The quality of rehabilitation services for patients with rheumatic and musculoskeletal diseases

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July 2022,
Anne-Lene Sand-Svartrud

Knowing is not enough; we must apply.

Willing is not enough; we must do.

Goethe

Summary

Background: Patients with rheumatic and musculoskeletal diseases (RMDs) constitute a large and increasing part of people in need for multidisciplinary rehabilitation services. Rehabilitation interventions are complex and individually adapted, and it is of utmost importance to coordinate all involved services to ensure continuous processes for each patient. However, several reports conclude that there is a gap between recommended and current delivery of rehabilitation services, with little coordination and communication across levels of healthcare, and lack of patient involvement in planning of supported self-management and follow-up interventions. Evaluation and improvement of rehabilitation quality may be guided by the three-fold model of structure, process, and outcomes, and capture the perspectives of both providers and patients. The use of quality indicators (QIs) and quality improvement programs (QIPs) are recognized as promising strategies to ensure better quality in healthcare, but these strategies are scarcely used within team-based rehabilitation for patients with RMDs.

Aim: The overarching aim was to explore and evaluate ways to measure, monitor and improve quality in rehabilitation services over time. The specific objectives were i) to assess the responsiveness of a QI set for use in rehabilitation, which comprises 19 structure, 11 process, and 3 outcome indicators, ii) to examine the associations between patient-reported quality of processes and clinical outcomes of rehabilitation, and iii) to investigate how a team-based QIP was delivered in rehabilitation practices, focusing on the structure dimension of quality and the providers' fidelity to the planned processes.

Methods: Three different studies were undertaken to address the objectives, all nested within the Norwegian stepped-wedge cluster-randomized BRIDGE trial. The BRIDGE program, developed to improve coordination, continuity and follow-up, was added to the existing programs at eight rehabilitation centres in secondary care. The program components were motivational interviewing, patient-specific goal setting, written plans for rehabilitation and self-management, digital self-monitoring of progress on outcomes, and tailored follow-up. Data were collected from the provider teams and 293 patients with various RMDs admitted to rehabilitation at the participating centres. The first aim was examined in a longitudinal pre-post study, using a construct approach to evaluate the responsiveness of the QI set by testing

62 hypotheses of expected changes in structure, process, and outcomes after adding the BRIDGE program. In the second study, using a longitudinal cohort design, linear and logistic mixed models were used to examine associations between the pass rates of QIs and outcomes (goal attainment, physical function, and health-related quality of life). The third aim was explored in a mixed methods (MMs) study, using a convergent approach to combine and compare quantitative (questionnaires) and qualitative (focus groups) data about program delivery.

Results: Analyses of responsiveness showed that ≤ 25% of the hypotheses were rejected, confirming the QI set's ability to detect changes in quality of delivered, team-based rehabilitation. In the cohort study, no associations were found between patient-reported pass rates of process indicators and the outcome variables. The MMs study indicated that structural improvements do not necessarily lead to better quality of rehabilitation processes, in terms of the interactions between providers and patients. The results further support that providers' program fidelity depends on both the rehabilitation content and on how this content is delivered. Potentials for improvements concerned follow-up and supported self-management, as well as the providers' skills, knowledge and development as specialized rehabilitation workers.

Conclusions: The QI set showed satisfactory responsiveness when applied in team-based rehabilitation for adults with various RMDs, and can be used as a tool to capture changes and monitor maintenance of rehabilitation quality. The set can also be used to establish benchmarks for good quality in rehabilitation, and to evaluate effectiveness of quality initiatives. Based on the results from the second study, we suggest that inferences about quality of rehabilitation should be drawn from complementary information about both structures, processes, and outcomes. Lastly, quality in rehabilitation depends on several contextual factors, which exist at the level of institutions, teams, and individual providers. It seems particularly important to support rehabilitation providers' confidence in delivering all parts of the intended care, and to develop a culture of continuous improvement within institutions and teams, and across sectors and levels of healthcare.

Sammendrag

Bakgrunn: Pasienter med muskelskjelettskader, -sykdommer og -plager (MUSSP) utgjør en stor og økende andel av voksne som har behov for tverrfaglig rehabilitering. Rehabilitering er komplekse intervensjoner som krever en kombinasjon av standardiserte og skreddersydde tiltak for hver pasient. Det er et mål at rehabilitering skal være preget av kontinuitet og samordning på tvers av aktører, tjenester og nivåer i helsetjenesten. Flere offentlige rapporter konkluderer imidlertid med at det er et gap mellom anbefalt og reell praksis i rehabiliteringstjenestene, særlig fordi tjenestene er lite samordnet, med lite informasjonsflyt, pasient-involvering, oppfølging og kontinuitet i forløpene. Evaluering og forbedring av kvalitet kan baseres på en tredelt modell som inkluderer struktur, prosess og utfallsmål, samt informasjon om hvordan kvaliteten vurderes av både tilbydere og pasienter. Bruk av kvalitetsindikatorer (KI) og kvalitetsforbedringsprogrammer (KFP) er anbefalte strategier for å sikre helsetjenester av god kvalitet, men er lite brukt i tverrfaglig rehabilitering for pasienter med MUSSP.

Mål: Det overordnede målet var å utforske og evaluere måter å måle, monitorere og forbedre kvalitet i rehabilitering over tid. Mer spesifikt ville vi i) vurdere responsivitet av et KI-sett utviklet for bruk i rehabilitering, som inneholder 19 struktur-, 11 prosess- og 3 utfalls-indikatorer, ii) undersøke sammenhenger mellom pasientrapportert kvalitet og kliniske utfallsmål i rehabilitering, og iii) undersøke hvordan et teambasert KFP ble levert i klinisk rehabiliteringspraksis, med fokus på struktur-dimensjonen av kvalitet og i hvilken grad klinikere faktisk leverte programmet som planlagt (program fidelity).

Metoder: Forskningsspørsmålene ble besvart gjennom tre delstudier som alle inngikk i en større randomisert kontrollert studie med trappetrinn-design (BRIDGE studien). BRIDGE programmet, som ble utviklet for å bedre kvalitet og samordning, ble implementert ved åtte norske rehabiliteringssentre i spesialisthelsetjenesten, med planlagt kontinuitet og oppfølging i kommunene. Komponentene i programmet var motiverende intervju, pasientspesifikk målsetting, skriftlige planer for rehabilitering og egeninnsats, digital monitorering av fremdrift i forhold til utfallsmål, og planlagt og skreddersydd oppfølging etter utskrivelse. Data ble samlet inn fra de tverrfaglige teamene ved hvert senter og fra totalt 293 pasienter med ulike MUSSP som var henvist til rehabilitering ved sentrene. I en longitudinell før-etter studie ble KI-settets responsivitet undersøkt ved testing av 62 hypoteser om forventede

endringer i struktur, prosess eller utfallsmål etter implementering av BRIDGE programmet. Sammenhenger mellom pass rates av KI og hvert utfallsmål (måloppnåelse, fysisk funksjon og helserelatert livskvalitet) ble undersøkt ved lineære og logistiske regresjonsanalyser (mixed models) i en kohortstudie, mens et konvergent mixed methods (MMs) design ble benyttet for å kombinere og sammenligne kvantitative (spørreskjema) og kvalitative (fokusgrupper) data om levering av BRIDGE programmet.

Resultater: I den første delstudien ble ≤ 25% av hypotesene forkastet, noe som bekrefter at KI-settet har tilfredsstillende evne til å fange opp endringer i tverrfaglige rehabiliterings-tjenesters kvalitet. I kohortstudien ble det ikke funnet noen sammenhenger mellom pasientrapporterte pass rate-verdier for prosessindikatorene og utfallsvariablene. Resultatene i MMs-studien indikerte at forbedringer i struktur ikke nødvendigvis fører til bedre kvalitet i rehabiliteringsprosessene hva angår prosedyrer og samspill mellom klinikere og pasienter. Videre underbygger resultatene at klinikernes troskap til programmet avhenger både av innholdet i kvalitetsforbedringsprogrammet og måten programmet blir levert på. Avdekkede forbedringsområder omfattet oppfølging etter utskrivelse og støtte til egenmestring, samt å støtte klinikerne i deres videreutvikling av kunnskap og ferdigheter som trengs for å veilede pasientene i egenmestring og livsstilsendringer over tid.

Konklusjoner: KI-settet er godt egnet til å fange opp endret eller opprettholdt nivå i rehabiliteringstjenestenes kvalitet, og kan brukes for å monitorere kvalitet i tverrfaglig rehabilitering for voksne med MUSSP. Indikatorsettet kan videre brukes for å etablere grunnlag for sammenligning på tvers av institusjoner og nivåer i helsetjenesten, og for å evaluere effekten av kvalitetsforbedringstiltak. For å få et samlet bilde av kvalitet i rehabilitering bør vurderinger, beslutninger og kvalitetsforbedrende tiltak baseres på informasjon om både strukturer, prosesser og utfallsmål. Kvalitet i rehabiliteringstjenester påvirkes i stor grad av kontekstuelle faktorer på institusjons-, team-, og individnivå. Ledere bør derfor iverksette tiltak for å støtte klinikernes videreutvikling av kunnskap og fortrolighet med intervensjoner som inngår i alle trinn i rehabiliteringsprosessen. Det er også nødvendig å utvikle en kultur for kontinuerlig forbedring innen institusjoner og tverrfaglige team, samt på tvers av aktører og tjenestenivåer i rehabilitering.

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Abbreviations

BMI	body mass index
COSMIN	COnsensus-based Standards for the selection of health Measurement INstruments
EQ5D-5L	EuroQoL 5D-5L health-related quality of life 5 dimension 5 level
FG	focus group
FU	follow-up
HP	health professionals
HRQoL	health-related quality of life
ICC	intraclass correlation coefficient
IOM	United States Institute of Medicine (today termed The National Academy of Medicine)
MMs	mixed methods
MI	motivational interviewing
MRC	Medical Research Council
N	nurse
OECD	The Organization of Economic Co-operation and Development
OT	occupational therapist
P	patient
PP	patient participation
PR	pass rate
PROMs	patient-reported outcome measures
PSFS	Patient-Specific Functional Scale
PT	physiotherapist
QI	quality indicator
QIP	quality improvement program
RMD	rheumatic and musculoskeletal disease
SE	sport educator
SPO	Donabedian's model of structure, process, and outcomes
STAR-ETIC	Scandinavian Team-Arthritis register – European Team Initiative for Care research
SW	social worker
SW-CRT	stepped-wedge cluster-randomized controlled trial
T1	the control phase in the BRIDGE trial
T2	the intervention phase in the BRIDGE trial
WHO	World Health Organization
30secSTS	the 30-second sit-to-stand test

List of additional files

Additional file 1

Components in the BRIDGE program with available tools to support the process.

Additional file 2

A guiding booklet for health professionals, to facilitate high fidelity to the BRIDGE program.

Additional file 3

Interview guide for the focus groups.

List of papers

This thesis is based on the following papers:

Paper I

Sand-Svartrud AL, Berdal G, Azimi M, Bø I, Dager TN, Eppeland SG, Fredheim GO, Hagland AS, Klokkeide Å, Linge AD, Tennebø K, Valaas HL, Aasvold AM, Dagfinrud H, Kjeken I. A quality indicator set for rehabilitation services for people with rheumatic and musculoskeletal diseases demonstrates adequate responsiveness in a pre-post evaluation. *BMC Health Services Research 2021 Feb 20;21(1):164*
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Paper II

Sand-Svartrud AL, Berdal G, Azimi M, Bø I, Dager TN, Eppeland SG, Fredheim GO, Hagland AS, Klokkeide Å, Linge AD, Sexton J, Tennebø K, Valaas HL, Mjøsund K, Dagfinrud H, Kjeken I. Associations between quality of health care and clinical outcomes in patients with rheumatic and musculoskeletal diseases: A rehabilitation cohort study. *BMC Musculoskeletal Disorder. Accepted March 28th 2022;*
DOI: **https://doi.org/10.1186/s12891-022-05271-3**

Paper III

Sand-Svartrud AL, Berdal G, Aanerud GJ, Azimi M, Bjørnerud AM, Dager TN, Ende CHM van den, Johansen I, Valaas HL, Dagfinrud H, Kjeken I. Delivery of a quality improvement program in team-based rehabilitation for patients with rheumatic and musculoskeletal diseases: a mixed methods study. *Disability and Rehabilitation. Submitted March 2022 and under review.*
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1. Introduction

Evaluating and improving the quality of healthcare have been increasingly emphasized over the past few decades. Along with access to health services, sufficient quality of provided care is crucial to achieve enhanced population health and desired improvements in clinical outcomes [1]. Strategies to improve the quality of care may cover the entire care delivery system, such as promotive, preventive, curative, rehabilitative or palliative health services [1]. The work in this thesis addresses evaluation and improvement of quality in rehabilitation for people with rheumatic and musculoskeletal diseases (RMDs).

