)	
Increased	1009 (27.04)	572 (15.33)	2151 (57.64)	

Appendix 11. Logistic regressions for the odds of decreased HUI3 utility score between the Cohort 2 period (from March 2019-Feb 2020 to March 2020 to Feb 2021) and Cohort 1 period (from March 2018 to Feb 2019 to March 2019 to Feb 2020), and by the clients' characteristics, changes of CI and health care services (n = 16,603: Cohort 1 = 8743, Cohort 1 = 7860).

Variables	Adjusted Model 1		Adjusted Model 2		Unadjusted Model	
	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value
Cohort 2 v. Cohort 1	1.16 (1.09, 1.23)	<0.001	1.18 (1.11, 1.26)	<0.001	1.16 (1.09, 1.23)	<0.001
Female vs. Male	0.94 (0.87, 1.00)	0.059	0.94 (0.88, 1.01)	0.095	0.96 (0.90, 1.02)	0.188
Age						
65-74 years						
75-84 years	1.42 (1.29, 1.56)	<0.001	1.42 (1.29, 1.56)	<0.001	1.42 (1.30, 1.55)	<0.001
≥ 85 years	1.72 (1.57, 1.88)	<0.001	1.71 (1.56, 1.87)	<0.001	1.63 (1.50, 1.77)	<0.001
CI change groups						
No change and decreased						
Increased 1 score	1.88 (1.72, 2.06)	<0.001	1.77 (1.61, 1.93)	<0.001	1.82 (1.67, 1.99)	<0.001
Increased 2 scores or more	2.69 (2.45, 2.95)	<0.001	2.45 (2.23, 2.69)	<0.001	2.57 (2.36, 2.80)	<0.001
Clinical Specialties Support care change						
No change and decreased						
Increased			1.84 (1.70, 1.98)	<0.001	1.83 (1.71, 1.97)	<0.001
Non-Regulated Support care change						

No change and decreased						
Increased			1.15 (1.08, 1.23)	<0.001	1.09 (1.02, 1.16)	0.007
Baseline variables						
HUI3 standardized score (baseline)	1.64 (1.58, 1.69)	<0.001	1.74 (1.68, 1.81)	<0.001	1.58 (1.53, 1.64)	<0.001
CI score (baseline)	1.03 (1.01, 1.05)	<0.001	1.02 (1.00, 1.04)	0.019	0.95 (0.93, 0.96)	<0.001
Specialized care (baseline)			1.00 (0.99, 1.01)	0.897	0.98 (0.96, 0.99)	<0.001
Non-specialized care (baseline)			1.01 (1.01, 1.02)	<0.001	1.00 (0.99, 1.00)	0.004

Note: Adjusted Model 1 adjust effects of sex, age, CI change, and baseline CI and HUI3. Adjusted Model 2 further adjust the specialized and non-specialized care change and its baseline score from Model 1.

Appendix 12. Linear regressions for the difference in HUI3 utility change (DID) score between the Cohort 2 period (from March 2019-Feb 2020 to March 2020 to Feb 2021) and Cohort 1 period (from March 2018 to Feb 2019 to March 2019 to Feb 2020), adjusting for the clients' characteristics, changes of CI and health care services (n = 16,603: Cohort 1 = 8743, Cohort 1 = 7860)

Variables	Model 1		Model 2	
	Coefficient (95% CI)	P-value	Coefficient (95% CI)	P-value
Cohort 2 v. Cohort 1	-0.021 (-0.028, -0.014)	<0.001	-0.023 (-0.030, -0.016)	<0.001
Female vs. Male	0.011 (0.003, 0.018)	0.008	0.009 (0.001, 0.017)	0.023
Age				
65-74 years				
75-84 years	-0.037 (-0.048, -0.026)	<0.001	-0.036 (-0.047, -0.026)	<0.001
≥ 85 years	-0.067 (-0.077, -0.056)	<0.001	-0.064 (-0.074, -0.054)	<0.001
CI change groups				
No change and decreased				
Increased 1 score	-0.073 (-0.083, -0.063)	<0.001	-0.062 (-0.072, -0.052)	<0.001
Increased 2 scores or more	-0.147 (-0.157, -0.137)	<0.001	-0.130 (-0.140, -0.120)	<0.001
Clinical Specialties Support care change				
No change and decreased				
Increased			-0.092 (-0.100, -0.083)	<0.001
Non-Regulated Support care change				
No change and decreased				
Increased			0.000 (-0.007, 0.007)	1.000
Baseline variables				
HUI3 (baseline)	-0.361 (-0.373, -0.348)	<0.001	-0.390 (-0.403, -0.377)	<0.001

CI score (baseline)	-0.003 (-0.005, -0.001)	0.003	-0.001 (-0.003, 0.001)	0.248
Specialized care (baseline)			0.000 (-0.002, 0.001)	0.714
Non-specialized care (baseline)			-0.002 (-0.002, -0.002)	<0.001
Constant	0.139 (0.125, 0.153)	<0.001	0.180 (0.165, 0.195)	<0.001

Appendix 13. Mean scores of the service time (hours per month) by the baseline quartile groups of the activity type (N = 8743)

Variable	Baseline mean score (SD)
Activity Type	
Case management services	
First quartile	0.337 (0.107)
Second quartile	0.632 (0.092)
Third quartile	1.062 (0.175)
Fourth quartile	2.557 (1.349)
Non-regulated services	
First quartile	1.338 (1.279)
Second quartile	8.422 (2.995)
Third quartile	23.545 (6.215)
Fourth quartile	76.263 (52.187)
Clinical specialties services	
First quartile	0.507 (0.131)
Second quartile	1.012 (0.181)

Third quartile	2.019 (0.482)
Fourth quartile	8.093 7.033)
Respite services	
Not provided	0 (0)
Provided	13.359 (14.384)

Appendix 14. Frequency distribution (n (%)) of HUI3 change by activity provision at baseline

	Improved HUI3 n (%)	Stable HUI3 n (%)	Decreased HUI3 n (%)	P-value
Total sample	2436 (27.86)	1741(19.91)	4566 (52.22)	
Case management services				<0.001
First quartile	557 (24.58)	566 (24.98)	1143 (50.44)	
Second quartile	609 (28.34)	459 (21.36)	1081 (50.30)	
Third quartile	613 (28.29)	390 (18.00)	1164 (53.71)	
Fourth quartile	657 (30.40)	326 (15.09)	1178 (54.51)	
Non-regulated services				<0.001
First quartile	602 (27.54)	407 (18.62)	1177 (53.84)	
Second quartile	620 (28.35)	437 (19.98)	1130 (51.67)	
Third quartile	620 (28.38)	435 (19.91)	1130 (51.72)	
Fourth quartile	594 (27.19)	462 (21.14)	1129 (51.67)	
Clinical specialties				<0.001
First quartile	539 (24.50)	538 (24.45)	1123 (51.05)	
Second quartile	600 (27.55)	433 (19.88)	1145 (52.57)	
Third quartile	661 (30.31)	368 (16.87)	1152 (52.82)	
Fourth quartile	636 (29.12)	402 (18.41)	1146 (52.47)	
Respite services				<0.001
Not provided	2252 (27.74)	1630 (20.08)	4236 (52.18)	
Provided	184 (29.44)	111 (17.76)	330 (52.80)	

Note: p-value is for the difference between baseline and follow-up. The chi-square test was used to test the difference in frequency distribution among the groups.