The World Health Organization (WHO) has placed a clear emphasis on a shift in the way health services are managed and delivered, by calling for efforts to address healthcare that too often is fragmented and of suboptimal quality [2]. In the *Framework on integrated people-centred health services,* WHO has proposed the following vision for healthcare delivery:

> *"All people have access to health services that are provided in a way that are coordinated around their needs, respects their preferences, and are safe, effective, timely, affordable, and of acceptable quality."* [3]

Developed as universal, this vision can be used in all countries [2]. However, national efforts to improve the quality of care should respond well to the existing status of provided care, the current health needs of the population, and the broader health planning in each country [1,2].

In several reports in Norway, the public health authorities have concluded that rehabilitation services for long-term conditions are characterized by large variations in content and quality, with insufficient degree of patient involvement, and lack of continuity and coordination across levels of healthcare [4-7]. Based on these documents, efforts are called for to improve the delivery, and identify ways to monitor and compare the quality and effects of rehabilitation within and between institutions, municipalities and levels of care [4-7]. National quality indicators have been developed for several diagnoses as means to improve the transparency concerning outcomes and healthcare performances, and reduce the extent of undesired variations in healthcare delivery [8]. However, work remains to establish and use quality indicators within rehabilitation for people with RMDs.

Given this situation, a new rehabilitation program, termed the BRIDGE program, was developed to improve the continuity and coordination in team-based rehabilitation for people with RMDs, and bridge gaps across levels of care [9]. This quality improvement program was intended to strengthen the degree of patient involvement in all stages of the multidisciplinary rehabilitation process, starting in secondary healthcare and continuing with subsequent follow-up in primary care. A newly developed set of quality indicators for use in rehabilitation for patients with RMDs was included in the study [10]. The set includes two separate questionnaires, allowing the quality to be evaluated from the perspectives of both providers and patients.

In this thesis, the overarching aim was to explore and evaluate ways to measure, monitor and improve the quality of RMD rehabilitation services over time. More specifically, this work addresses the longitudinal measurement properties of the quality indicator set, and explores associations between improved quality and patient-reported clinical outcomes. It also focuses on providers' perspectives on quantitative and qualitative aspects of efforts to enhance the quality when adding the BRIDGE program to traditional rehabilitation programs at the participating Norwegian rehabilitation institutions. The applied research designs are a pre-post evaluation, a cohort study, and a convergent mixed methods approach.

As the current evaluations and results cover institutional and individual aspects of both the structure, process and outcome dimensions of quality, this work may inform different stakeholders in rehabilitation, such as patients, providers, researchers and people in position to plan or evaluate efforts to improve quality from one or multiple entry points, in a team-based rehabilitation context for long-term conditions.

2. Background

Patients with long-term RMDs constitute a large part of people in need for rehabilitation services [11]. Quality of rehabilitation for these patient groups is therefore vital. Despite documented variations in quality of rehabilitation, there are no consensus regarding recommendations for good practice, neither are there clear strategies for how to measure whether quality demands are met, or how quality could be improved. This chapter starts with a brief introduction to RMDs and rehabilitation needs. Thereafter follows background information about quality of healthcare, and suggested approaches to evaluate and improve the quality. Due to the context for this work, brief background information on the state of rehabilitation quality in Norway is included, as well as a presentation of a quality indicator set developed for use in rehabilitation for patients with RMDs in the same context [10].

Some of the literature used in this chapter were published after the time of planning the BRIDGE study. These are described as “current” or marked with an asterisk (*).

2.1 Rheumatic and musculoskeletal diseases (RMDs)

2.1.1 A brief introduction

While there are more than 200 different RMDs, some characteristics are common in this diverse group of diseases. First, RMDs commonly affect the joints, and for some diseases also bones, muscles, cartilage, tendons, ligaments and internal organs. Second, RMDs are most often long-term diseases, and if not treated appropriately, they worsen over time [12]. The RMDs affect both children and adults, and the prevalence increases with age [12].

The aetiologies of RMDs vary and are not yet fully understood. However, the diseases have been partly explained by problems of the immune system, inflammation, infections, deterioration of joints, bones or muscles, and complex interactions between genetic factors and environmental risk factors [12-14]. The latter include unhealthy lifestyle factors, such as smoking, physical inactivity, and obesity [12-14]. For simplicity, RMDs can be grouped into i) joint conditions, for example osteoarthritis, connective tissue diseases, and inflammatory rheumatic diseases, ii) bone conditions, for example osteoporosis, iii) spinal disorders, for example low back pain, iv) regional and widespread pain disorders, for example fibromyalgia, v) musculoskeletal disorders related to occupation and sports injuries or traumas, and vi)

genetic, congenital and developmental childhood disorders [15]. For other groups than fractures or trauma, the conditions usually have a gradual progressive onset. Decisions on the diagnoses are often based on clinician features, laboratory tests, imaging assessments, and burden assessments [15-16].

In this work, the focus is on rehabilitation provided to an adult population with inflammatory rheumatic diseases, systemic connective tissue diseases, osteoarthritis, osteoporosis, fibromyalgia or widespread pain, or non-specific low back-, neck-, or shoulder pain (persistent for more than 3 months) [9]. In this heterogeneous group of patients, symptoms and prognosis differ, but the clinical features of the diseases are most often characterized by persistent or recurring pain in affected areas of the musculoskeletal system, and physical disability [13,15]. Other clinical features include stiffness and restricted range of movement in affected joints, joint instability, muscular weakness, fatigue, and sleep disturbance. In the presence of joint inflammation, the signs are tender, swollen, red and warm joint(s) [16].

2.1.2 The impact of RMDs at the level of the individual

The consequences for the individual and his or her daily life vary, and can be described using the International Classification of Functioning, Disability and Health (ICF) [15, 17]. During the course of the disease, the impact on the individual can be assessed as impairment of body functions and structures, for example by biomarkers of disease activity of arthritis, measurement of movement range in affected joints, or imaging assessments of loss of cartilage in osteoarthritis. The impact can also be assessed as limitations of activities and restrictions of participation, for example by the patient's subjective assessments, using generic and disease-specific instruments [15, 17-18]. The overall function and well-being are influenced by the patient's personal and environmental contextual factors, such as how individuals interpret their illness, cope with stressors, their self-efficacy related to treatment advices, and how others in their social environments respond to their needs [15,17, 19]. A variety of instruments are used to assess important health domains, such as general health, physical-, social-, and mental function and well-being, limitations in activities of daily living, and restricted participation in valued and necessary activities and social contexts [13, 15, 18]. This spectrum of assessments, from biomarkers to self-efficacy and social support, illustrates the usefulness of a biopsychosocial approach when considering the individual disease impact [15,17].

2.1.3 The impact of RMDs at the level of society

RMDs is a major cause of absence from work or loss of productivity at work for employed patients. Both work disability and the need of early retirement or social benefits are included in the burden of RMDs at the society level. Other factors, affecting all patients, include the use of healthcare resources across levels of care, medications, devices and aids, and several other direct costs associated with disease prevention, detection, treatment, and rehabilitation [20]. Previous and current studies have suggested that RMDs, due to high prevalence and disability, have an essential and growing impact on the world-wide burden of diseases [11, 15, 20-21]. Based on a large WHO database, it is shown that RMDs are the second cause of "years lived with disability" worldwide, and the disease-group has highest impact in the continent of Europe. The latter is probably due to higher life expectancy in high income countries. The overall burden of RMDs has significantly increased between year 2000 and 2015, and is expected to continue to grow [20].

Comorbidity is another important issue when considering the burden of RMDs. In particular, it is important to prevent cardiovascular diseases and other conditions associated with persistent inflammatory activity, RMD-related organ damage, side-effects of RMD-medication, and the risk of unhealthy lifestyle factors, such as a sedentary lifestyle due to persistent pain, fatigue, and decreased physical mobility [15, 22]. Due to the increased risk of comorbidities, RMDs are also associated with increased mortality [15].

Taken together, the essential burden on the affected individuals, their families and caregivers, and the society, highlights the importance of high quality healthcare services for these patients, including development of strategies for the prevention, treatment control, and rehabilitation [11, 15, 20-21]. Of particular interest for rehabilitation, is the focus on optimal management of the consequences for the affected individuals in their everyday life. Thus, seeking possibilities for maintained participation in daily life's activities, physical activities, and social contexts that is relevant for the individual is important [23].

2.2 Multidisciplinary rehabilitation for RMDs

2.2.1 The concept of rehabilitation

In 2011, the WHO presented the following definition of rehabilitation: *"a set of measures that assist individuals who experience, or are likely to experience, disability to achieve and maintain optimal functioning in interaction with their environments"* [24, page 96]. The concept of multidisciplinary rehabilitation refers to "*rehabilitation provided by two or more types of rehabilitation professionals*" [25, page 35].

In Norway, when plans were made for the BRIDGE trial, the national definition of rehabilitation was: *"a process which is planned and limited in time, including clear goals and measures, where several professions or services cooperate in assisting the individual user in his or her own efforts to achieve best possible functioning and coping capabilities, and promoting independence and participation in society"* [26].

While performing our trial, a revised Norwegian definition was launched, in which the concept *"participation"* was outlined in more details as *"participation in education and working life, social contexts, and society"* [27]. In addition, the revised definition stated that rehabilitation: i) *"targets single users who experience, or are likely to experience, disability (e.g. limited physical, mental, cognitive, or social functional ability)"*, ii) *"is based on the single users' life situation and goals"*, iii) *"is a goal-directed, collaborative process in different arenas between the user, next of kin, and service providers"*, and iv) *"is characterized by measures which are coordinated, coherent, and knowledge-based"* [27].

Thus, both international and national definitions of rehabilitation outline the importance of the individual patient's coping and functioning in interaction with their environment, as well as the combination of both prevention and management of disability [24, 26-27]. Further, the clarifications of the Norwegian definitions, in terms of planned processes, clear goals and measures, and coordinated collaboration between professions and services, correspond well to WHOs description of rehabilitation; In "the World report on Rehabilitation", rehabilitation is described as a process provided along a continuum ranging from hospital to community care, in cross-sectoral processes, meaning that health professionals collaborate with specialists within education, employment, social welfare and other fields [24].

This thesis is based on this understanding of rehabilitation, as well as on "the Rehabilitation Cycle" covering the process from identification of needs and modifiable factors, defining goals and measures, implementing coordinated plans for goal attainment, assessing the effectiveness, and agreeing on new decision making, as cited by WHO [24] (figure 1).

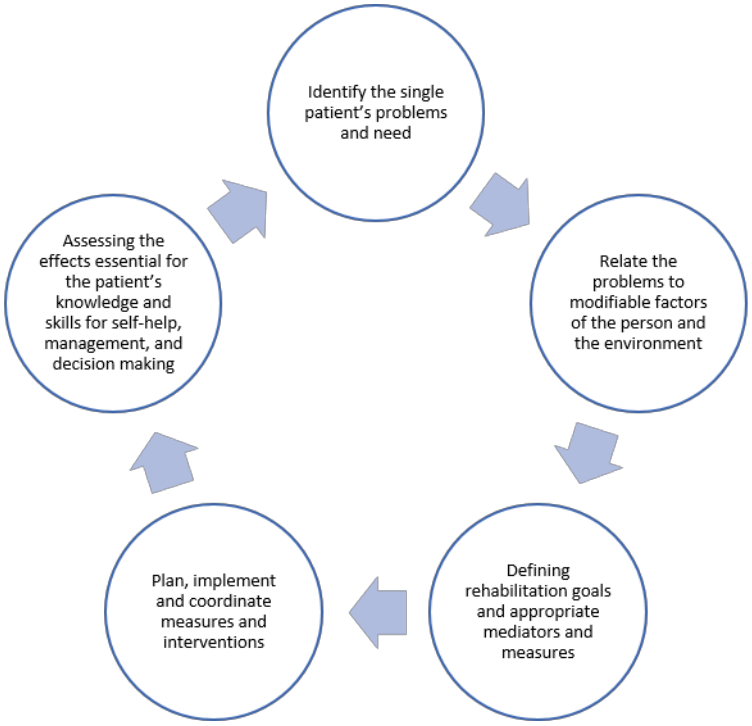


Figure 1 The Rehabilitation Circle, cited in "the World Report on Rehabilitation" [24, the author's reproduction].

2.2.2 Multidisciplinary rehabilitation

Multidisciplinary rehabilitation is highlighted in this thesis due to the interrelating biological, physical, psychological, and social consequences associated with RMDs, best understood in a biopsychosocial perspective [15, 28-29]. These relationships require coherent input from several professions, most typical nurses, physiotherapists, occupational therapists, and physicians. Other relevant professions include social workers, psychologists, pharmacists, dietitians or nutritionists, and orthotists [30-31].

In collaboration with a multidisciplinary team, a patient can achieve and maintain optimal functioning through different approaches, such as maintenance or improvement of current

function, compensation for lost function, slowing the pace of natural progression, or prevention of loss of function [24]. As pain and disability are driven by multiple, interacting factors, the patient and the rehabilitation professionals will most likely assess disease-related changes in body functions and structures, but also look beyond this to include psychological, social, personal and environmental influences [19, 24, 29]. Thus, this thesis addresses the comprehensive approach across disciplines, to identify all relevant domains that contribute to the clinical picture, agree on modifiable elements, and facilitate a personalized coping- and self-management process for each patient [24, 29]. The presence of physical and/or mental health comorbidities induces further complexity in clinical decision making with the teams. Such complexity influences the degree of standardized versus tailored healthcare delivery for each patient [24, 29, 32].

2.2.3 Self-management

In this thesis, self-management is understood as "*the individual's ability to manage the symptoms, treatment, physical and psychosocial consequences and lifestyle changes inherent in living with a chronic condition*", resulting from the integrated contributions from the multidisciplinary teams [33, page 178].

This definition was presented more than 15 years ahead of our study, highlighting the importance of helping patients to utilize relevant skills necessary to maintain a satisfactory quality of life, by adequate cognitive, behavioural and emotional responses in a continuous process of dealing with the impact of their disease [33-34]. Frequently referred tasks included in self-management are i) medical or behavioural management, such as adhering to recommended physical training, ii) role management and creating new meaningful behaviour, such as people with joint pain who change the way he or she is gardening, iii) dealing with emotional reactions on having a long-term condition, and balancing whether wellness or illness get the most attention [35]. Common self-management skills are problem solving (including possible solutions suggested from professionals and significant others), decision making (based on sufficient and appropriate information), resource utilization (i.e. seeking help from several sources), forming of partnerships between provider and patients, and taking action, e.g. making behaviour specific action plans that the person is fairly confident he or she can accomplish, carry out, and monitor over time. The latter highlight the importance of sufficient self-efficacy during the process [35].

Equally highlighted as important is the training of the rehabilitation professionals, to build their confidence to support self-management, and to ensure that patients' self-management abilities are focused on and fostered in clinical settings [33, 36]. Results from a qualitative meta-synthesis prior to our trial indicated that clinicians perceived the delivery of self-management approaches as a difficult and complex process, requiring a shift away from hierarchical, medical models of practice, towards a person-centred approach in terms of a more collaborative communication style and the forming of partnerships [36]. To address this, the BRIDGE program was developed to stimulate patient involvement through all phases in the rehabilitation process, support clinicians to embed self-management principles into practice, and foster patients' ability to carry out supported self-management after discharge to attain their individual rehabilitation goals [9]. The program also addressed efforts to improve coordination and continuity in rehabilitation [9].

2.2.4 Coordination and continuity in rehabilitation trajectories

Coordination and continuity of care are central to ensure seamless interactions when care is delivered over time within multidisciplinary teams and across care settings or sectors, such as the health-, social-, work-, and education sectors [3, 37-39].

The concept of coordination can be defined as: "*ordering the care that different providers give to a patient, so that the results are greater than the sum of each provider's care. It involves two or more providers (individuals or organisations) communicating or collaborating with each other and with the patient, to provide care that takes account of others' actions"* [37, page 1].

The concept of continuity can be defined as: "*the degree to which a series of discrete healthcare events is experienced as coherent and connected and consistent with the patient's medical needs and personal context* "[38, page 1221]. Originally, this definition allows continuity to be understood both from the patient and the provider perspective. In 2018, the WHO used the same definition, but with small changes resulting in the patient perspective being embedded in the definition of continuity of care: "*the degree to which a series of discrete healthcare events is experienced by people as coherent and interconnected over time and consistent with their health needs and preferences"* [39, page 8].

In the same document, the provider perspective was embedded in the definition of coordination of care: "*a proactive approach to bringing together care professionals and providers to meet the needs of service users to ensure that they receive integrated, person-focused care across various settings*" [39, page 8]. The latter, person-focused care, refers to "*practices in which the person is seen as a whole, with many levels of needs and goals, the needs being derived from their personal social determinants of health*" [39, page 8].

Taken together, when rehabilitation is delivered from several professions across sites and settings, the concepts of continuity and coordination of care capture to what degree the individual patient experiences coherent and interconnected care over time, as well as the providers' efforts to discuss and agree on the organization of all contributions from the involved professions and services, aiming for better results than the sum of each provider's contribution [37-39]. For a patient, the experience of continuity may include the perception that the involved providers know his or her preferences, values and context, agree on shared rehabilitation plans, perform coherent and not duplicated assessments and measures, and know what has happened before and what is planned in the immediate future. For providers, coordinated care may include shared information among all involved parties, and the confidence that the different contributions are delivered in a complementary and timely manner and will be pursued, adjusted, or added to, by other providers throughout a longitudinal process for the patient [38-39].

Although recognized as important aspects of quality in rehabilitation, the experiences of continuity and the practicing of coordination vary in different care context [9]. Hence, continuity and coordination are central concepts in the BRIDGE study [9], and included in initiatives to evaluate and improve quality of care.

2.3 Quality of healthcare services

Healthcare services, systems and policies are among the environmental factors included in the ICF framework, expected to influence the functioning of populations and individual patients. Examples of factors to consider within the healthcare services are equipment and aids, the content, frequency and duration of provided interventions, the competence and professional background of the clinicians and leaders involved, and the organization of time and resources [17]. The presence or absence of recommended factors within the care delivery may be considered as sources of variation affecting the functioning of those using the health service. For example, the absence of important factors in a rehabilitation program may influence patients negatively if it results in them performing below their capacity [17].

Over the past decades, there has been an increased interest for research on the quality of healthcare. One reason is a view on quality of care as one of many determinants of patients' health and functioning, resulting in efforts to optimize healthcare delivery, implement evidence-based care, and reduce unwarranted variation of provided care (40). In addition, the interest may also be motivated by regulatory requirements, the need for comparable register-data at regional or national level, economic intensives caused by cost pressures on health systems, demanded transparency and accountability, and other strategies initiated by policy makers and health authorities [40-43]

2.3.1 Defining quality

Probably the most widely used definition of quality of care was proposed in 1990 by the United States Institute of Medicine (IOM) committee, stating that "*Quality of care is the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge*" [44, page 21].

The definition allows for a broad set of *health services*, including rehabilitative care across care levels, and a broad set of *outcomes*, such as physical and social functioning, emotional status, physiologic measures, and health-related quality of life (HRQoL) [44]. The term *desired outcomes* imply that the patients' preferences and values are acknowledged and included in decision making processes, and that the service is directed towards those outcomes [44]. As desired goals may differ between patients, providers, payers, governments

and administrators, the evaluation of quality should be considered from the perspectives of multiple parties [44]. In the context of this thesis, the following elucidations from the IOM committee members are also notable:

a) The purpose of efforts to improve the quality of provided care is to "*increase the likelihood*" of expected net benefit for the patients. In other words, the fact that other health determinants, beyond the influence of the healthcare, are recognized, does not inhibit the recommendation of initiatives to improve the quality of the health services and programs [44].
b) The professional process performance is emphasized, implying the responsibility of the leaders and clinicians to use the best knowledge available. The conceptualization of *professional performance* addresses the practice of technical, medical, and scientific knowledge, including interpersonal skills used in healthcare, as such skills are important to increase the likelihood of desired outcomes and decrease the likelihood of undesired outcomes [44]. Hence, in work targeting quality improvements, it is relevant to address providers' habits, behaviours, beliefs, and performances used in their everyday practices. Such information about the process of care, combined with the institution's capacity (structure) and the patients' outcomes, are emphasized in the IOM-report, referring to Donabedian's classic triad of structure, process, and outcome (presented in section 2.4.2) [44].
c) Quality problems may concern overuse of unnecessary services, and underuse of needed services. Underuse include rehabilitation services not provided to relevant populations, and missing parts of recommended care for those actually served [44].

2.3.2 Dimensions of quality

As quality of healthcare is a multidimensional concept, a description will depend on the selected dimensions or components of quality. In some documents, quality is based on the degree of *patient's satisfaction* with care. In other descriptions, satisfaction is not considered as a discrete attribution of quality, but rather as an aspect inherent in more over-arching dimensions, such as *patient-centred care*, *integrated care* or *acceptable intervention* [45-47].

Most commonly, a set of dimensions, or list of components is used to describe what is meant by high-quality of healthcare. Leaders of health services may use such lists to identify which

dimension(s) of quality that present the largest challenges in their institution or municipality [45]. One of the first sets of dimensions was published by IOM in 2001 [48]. At that time, serious concerns regarding quality of healthcare had been issued in public disputes and discussed in peer-reviewed journals for over a decade. IOM reviewed the research literature and identified six areas for healthcare to improve on; safety, effectiveness, patient-centeredness, timeliness, efficiency, and equity [48].

The work of IOM [44, 48] has since been widely adopted, adjusted and further developed and used in frequently cited documents from the WHO [39, 45-47], The Organization of Economic Co-operation and Development (OECD) [42-43], and in national white papers on the quality of healthcare [49-51]. In figure 2, commonly used dimensions of quality are presented. As described earlier, patients, providers, health authorities, and others involved in the healthcare delivery may perceive and describe the quality differently [44, 46-47]. Therefore, when using the dimensions of quality, one should consider the perspectives of different parties [44, 46-47].

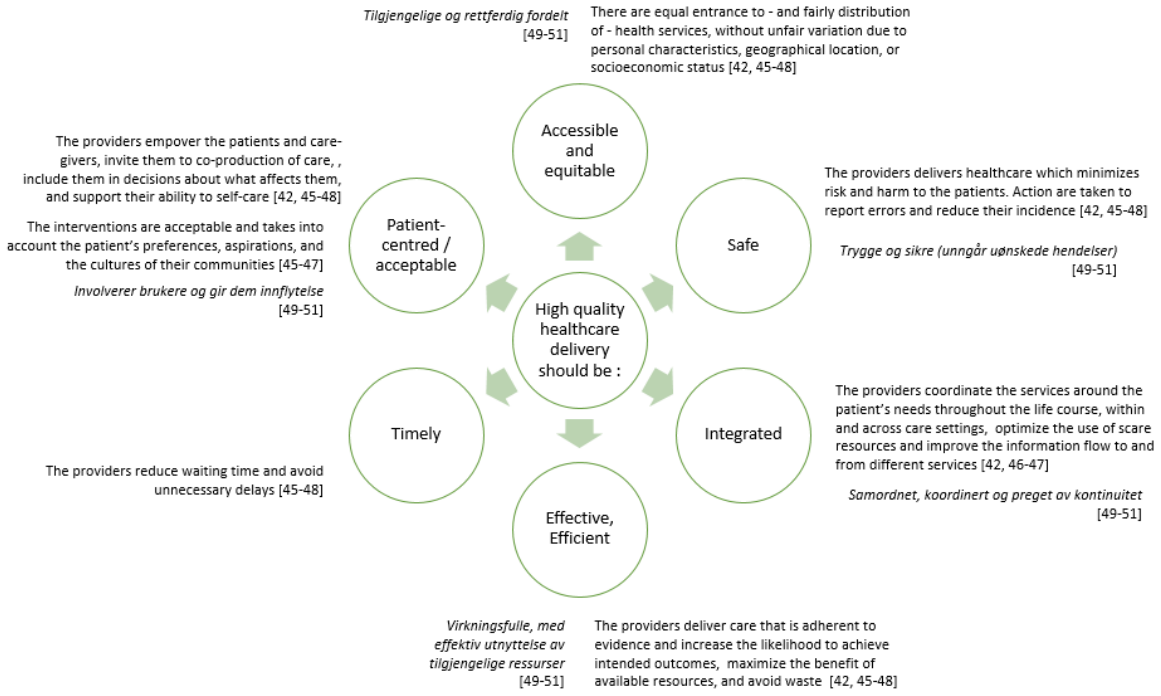


Figure 2 Commonly used dimensions of healthcare quality and areas for health systems to improve on, described in influential documents from the United States Institute of Medicine, the World Health Organization, and the Organization of Economic Co-operation and Development [42, 45-48]. *Italics=Norwegian health authorities [49-51].*

2.4 Evaluation of quality of care

Progress towards quality improvements can be driven by various tools and strategies [45, 47, 52-53]. Measurement plays an important role in quality improvement [54], and the use of quality indicators is one method to measure current status, clarify areas of improvement, and evaluate quality over time.

2.4.1 Quality indicators

Measuring the quality of selected dimension(s) of healthcare is often perceived as a prerequisite for improving it (53). However, direct measurement of quality is not possible, as it is understood as a complex, multidimensional concept, requiring many different measures [55]. The use of quality indicators (QIs) allows the measurement of a set of quantitative, clearly defined and identifiable events that are expected to occur, or that per se are undesirable, during a particular healthcare delivery, which are also relevant for inferences about the provided quality [54-57]. Such indicators do not provide definitive judgements, but can be attributed to the provided care and *indicate* the level of quality or areas of potential problems needed to be addressed [54-57]. This understanding is reflected in the frequently used definition of a QI, published by Lawrence and Olesen [57, page 104]: *"A measurable element of practice performance for which there is evidence or consensus that it can be used to assess the quality, and hence change in the quality, of care provided"*.

Data collected by the use of QIs can be used at an international, national, regional or local level, for external or internal evaluations, for a variety of purposes, as presented in table 1.

If possible, the development of QIs should be based solely on scientific evidence, such as controlled trials [54, 60]. In some areas of healthcare, such as in rehabilitation of people with RMDs, the scientific evidence is limited and/or methodologically weak. In such cases, the developers can incorporate the best available, scientific evidence, clinical guidelines or recommendations, data on existing variations, and expert opinions from providers and patients, using structured and rigorous consensus processes [54,60], such as the RAND/UCLA Appropriateness Method [61]. Lawrence and Olesen highlighted the importance of QIs in areas where limited evidence exists, by stating that "indeed it is in just such areas that practitioners usually need most guidance" [57, page 104].

Table 1 Overview of common purposes of using quality indicators.

Overarching purpose:
To monitor, evaluate, improve and equalise the quality of care, and support health delivery that positively affect desired patient outcomes
More specific purposes:
• To perform bench marking processes in order to equalise and improve the quality of provided care. • To identify successes, and identify, prevent or correct (potential) local- or system-wide problems. • To guide health authorities in priority-setting and management of health services, e.g. regarding political, financial, or other resource issues, including plans for future systems of healthcare. • To guide national or regional quality initiatives and strategies, in some cases as public disclosures. • To provide collective data and secue the comparability across units at different levels. • To guide owners and managers in local quality improvements, based on provided information whether selected dimensions are below or in line with recommended quality standards. • To give continuous feedback to managers and clinicians on current delivery, and follow trends over time (improving, maintaining, or worsening trend). • To guide collaborative quality programs, e.g. across institutions / teams / similar health services. • To guide implementing of new guidelines in clinical practices. • To support professional development, educational efforts, and programs for specialisation. • To compare healthcare delivery across different sites, and contribute to transparency for all involved. parties regarding variations in healthcare performances and outcomes. • To provide a basis of information for patient's organisations (system level). • To provide a basis of information for patient advisory boards within institutions (system level). • To provide a basis for individual users (patient level), when choosing among several available health services. • To provide a basis for external reviews, by comparing expected standards with achieved standards (e.g. ranging from unacceptable to optimal level of delivered quality). In some cases, as a clinical audit process in which the providers can explain the results before the results are attached to financial incentives (as rewards or penalties).
[37, 47, 50, 55, 58-60]

2.4.2 Donabedian's model of structure, process, and outcomes

As stated by Lawrence and Olesen [57], the term "*element of practice performance*" in the definition of a QI can relate to the work of Donabedian, a physician and researcher cited as one of the pioneers in the field of health services research [62-64]. Already in 1966, Donabedian introduced a three-fold approach to the evaluation of healthcare delivery, as inferences about the quality can be drawn from information related to the classic triad of structure, process, and outcomes (SPO) [62, 65]. He proposed that "good structure increases the likelihood of good process, and good process increases the likelihood of a good outcome" [63, page 1745]. In some situations, pre-existing knowledge of the linkage between structure and process, or process and outcomes, is documented in the research literature. Thus, one can argue that measuring the ultimate outcomes will simultaneously imply something about the quality of the prior process or the underlying structure. Indeed, Donabedian did ask for documented causal relationships between the components, if possible [62,63]. However, he

was far from a reductionist, so even more, he emphasized the subtle interplay between the components in the model, and the general rule of including elements of both structure, process and outcomes when evaluating the quality [63-64]. One reason for the recommended three-part approach is that many outcomes, by their nature, reflects all contributions to health and functioning, also those beyond the provided care. Consequently, quality of provided care could be judged as good if the practice, at the time it was given, aligned to the expected standard. However, inferences about this is not possible unless process and structure are assessed, in addition to the outcomes [63]. Another reason is the high degree of complexity in the process itself, in which many interventions are subject to individual adjustments. The responsibility for success or failure is shared by the provider and the patient, and the interactions are influenced by both part's valuations, interests, and circumstances. Therefore, leaders and clinicians can evaluate whether their structure and process conditions are more or less favourable to achieve the desired patient outcomes. In other words, to deal with structural barriers and support the clinicians to provide the intended processes of care are fundamental foci within the work of quality improvement, to gain better outcomes for the patients [63].

Within research on quality, this SPO model is widely used today, also in the field of RMDs [47, 66-73]. In table 2, more details are given of each component. The long-term usefulness of the model may be ascribed to the fact that it reflects three important parameters for evaluating healthcare practices, and that it is sufficiently flexible to encompass new medical discoveries, the shifting healthcare needs of the population, and changes in the healthcare systems [41]. Within rehabilitation, adaptations of the SPO model elucidate the dynamic bilateral influence between processes and outcomes, and adds theoretical concepts from ICF, such as the patient's personal and environmental contextual factors, and outcomes categorized as body functions and structures, activity and participation [41, 74].

In this thesis, the assessments of quality included the triad of structure, process and outcomes, evaluated from the perspectives of patients and providers in the BRIDGE study.

Table 2 Definitions of each component in Donabedian's model of quality, including illustrating examples.

	Structure	**Process**	**Outcomes**
The World Health Organization (2018): *Handbook for national quality policy and strategy* [47, page 29]	*"relates to the setting within which care is delivered"*	*"relates to the provision of care itself"*	*"is the measurable effect on health status, which may be affected by a wide range of factors"*
	For example: -the health facility -human resources -financial resources	For example: -all aspects of the transaction between patients and providers	For example: -identified goals and priorities
Donabedian (1980): *The Definition of Quality and Approaches to its Assessment* [62] and Donabedian (1988): The quality of care. How can it be assessed? [63, page 1745]	*"The attributes of the setting in which care occurs"* "*Tools and resources that the providers have at their disposal*"	*"Denotes what is actually done in giving and receiving care".* *"A set of activities that go on within and between providers and patients."*	*"The effects of care on the health status of patients and populations".* *"A change in the patient's health status that can be attributed to the provided care."*
	For example: -materials -equipment -physical setting -organizational setting -the number, distribution and qualifications of the personnel -financing	Includes two elements addressing the performance of providers: 1. The procedural / technical (current science, knowledge, best practice) 2. The management of the interpersonal process, adaptions to the uniqueness of each individual patient	For example: -social function -mental function -physical and physiological aspects of performance -salutary change in the patient' health-related behaviour -improvements in the patient's knowledge about health

2.4.3 Quality indicators addressing RMDs

For different RMDs, several sets of QIs have been developed around the world, often motivated by the need to guide practitioners in choosing between an increasing number of medical treatment options, reducing gaps between daily practice and new recommendations, lowering cardiovascular risk and other comorbidities, and improving clinical outcomes [56]. Available indicator sets include, but are not limited to, those presented in table 3, covering general practice, primary care, specialist care, and physical therapy in Europe, Australia and USA. Among the listed indicators, some are designed for local studies or regional research communities, others are developed by national or international task forces, and a few are included in national indicator records [56, 73, 75-77, 106]. Within the listed sets, the number of process indicators is highest, compared to the number of structure indicators and patient

outcomes [56, 73, 75-77]. A brief overview of the content of the listed indicator sets is given in table 4.

Most of these indicators are developed to cover early management and monitoring of the disease course in RMDs. In the context of rehabilitation, a wider perspective is more suitable. Consistent with the different categories of healthcare needs defined in “the OECD framework for healthcare system performance measurement”, both early management and rehabilitation address the category named “Getting better” (pertaining people newly affected by a disease) [107]. However, rehabilitation in the context of long-term care additionally addresses the category “Living with illness or disability” (pertaining those living with a chronic condition) [107]. For the latter, a more rehabilitation-specific set of QIs is needed, to cover typical content pertaining this health strategy, such as personalized goal setting processes and coordinated, multidisciplinary activities to support self-management and coping over time and across care levels.

Based on a systematic literature search including papers published between January 1980 and October 2014, a researcher team in Norway found no publications which described an appropriate indicator set for team-based rehabilitation for patients with RMD covering more than a particular diagnose [10]. The Norwegian research group therefore developed a set of QIs for use in multidisciplinary rehabilitation for patients with RMDs. The set was not limited to a particular diagnose, but rather tailored to rehabilitation for adults with non-traumatic, non-surgical RMDs, in general [10]. As the set was designed for use in Norway, a brief overview of the Norwegian rehabilitation context is given before the development and pilot testing of the quality indicator set is described in more detail.

Table 3 Overview of some available indicators within RMDs.

Sources (time period for included papers)	**Disease group**		**Number of available QI set**
Systematic review (2000-2016) [73], and review [56], and review (2001-2010) [75]	inflammatory rheumatic diseases	*Mixed group:* Inflammatory diseases (RA, JIA, PsA, AS)	1 [78]
		RA	7 [79-85]
		JIA	1 [86]
		PsA	1 [87]
Umbrella review [76*], and single papers	systemic connective tissue diseases	SLE	2 [88-89,90*]
Systematic review (2000-2016) [73], and review (2001-2010) [75] and review [56], and systematic review [77], and single papers	osteoarthritis	*Mixed group:* OA and RA	3 [91-93]
		OA	8 [94-101]
Systematic review (2000-2016) [73], and a single paper	osteoporosis	*Mixed group:* osteoporosis, OA, RA	1[102]
		osteoporosis	1 [103*]
A single paper (recommendations, no quality indicators found)	fibromyalgia or widespread pain		0[104]
A single paper	non-specific low back, persistent for > 3 months	Non-specific LBP	1[105*]

QI; quality indicator, RA; rheumatoid arthritis, JIA; juvenile idiopathic arthritis, PsA; psoriatic arthritis, AS; ankylosing spondylitis, SLE; systemic lupus erythematosus, OA; osteoarthritis, LBP: low back pain.
*=*published after the date for starting the BRIDGE study*

Table 4 Overview of common content in available quality indicator sets for RMDs.

	The contents address:
Phases in the course of the disease:	Detection / decisions on diagnose
	Early management of the disease
The most common themes:	Medications / pharmacological management
	Early clinical assessments of disease activity (if relevant), pain, and functional status
	Regular follow-up (monitoring) of disease course and potential structural damages, by physician or nurse
Additional themes in some indicator sets:	Screening, management, or prevention of comorbidity
	Education/information (e.g., within 3 months), concerning treatment and self-management of disease
	Advice for exercise and physical activity (e.g., within 3 months)
	Follow-up (at appropriate time intervals, or at least once within 12 months) from relevant health professionals (most often a physiotherapist or nurse) regarding functional status.
Additional themes in fewer indicator sets:	Pharmacological safety in pregnancy counselling and other reproductive issues
	Pharmacological safety regarding vaccines in combination with pharmacotherapy
	Time to referral (early care)
	Waiting times
	Use of assistive devices
	Assessment of labor force participation
	Counselling on weight loss or other life style factors
	Referral to orthopaedic surgery
Developed from the perspectives of:	Mainly physicians
	Some sets: only physiotherapists
	Some sets: including patients' view, nurses' view or input from other professions

[56, 73, 75]

2.4.4 Rehabilitation in a Norwegian setting

The Norwegian healthcare system is mainly publicly funded, and organized across the state, regions, and municipalities. By law, the responsibility for providing rehabilitation services is shared between specialist and municipal health services, and the services should be planned, coordinated, and based on patient involvement [27]. For patients with RMDs, the rehabilitation service pertains specialized healthcare delivered in hospitals or private rehabilitation institutions, as multidisciplinary in- or outpatient services. It also comprises services delivered in primary healthcare, such as general practitioners, physiotherapy, occupational therapy, home care, and nursing services [29]. Another municipal service is the Healthy Life Centres, which offer participation in exercise groups, and individual or group-based counselling for healthy lifestyle, such as increased physical activity, healthy nutrition, and tobacco cessation [108]. For many, the rehabilitation process typically starts in secondary care as an inpatient stay of 2-4 weeks duration, followed by self-management at home, ideally supported from healthcare providers in primary care [109]. While shared responsibility between care levels still persist, political strategies address the high cost pressure in specialized care, and demand shorter and fewer inpatient stays, and enhanced responsibility for long-term rehabilitation in primary care [110]. Such transfer of responsibility requires good quality and adequate competence across levels of care.

Prior to the development of the quality indicators for rehabilitation, Norwegian health authorities had concluded that the quality of rehabilitation services in general was low, and that it varied among centres and care levels [4-6, 110-111]. Several areas for improvement were pointed to, in particular that patients' needs for involvement and continuity of care were not sufficiently met, that the information flow between care levels were substandard, that the degree of coordinated services around the individual was low, that follow-up was lacking, and that more knowledge was needed among clinicians and managers, particular in primary care [4-6, 110-111]. The same short-comings were described in subsequent white papers [7, 112-113].

2.4.5 A quality indicator set for use in rehabilitation

Supported by the Norwegian Health Directorate, a QI set for use in rehabilitation for RMDs was developed and pilot tested, according to the RAND/UCLA Appropriateness Method [10, 114]. The indicators in the final set, and how they relate to each other, are presented in section 4.6.1.

Development

The RAND/UCLA method is one among others consensus techniques used to develop indicators for areas where the scientific evidence alone is insufficient [54]. Using a consensus approach, the indicator developers are allowed to integrate the best available scientific evidence, expert opinions, and data about existing variation in quality, to gain consensus on important indicators reflecting good quality in the delivery of multidisciplinary rehabilitation [10, 60].

The basic steps in the development process are presented in figure 3. In brief, an expert panel reached consensus on measurable, evidence-based statements for quality in rehabilitation, addressing each dimension in Donabedian's model of quality. The RAND/UCLA process resulted in 19 structure, 11 process, and 3 outcome indicators [10].

Measurement properties

In the pilot testing (shown in the last part of figure 3), the indicator set was deemed as feasible for monitoring quality in rehabilitation in primary and secondary care [10]. Further, face validity was regarded as good, judged from the perspectives of both patients and providers [10]. Ensuring content validity was an inherent part of the consensus process, as the members of the expert panel evaluated, in many steps, whether a domain or an indicator was appropriate for the concept being assessed, made decisions about the dimensions of quality, adapted the instruments in line with the voting rounds, and deleted items deemed as not necessary to provide an adequate reflection of quality [115, 10]. However, a QI set should also be able to measure changes over time [115, 60]. In Paper I in this thesis, the aspect of responsiveness of the QI set for rehabilitation was therefore tested.

Figure 3 Basic steps in development of a quality indicator set for rehabilitation, using the RAND/UCLA Appropriateness Method. The figure is based on written information from the developers [10].

2.4.6 Associations bettween processes of care and clinical outcomes

In the literature, there is a long and ongoing debate addressing the different perspectives of quality [116-117]. Some argue that the process indicators are most useful, for example to evaluate if the providers' performances are in accordance to clinical guidelines, or to compare variation in healthcare delivery within or between institutions or countries. Others highlight the outcome indicators as most important, accumulating both the influence from delivered healthcare and the individual's contexutal factors that are important for the end-point [116]. However, the delivered care must have a major influence on the outcomes, if outcomes alone (without the other parts of SPO model) should be appropriate and useful as indicators of quality. Process indicators are pointed to as the most direct measures of delivered care, but less useful as QIs if no link to important outcomes can be demonstrated [116]. Thus, the associations between process indicators and clinical outcomes are often discussed in various areas of reserach, and the conclusions regarding the relationship between process and outcomes are inconsistent [99, 118-119. 120*-123*].

This means that outcome benefits of a recommended process is not an obvious matter of course, despite the presence of a scientific research and consensus rationale for the given process [117]. Partly, this can be explained by known methodological problems in studies of associations between processes and relevant outcomes, including the proximity of the outcome to the process of care, and the ability to explain or control for confounding factors [117]. However, more knowledge is needed about the associations between different dimensions of quality indicators. Therefore, in Paper II in this theses, we examined the associations between pass rates for the process indicators and the subsequent outcomes for patients with RMDs.

2.5 Improvement of quality of healthcare

Improvement of healthcare and clinical outcomes is a focus for many stakeholders at the organizational levels in all parts of the health system. Involved parties include the national governance, the public health sector, leaders of health services, and different policy-makers, including managers of financing systems, public care pathways, digital information systems, medicines, devices, technologies, and other healthcare facilities [45*, 123]. In this thesis, the

focus is on quality improvement strategies for which leaders of multidisciplinary teams, clinicians, and patients can be regarded as the prime drivers, at the level of institutions, teams and individuals [123].

2.5.1 Standardized versus individualized delivery of rehabilitation

The content of rehabilitation programs typically comprises a number of interacting elements, in which some are mandatory, and others will be deliberately designed and adapted to each patient and the local circumstances [23-24, 31-33]. Obviously, delivery of complex rehabilitation services is influenced by the behaviours and reasoning of both the patients and the providers, in the range from standardized elements similar for all patients with comparable clinical pictures, to highly individualized elements informed by each patient's values and preferences [32]. Hence, delivery of complex rehabilitation services, by its nature, is characterized by a high degree of variation [32]. This variation in everyday clinical practice can be deliberate or not [32,124]. In the field of health service research and quality improvement, a prominent aim is to allow warranted variation and prevent unwarranted variation [124].

At the level of teams and individual clinicians, unwarranted variation are differences in the everyday healthcare delivery which cannot be explained by patient's preferences or the type of severity of illness and disease [124]. Within rehabilitation, this may concern the providers' underuse of interventions which are in line with proven effectiveness or consensus; also called variation in effective care [124]. It can also concern variations in preference-sensitive care, reflecting conditions where two or more medically acceptable interventions or actions exist, and, accordingly, the choice should be made by the patient. The latter include practice patterns in which professionals tend to dominant the treatment choice, rather than the patient's preferences and considerations of what is important, valuable and possible to accomplish [124].

Strategies to ensure warranted practice include checklists for fidelity to predefined parts of an intervention, or the use of prompts or reminders to guide the providers attention to proposed actions or things to do under certain clinical circumstances or in a suggested sequence during the longitudinal care of long-term conditions [123]. However, it is important to note that fidelity is not straightforward in relation to complex interventions, as it should be assessed in relation to the mixture of ingredients scoping from low to high degree of standardization [32].

2.5.2 Clinicians' behaviour change in order to improve the quality

For all the involved parties, it is important to perceive the healthcare delivery as a modifiable factor associated with a potential for better clinical outcomes. Initiatives to improve the quality imply the willingness from managers and members of the multidisciplinary team to measure the quality of their own practice, and be open about knowledge, behaviours, beliefs, and attitudes that inform their everyday clinical reasoning and actions [32, 45*, 56].

Thus, a good understanding of clinicians' behaviours within the frame of quality improvement is fundamental. Equally important is the allowance of a broad assessment of fidelity, covering fidelity to predefined components intended to be delivered to a large proportion of the patients, as well as fidelity understood as the warranted variation of delivery, explained by intended adaptations to contextual factors and patient preferences [32].

In rehabilitation, more knowledge is needed on the use of complex interventions to improve the quality of care. Therefore, in paper III, we investigated the implementation of a team-based quality improvement program (QIP) for patients with RMDs, by combining measurable and interpretative aspects of the program delivery.

3. Overall aim and specific objectives

The overall aim of this thesis was to explore and evaluate ways to measure, monitor and improve quality in rehabilitation services over time, focusing on the longitudinal measurement properties of a QI set, associations between improved quality and clinical patient outcomes, and the delivery of a team-based quality improvement program.

The specific objectives were:

1. To assess the responsiveness of the QI set for rehabilitation services for people with RMDs. (Paper I)

2. To examine the associations between patient-reported level of quality of the rehabilitation processes and subsequent clinical outcomes among patients with RMDs. (Paper II)

3. To investigate how a team-based quality improvement program was delivered in routine rehabilitation practice at different sites, focusing on the structure dimension of quality and the providers' fidelity to the intended processes. (Paper III)

4. Materials and Methods

In the BRIDGE project, the decisions about design, materials and methods were motivated by a research interest in two aspects of RMD rehabilitation. First, we wanted to evaluate the effectiveness of the BRIDGE program compared to traditional rehabilitation programs. Second (the current work), we aimed to compare the quality of rehabilitation across different centres, and to explore the relationships between adherence to structure and process dimensions of quality and clinical outcomes. The clinical context and constraints of the whole BRIDGE trial are therefore presented early in this chapter, before further details are given about the design, materials and methods used to address the specific research questions of this thesis. The last section will address ethical issues and formal requirements, as well as the researcher's role and reflexivity. First, the philosophical worldview underlying this thesis is presented.

4.1 The pragmatic position

As demonstrated by the aims, the work comprising this thesis was not limited to discrete variables that can be empirically measured or observed. Driven by the varied content of the aims and research questions, the positioning in a pragmatic worldview was considered most suitable. In pragmatism, there is an underlying ontological issue that differ from the duality between reality independent of the mind and within the mind [125, 126]. Consequently, the epistemological issue in pragmatism allows knowledge to be developed in different ways, using both more objective and more subjective approaches [125, 126]. Pragmatism is a multi-perspective approach in that researchers can draw from both positivism, post-positivism, interpretivism and other approaches, and choose the methods and procedures for data collection and analyses that are most suitable for the research questions and the research context [126].

Applied to the work of this thesis, *the quality of rehabilitation* and *the delivery of rehabilitation services* were considered as phenomena consisting of elements characterized as measurable, as well as of more constructivistic elements. While some features could be measured as discrete components covered by standardized instruments, the development of knowledge about other features required an interpretative approach. Therefore, different study designs with varied procedures for data collection and analyses were chosen for the current work.

As explained in the following, the pragmatic position was suitable also for other reasons than combining quantitative and qualitative data in Paper III: The outcomes used in the quantitative parts of this work were self-reported questionnaires completed by providers or patients, and patient-reported outcome measures (PROMs). The philosophical challenge related to self-report and PROMs are stated as follows: “PROMs need to reflect individual experiences (interpretivism) but ultimately yield a numeric score on a scale that represents a pre-defined construct (positivism)” [127, p 124]. Consequently, the use of self-report instruments and PROMS fits to be positioned in a multi-perspective, pragmatic position.

An additional argument for the pragmatic position is the combination of a complex intervention (the BRIDGE program) investigated in a randomized controlled trial (a stepped-wedge design, introduced in chapter 4.2) [9]. Characteristics for complex interventions are that they contain several interacting components, a large number of variables, that adaptations of the intervention at different sites are permitted (to some degree), and that the integrity of the intervention is influenced by the persons who provide and receive the program [32,128]. In contrast, if randomized controlled trials are guided by positivism / post-positivism and assumptions from natural sciences, such as absolute /conjectural truth, it optimally require highly standardized and replicable interventions that are identically delivered at different sites [129]. However, a randomized controlled trial conducted from a pragmatic position, as the BRIDGE trial, allows some aspects of the intervention to be understood as discrete elements that are readily measurable, and other aspects to be understood as integrated within the complex, multidisciplinary intervention, more suitable for an interpretative approach [126].

4.2 Clinical context, the BRIDGE trial

The BRIDGE trial was designed to improve the quality, continuity, and coordination of rehabilitation for patients with RMDs [9]. The trial involved rehabilitation services and patients admitted to rehabilitation in secondary healthcare in Norway. Patients were included between August 2017 and July 2018, and followed for 1 year.

4.2.1 The intervention

A structured goal setting and tailored follow-up program, the BRIDGE program, was developed by the study researchers in cooperation with two patient research partners and the local project coordinators at the participating centres. The program highlighted a dialog-based interaction between providers and patients to support the patient’s self-management during

the stay and after discharge, and was designed to facilitate a high degree of patient involvement throughout the rehabilitation process. The program was meant to act as a bridge across levels of care, as the patient's goal-directed rehabilitation process started at a rehabilitation centre in secondary care, supported by a multidisciplinary team, and continued in primary care, supported by next of kin, relevant health professionals, or other suitable services, planned prior to discharge. To ensure continuity, a mandatory telephone follow-up (FU) conversation was included in the program, conducted by a member of the team about 4 weeks after discharge. If needed, the team member could conduct up to four supportive telephone conversations during the FU-period.

The main components in the BRIDGE program and it's intended patient-reported outcomes, are presented in figure 4. The program was based on theories of goal setting and health-related behavioural change, and highlighted all phases of the rehabilitation process: goal negotiation, goal identification, action- and coping planning, action (carry out the plan), appraisal and feedback, and new decision making [130-131]. More information about each component, including its theoretical foundation, is given in Additional file 1. Details on theoretical approaches and behaviour change techniques included in the BRIDGE trial, has previously been described by Berdal et al [137].

The study researchers provided an educational outreach visit at each centre prior to the intervention phase. The visit was directed at the local coordinator, the multidisciplinary team, and their leader(s), and comprised education, practice and guidance on each component included in the program.

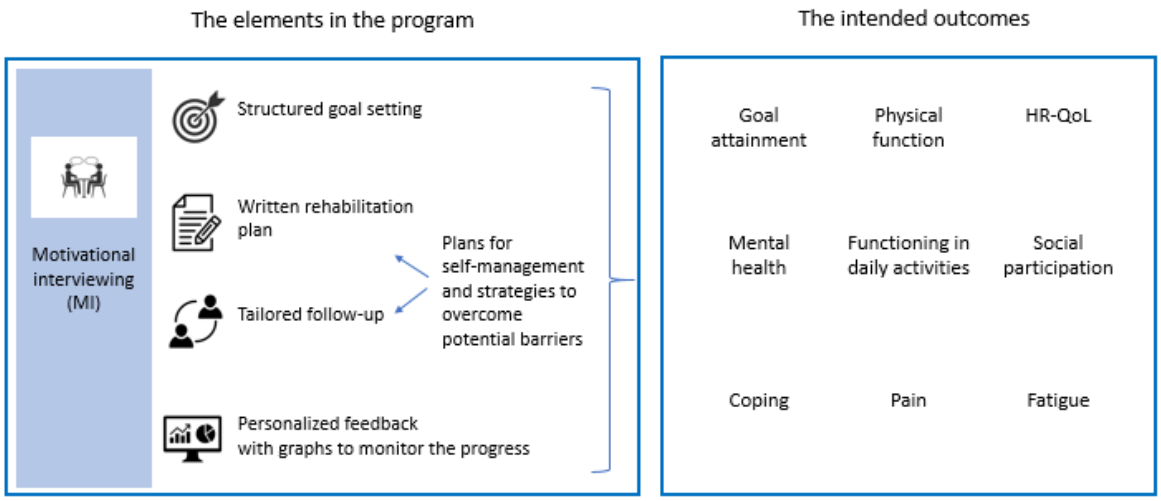


Figure 4 Main components of the BRIDGE program and intended outcomes. *(The figure is the author's modification, based on Berdal's congress presentation [138], with icons reproduced under license from Shutterstock.com)*

4.2.2 The BRIDGE trial framing the current studies

In order to evaluate the effectiveness of the BRIDGE program compared to the traditional rehabilitation programs, the BRIDGE trial was designed as a multicentre, pragmatic stepped-wedge cluster-randomized trial (SW-CRT) [9, 139]. Eight rehabilitation centres started simultaneously in the control phase (T1, delivering their traditional programs) and switched to the intervention phase (T2, adding the new BRIDGE program) in a randomized order based on pre-defined time points (figure 5). The number of patients included in T1 and T2 is presented in figure 5. The effectiveness of the BRIDGE program was evaluated at discharge, and after 2, 7, and 12 months, on the patients' goal attainment (primary outcome), physical function and HRQoL (secondary outcomes), and six other outcomes (tertiary outcomes) (figure 4).

	2017					2018						Patients
Cluster*	Aug.	Sep.	Oct.	Nov.	Des.	Jan.	Feb.	Mar.	Apr.	May	Jun.	In total
1	6										46	52
2		14									32	46
3			7								16	23
4 (hospital)				17							14	31
5 (hospital)						14					14	28
6							52				18	70
7 (hospital)								60			18	78
8									36		10	46
Patients:								T1 group	**206**	T2 group	**168**	**374**

Figure 5 The BRIDGE stepped-wedge cluster-randomized trial design, with number of patients included from each cluster in control (T1, light grey, traditional programs) and intervention (T2, dark grey, adding the BRIDGE program) phases. *the clusters included five rehabilitation institutions and three hospital departments.

4.3 Study designs in this thesis

To address the aims of this thesis, we used three different designs, all nested within the SW-CRT. An overview of the three papers and their aims, designs, data sources and analyses are given in table 5.

In Paper I, the focus was on the QI set and its longitudinal measurement properties when used in the BRIDGE trial. In order to assess the responsiveness of the QI set, we used a pre-post-evaluation design [115, 125] comparing pass rates before and after adding the BRIDGE program. In Paper II, we aimed to examine whether higher quality, as measured by patients' responses to the process indicators in the QI set, was associated with better patient-reported outcomes. The particular PROMs were the primary and secondary outcomes in the BRIDGE trial. All patients in the trial were analysed as one cohort, regardless of group allocation [125, 140]. In Paper III, we focused on the intervention phase of the BRIDGE trial, and used a mixed methods design to compare and combine data from different sources [126]. We used quantitative data to capture both changes measured by the structure indicators after adding the BRIDGE program and the provider-reported program fidelity during the intervention phase, and qualitative data from focus groups addressing how providers experienced the program delivery when implementing the BRIDGE program in clinical practice at the local rehabilitation centres.

Table 5 An overview of aims, study designs, data and analyses in this thesis

Overall aim for the thesis	To explore and evaluate ways to measure, monitor and improve quality in rehabilitation services over time		
	Paper I	**Paper II**	**Paper III**
Aim for each study	To assess the responsiveness of the QI set	To examine the associations between patient-reported level of quality of the rehabilitation processes and subsequent clinical outcomes	To investigate how a team-based quality improvement program was delivered in routine rehabilitation practice at different sites, focusing on provider-reported structure and process dimensions of quality
Study design	A pre-post evaluation	A cohort study	A mixed methods approach
Data sources	Provider-reported QI-data, answered twice: at the beginning of T1 and then at T2. Patient-reported QI-data, answered 2 months after admission, from the T1- and T2-group	Patient-reported data from all patients included in the BRIDGE trial, regardless of group allocations: • QI-data, answered at 2 months • PROMS, answered at baseline, admission, 2 and 7 months • Background variables, answered at baseline Centre	Provider-reported data collected during the T2-period of the BRIDGE trial: • QI-data at T2 • Fidelity checklist values, reported for the providers' program delivery to each patient during T2 • Focus-group data collected from the providers at T2 (after the last FU-conversations in the trial)
Data analysis	Evaluation of responsiveness using a construct approach, with predefined hypotheses regarding expected changes in QI pass rates between T1 and T2.	Regression analyses. The main analysis was a linear mixed model approach for each outcome (i: goal attainment, ii: physical function, iii: HRQoL). Independent variable: QI pass rates Baseline predictors, repeated measurements, and the centre level clustering were accounted for.	The results from three data sources were integrated, using a convergent mixed methods approach. Results from analysing quantitative data regarding QI pass rates and program fidelity were compared and combined with results from a thematic analysis of qualitative data from the focus groups.

QI: quality indicator, T1: before / T2: after adding the BRIDGE program, PROMS: patient-reported outcomes, HRQoL: health-related quality of life, FU: the follow-up period after discharge

4.4 Participants and recruitment

The BRIDGE study involved providers with different professional background and patients admitted to rehabilitation due to RMDs.

4.4.1 Providers

The National Advisory Unit on Rehabilitation in Rheumatology recruited centres located across all health regions in Norway. Eligible centres provided inpatient or outpatient rehabilitation programs in secondary healthcare for the patient groups addressed by the inclusion criteria for patients listed in 4.4.2. An additional criterium was program delivery in multidisciplinary teams consisting of at least four health professions.

For the focus groups (FGs), the study researchers asked the local project coordinators to invite providers to participate, according to the inclusion criteria for providers, listed in table 6. To establish a purposive sample, we aimed to include members from all participating centres, both genders and optimally, at least one representative from each of the professions present in the teams, such as nurse, social worker, physiotherapist, occupational therapist, and sports educator. Due to budget constraints, the coordinator and up to two colleges could participate from each centre. One of 16 professionals who gave their consent was not able to participate due to other commitments the particular day for the FGs.

Table 6 Inclusion criteria for members of the focus groups

- Being a member of the multidisciplinary team at one of the participating centres in the BRIDGE trial
- Being involved in delivery of the BRIDGE program
- Being able to communicate in Norwegian or a Scandinavian language

4.4.2 Patients

At admission to rehabilitation at one of the participating centres, patients were recruited by the local project coordinator or other members from the multidisciplinary team, who performed the eligibility screening and inclusion procedures. The inclusion and exclusion criteria for patients are listed in table 7. Group allocation was determined by the patient's admission date and whether the particular centre was in the control or intervention phase at that date.

Table 7 Inclusion and exclusion criteria for patients

Inclusion:

- Admitted to rehabilitation due to one of the following diagnoses:
  - ✓ inflammatory rheumatic diseases,
  - ✓ systemic connective tissue diseases, osteoarthritis,
  - ✓ osteoporosis,
  - ✓ fibromyalgia or widespread pain, or
  - ✓ non-specific low back-, neck-, or shoulder pain (persistent for more than 3 months).
- ≥18 years old
- able to read and understand questionnaires in Norwegian
- access to a smartphone, tablet or other equivalent device for digital data collection, including a personal electronic credential for secure identification online

Exclusion:

- Fracture(s)
- Severe psychiatric disorders or cognitive impairment if contradictory to the ability to follow a structured and goal directed rehabilitation process over time

4.5 Data collection

4.5.1 Provider data

The data collected from the providers are presented in figure 6.

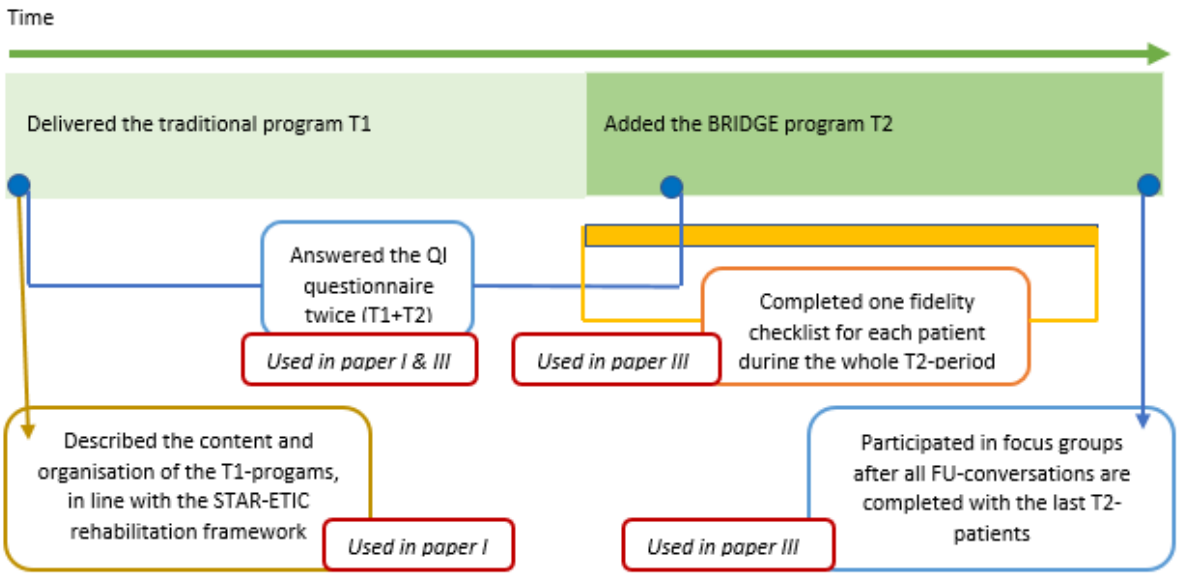


Figure 6 Data collected from the providers.

Quality indicators

Data about the quality of rehabilitation were collected by means of the structure indicators from the QI set for use in rehabilitation (10). At two time points, a representative from each centre completed the QI questionnaire in a telephone-based interview conducted by the

central project coordinator (ALSS). The representative was the leader of each centre, or a member of the multidisciplinary team who knew the rehabilitation centre well. The first interview was carried out at the beginning of T1, and the second took place 6-8 weeks into the T2 period. The period of 6-8 weeks allowed the providers to develop their own written procedures for daily use, based on the written BRIDGE material provided few days prior to T2. However, QI-data about available structures at T2 included both written material and procedures provided by the BRIDGE and the centre-specific written material and procedures addressing the same issues.

Background information about the traditional rehabilitation programs

In the first interview, the representatives also gave detailed information about the content and organization of the rehabilitation program delivered at T1. An interview-guide based on the Scandinavian Team Arthritis Register-European Team Initiative for Care Research (STAR-ETIC) rehabilitation framework was used (28). Prior to the T1-interview, the leader of each centre was asked to prepare information addressed in the STAR-ETIC framework. The prepared information was confirmed and, if necessary, supplied with more information during the interview.

Program fidelity and experiences addressing the delivery of the BRIDGE program

Data about the delivery of the BRIDGE program were collected in two ways. By using a provider-reported fidelity checklist, we measured to what extent the program components were delivered as intended. By using FGs, we explored other aspects of fidelity, which were harder to measure in a questionnaire, such as the provider experiences of the delivery and reasons, attitudes and reflections underlying their actions and interactions during T2.

During T2, the providers completed a fidelity checklist for each patient who followed the new program. The fidelity checklist was included in the written BRIDGE material, as part of the guiding booklet to be used by the health professionals when delivering the BRIDGE program.

After the providers had completed all potential follow-up interventions, we carried out three FGs with representation from all centres and all professions who had delivered the program. The FGs were held about 6 months after discharge of the last patients in the T2 period.

Prior to the FGs, those who confirmed that they wanted to participate sent some background information to the study researchers, regarding their age, profession, workplace, work experience within rehabilitation, and postgraduate education (in general) and courses or

education in motivational interviewing (in particular). Based on this information, the participants were purposely assigned three different groups.

The participants met for a two days meeting. Most of them knew each other and the study researchers from previous meetings. At the first day, the status in the project and further plans were discussed, before moderators and assistant-moderators met to discuss the group allocations and intentions of the FGs planned for the next day. In the evening there was a dinner, allowing the relations between participants and moderators to be even more comfortable. The FGs were carried out in three different rooms, as one session before (30 minutes) and two after (2x45 minutes) a lunch break. Adjustments of the length of sessions and breaks were based on the moderators ongoing considerations. At the end, there was a short plenum session summarizing highlights on what was discussed in each FG.

4.5.2 Patient data

All participants in the BRIDGE trial used an online solution for self-reported health assessments at admission (A_1), discharge from the rehabilitation stay (A_2), and at home 2, 7 and 12 months after admission (A_3, A_4, and A_5, respectively). They logged in using a personal computer, tablet, or smartphone, and a personal electronic credential for secure identification (BankID). Non-responders received a short message-reminder on phone (sms). If still not answering the assessments, they were called once (by ALSS) before deemed as missing or dropouts. Checklists for each patient were used to facilitate the data collection procedures.

Physician-reported diagnosis (A_1), patient-reported background variables (A_1) and clinical outcomes (A_1-A_4), are presented in figure 7.

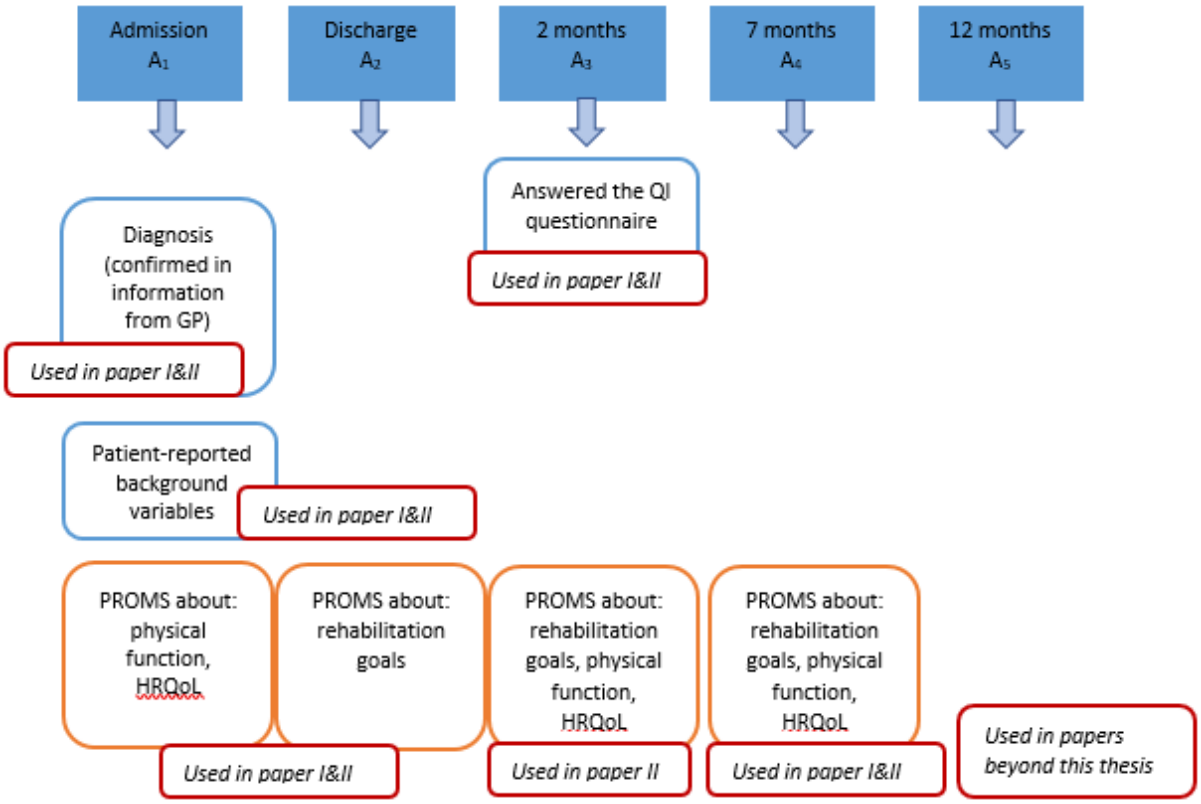


Figure 7 Patient reported data used in the current studies. *QI: quality indicators, GP: general practitioner, PROMS: patient reported outcomes, HRQoL: health related quality of life*

Quality indicators

Patient-reported data about the quality of rehabilitation were collected by the process indicators from the QI set for use in rehabilitation (10), at A_3. This time point was the first assessment time point after discharge, and was chosen to capture the patient perspective of the rehabilitation process in fair proximity to the rehabilitation stay, as well as in proximity to the first month of the follow-up period.

Background variables

Information on diagnoses was obtained from the one accountable for the request about rehabilitation in secondary healthcare, written by the general practitioners. Other background variables were self-reported and are presented in the table 8.

All variables were used to describe the patient sample in the BRIDGE trial, either as comparable groups allocated to T1 or T2 (Paper I) or as one cohort (Paper II). Nine variables were included as covariates in the regression analyses (Paper II) (table 8).

Table 8 Patient-reported baseline characteristics. *=Variables used as covariates in regression analyses.

Variable	Options	Notes
Age*	Open category, numbers, years	If missing: retrieved from the national identify number
Gender*	Female/ male	If missing: retrieved from the national identify number
Height	Open category, numbers, kg	Used by the researchers to calculate body mass index, BMI*
Weight	Open category, numbers, cm	(BMI = weight [kg]/height^2 [m^2])
Disease duration	Open category, numbers, years	
Medication usage	Open category, text	Categorized and used by the researchers as NSAIDs (non-steroidal anti-inflammatory drugs), DMARDs (disease modifying antirheumatic drugs), TNF-inhibitors/Biosimilars/JAK-inhibitors, analgesics, and "other drugs"
Civil status*	Marital status, five categories	Dichotomized and used by the researchers as Living with partner [yes/no]
Education level*	Primary and lower secondary school (1-10 years), Upper secondary school, 11-13 years), College- or university education, short (1-4 years) or long (>4 years)	Used by the researchers as Higher education level, yes ≥ tertiary education
Employment*	Employment [yes /no, if yes: full-time / part-time]	Used by the researchers as Paid work, yes= part- or full-time.
Social security benefits	Presence of six social security benefits [yes/no]	Used by the researchers as Recipients of social security benefits [yes/no]
Comorbidities*	Presence of 16 diseases [yes/no]	Used by the researchers as Comorbidities, yes ≥ 1 additional diagnosis
Physical training*	Physical activities leading to increased heart rate and breathing for 3 times a week, 1-2 times a week, 1-2 times a month, or not regularly	Used by the researchers as Weekly physical training, yes = physical activities leading to increased heart rate and breathing for ≥30 minutes, minimum once a week)
Other activities	Social activities or hobbies 3 times a week, 1-2 times a week, 1-2 times a month, or not regularly	Used by the researchers as General activity, yes ≥once a week
Smoking*	Yes (every day), yes (now and then), no	Used by the researchers as Smokers, yes= now and then, or more often.
Snuff users	Yes (every day), yes (now and then), no	Used by the researchers as Snuff users, yes= now and then, or more often.

Clinical outcomes

The primary and secondary outcomes in BRIDGE were included in the studies in this thesis; two PROMs (goal attainment and HRQoL) and one performance measure (physical activity). However, the physical performance measure was self-reported, allowing all the outcome measures to be reported from home without support from health professionals. Other included

measures addressed coping, functioning in daily activities, social participation, mental health, pain, and fatigue.

Patients in both control- and intervention group completed the outcomes at every time point (A_1-A_5). As part of the BRIDGE program, digital graphs visualizing the progress on each PROM were available for patients in the intervention group.

4.6 Outcome measures

4.6.1 Quality indicators

The quality indicators [10] were used in the assessments in Paper I-III. The instrument captures reported quality of rehabilitation from both the providers' and the patients' perspective, as presented in table 9 and 10.

The providers completed the questionnaire comprising 19 structure indicators of quality, reflecting the structural foundation for the daily clinical practice. The leader answered yes or no to whether the institution had written documents (procedures or method descriptions) that were present and easily accessible at the rehabilitation unit, for the program component addressed by each indicator [10].

The patients completed the questionnaire comprising 11 process and three outcome indicators. They answered yes or no to whether they had received the content addressed by each process indicator, and to whether they had achieved one or more of the following outcomes; rehabilitation goals, an improvement in physical, mental or social functioning, or improved quality of life [10].

Table 9 The 19 structure indicators [10], answered by the leader of each rehabilitation centre *(P=the patient)*

	Is the following included (yes/no) in the written procedures of the rehabilitation unit that are in daily use?	
1	P shall participate in setting rehabilitation goals	
2	P shall participate in planning his/her own rehabilitation process.	
3	A template is used to prepare an individual rehabilitation plan for P	
4	P shall participate in evaluating his/her ongoing process.	
5	There are at least two meetings between P and the interdisciplinary team (or a professional who represents the team).	
6	P is asked before meetings if he/she wants their next of kin to attend any of the meetings.	
7	P is asked before meetings if he/she wants some of the professionals he/she will relate to after the rehabilitation to attend any of the meetings. This may include a physiotherapist, general practitioner or a person from work if participating in vocational rehabilitation.	
8	The rehabilitation unit uses standardized questionnaires and/or functional tests to assess physical, mental and/or social conditions.	
9	P shall participate in preparing a specified written follow-up plan (aside from the epicrisis) for the follow-up process after the rehabilitation period. This plan shall also include the P's own efforts to maintain or improve function/health.	
10	If there is a need for healthcare support after the rehabilitation period, the relevant personnel are to be informed about the plan or participate in the development of the follow-up plan.	
11	P's goal/goal attainment is to be assessed by a standardized	at the beginning of the rehabilitation period
12	instrument	at the end of the rehabilitation period
13		3–6 months after the rehabilitation period
14	P´s function is to be registered using a standardized instrument	at the beginning of the rehabilitation period
15		at the end of the rehabilitation period
16		3–6 months after the rehabilitation period
17	P´s health-related quality of life is to be assessed using a	at the beginning of the rehabilitation period
18	standardized instrument	at the end of the rehabilitation period
19		3–6 months after the rehabilitation period

Table 10 The 11 process and three outcome indicators [10], answered by each patient admitted to a rehabilitation program

	Statements (yes/no) concerning the rehabilitation period:	
1	Were your **health condition** and **life situation** assessed during the first days of your rehabilitation period?' (Answer 'no' if both aspects were not assessed.) If you have answered yes to question number 1, go to question number 2. If you have answered no to question number 1, go to question number 3.	
2	Did the assessments include both a physical examination and questions about mental and social conditions, network, home situation and - if relevant – your work situation?	
3	Was a written plan developed for the rehabilitation period (comprising your rehabilitation goals, what you should practise etc.)?	
4	Were you actively involved in setting the specific goals for the rehabilitation period?	
5	Were you actively involved in preparing the specific written plan for the rehabilitation period?	
6	Did you participate in at least two meetings with the interdisciplinary team or a professional representing the team during which your goal(s) and goal attainment so far were discussed?	
7	Were you asked if you wanted your next of kin to attend any of the meetings?	
8	Were you asked if you wanted professionals you will relate to after the rehabilitation period to attend any of the meetings, such as a physiotherapist, your general practitioner, the labour and welfare administration (NAV) or a person from work?	
9	Was a written plan developed for the period after rehabilitation, including what you were expected to work on yourself? If you have answered 'yes' to question number 9, go to question number 10. If you have answered 'no' to question number 9, go to question number 1 underneath, regarding outcomes.	
10	Did you participate in developing the plan?	
11	As a part of this plan, were you consulted as to whether you needed follow-up from healthcare or vocational professionals (NAV) or other personnel after the rehabilitation period?	
	Statements (yes/no) concerning the outcomes of the rehabilitation period:	
1	As a result of the rehabilitation period	have you achieved one or several goals that are important to you?
2		have you achieved an improvement in your physical, mental and/or social functioning that is important to you?
3		do you think your quality of life has improved?

Calculation of pass rates

Achievements (yes/no) of items in the QI set were measured using pass rates (PRs). Calculations comprised values at two levels; the summary PRs at the participant level (provider or patient), and the single indicator PRs at the group level (all participating centres or patients).

The participant-level

For each centre, we calculated the summary PR as "*the total number of items achieved at this centre*" divided by "*total number of items (=19)*". For each patient, we calculated the summary PR as "*the total of items achieved reported from a patient"* divided by *"the number of eligible items for the same patient"*. Basically, the number of eligible items were 11 for the patient-reported QIs. As seen in table 10: If the response was "yes" to item 1, item 2 became eligible, and the number of eligible items improved by one. If the response was "yes" to item 9, items 10 and 11 became eligible, and the number of eligible items improved by two.

The group-level

For each structure indicator, we calculated PRs for single items across the centres as "*the total number of centres who answered yes for this particular item"* divided by "*total number of centres who answered yes or no to the same item*". Correspondingly, for each process indicator, we calculated PRs for single items across patients as "*the total number of patients who answered yes for this particular item"* divided by *"the total number of patients who answered yes or no for the same indicator"*.

Pass rates

The scores were normalized to 100 to allow PRs to be reported as percentages, 0 -100, with 100 % indicating the best quality in rehabilitation. At the participant level, 100 % implied that the participant (provider or patient) had answered yes to all eligible items. At the group level, 100 % implied that all centres or all eligible patients had answered yes to a particular indicator. In order to report the QI scores consistently, we used PRs for both provider- and patient-reported QIs, despite the low number of participating centres (n=8).

Additional for Paper II analysis

To distinguish between different phases in the rehabilitation process, we grouped the single process indicators into the three following categories: Group A, Initial assessments (indicator 1-2), Group B, Patient participation and individual goal setting through the rehabilitation

process (indicator 3-6), and Group C, Patient participation in planning the follow-up, and coordination across levels of healthcare (indicator 7-11).

At the participant-level, we calculated a summary PR score for each group of indicators. The PR score for Group A was the total "yes" answers to indicator 1-2 divided by the eligible QI items in Group A for that patient. The PR score for Group B was the total "yes" answers to indicator 3-6 divided by 4, because eligible QI items in Group B is always 4. Finally, the PR score for Group C was the total "yes" answers to indicator 7-11 divided by the eligible QI items in Group C for that patient.

4.6.2 Clinical outcome variables

In Paper I and II we used three clinical outcomes: goal attainment assessed by the Patient-Specific Functional Scale (PFSF) [141-142], physical function assessed by 30-seconds Sit-To-Stand Test (30secSTS) [144-145], and HRQoL assessed by The EuroQoL 5D-5L (EQ5D-5L) [146]. We used the Norwegian versions of all instruments. These have been tested for psychometric properties with satisfactory results in RMD populations in rehabilitation settings in primary and secondary care [109].

The Patient-Specific Functional Scale

Primary outcome in the BRIDGE trial was goal attainment, measured by PFSF [109, 142-143]. In open-ended categories, patients reported up to five activities that they currently find difficult to perform because of their health condition. Experienced performance for each activity was thereafter scored on an 11-point scale (0-10, with 0 indicating "unable to perform" and 10 indicating "no problem at all") [109, 142-143]. In the BRIDGE trial, the patients responded to PSFS at admission and discharge. For this particular outcome, baseline was set at discharge because goals may change during the course of a rehabilitation stay. Thereafter, the content reported at discharge in the open-ended categories was fixed, allowing the patients to re-score the same activities at home after 2, 7 and 12 months [9].

The 30 -seconds Sit-To-Stand Test

Physical function was assessed by the 30secSTS [109, 144-145], in which the patient, seated in a chair, rises to a full standing position and then sits down again. According to specific performance instructions, patients completed as many full stands as possible within 30 seconds [109, 144-145]. At each time point for assessments in the BRIDGE trial, a video was integrated in the digital assessment solution, with verbal instructions and demonstration of

correct test performance. In the digital graph for feedback, the patients could follow their own progress on physical function, and also compare their results to a normative reference material [147].

The EuroQoL 5 dimensions 5 levels

Health-related quality of life was measured by EQ5D-5L [109, 146]. First, the patients responded to five dimensions of health status (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) from 1 (no problems) to 5 (extreme problems), resulting in an EQ5D index value, (1=maximum health). Second, they rated their current health state on a 100-mm visual analogue scale (0-100, 100=the best health you can imagine) [109, 146]. We used both the index value (EQ5D-index, based on normative reference material from the United Kingdom population [148]) and the VAS score (EQ5D-vas).

4.6.3 Fidelity checklist

The fidelity checklist was used in Paper III to capture the extent to which the program was delivered as intended. The list was developed for the BRIDGE program, reflecting measurable components intended to be delivered to all patients in the intervention group, as illustrated in figure 8. The list included 18 items with the response alternatives “yes” or “no”, and for two items also a “not appropriate” alternative. Members of the multidisciplinary teams, mainly the local project coordinators, completed one checklist for each patient during T2.

Calculations

A summary fidelity score for provided care to each patient was denoted as “*the number of items adhered to for this patient*”, divided by “*the number of eligible items for this particular patient’s rehabilitation process*”. Basically, the number of eligible items were 18, only changed to 17 or 16 if the response option “not appropriate” was used once or twice.
We also calculated a fidelity score for single items in the checklist, equal to “*the total number of “yes” for this item*” divided by “*the total number of eligible cases for this particular item*”. The results are presented as percentage, with 100 % representing the highest program fidelity.

A guiding booklet to facilitate high fidelity

The fidelity checklist was included in the guiding booklet for health professionals delivering the BRIDGE program, together with short information, reasons and examples related to each stage in the program delivery. There was one guiding booklet utilized for each patient, allowing the providers to be reminded of each component intended to be delivered to each

particular patient. The booklet also allowed the providers to improve their own program delivery, using pages in the booklet called “reflections regarding my own clinical practice”. Examples of reflecting questions included in the booklet are presented in Additional file 2.

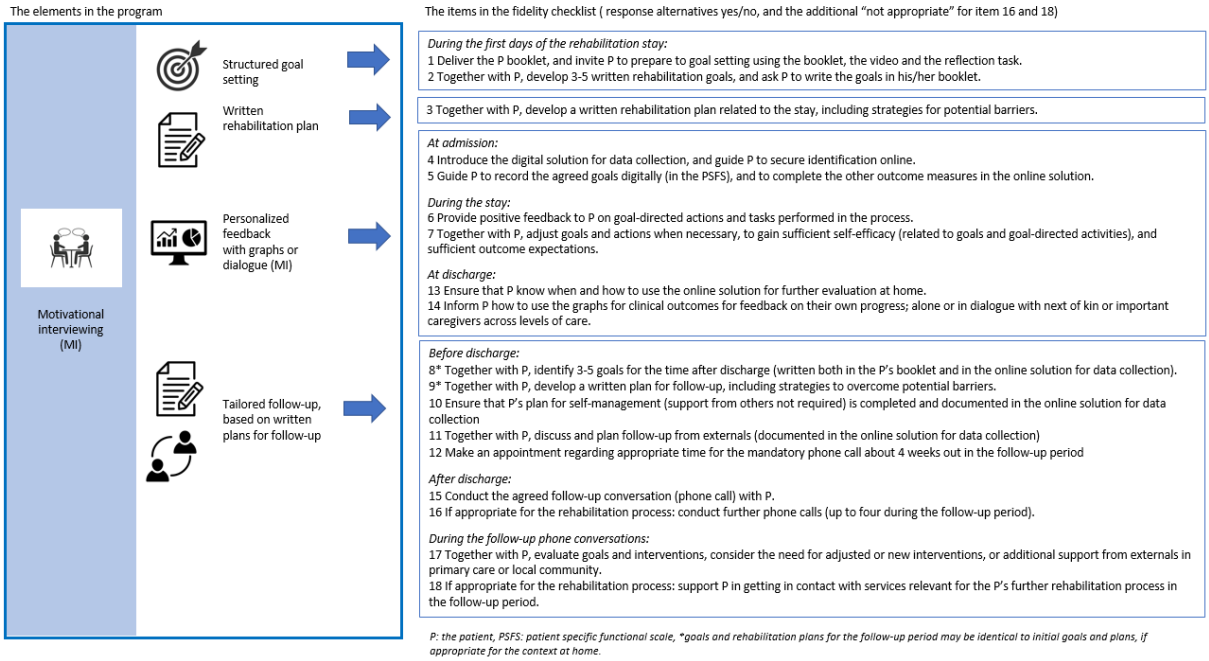


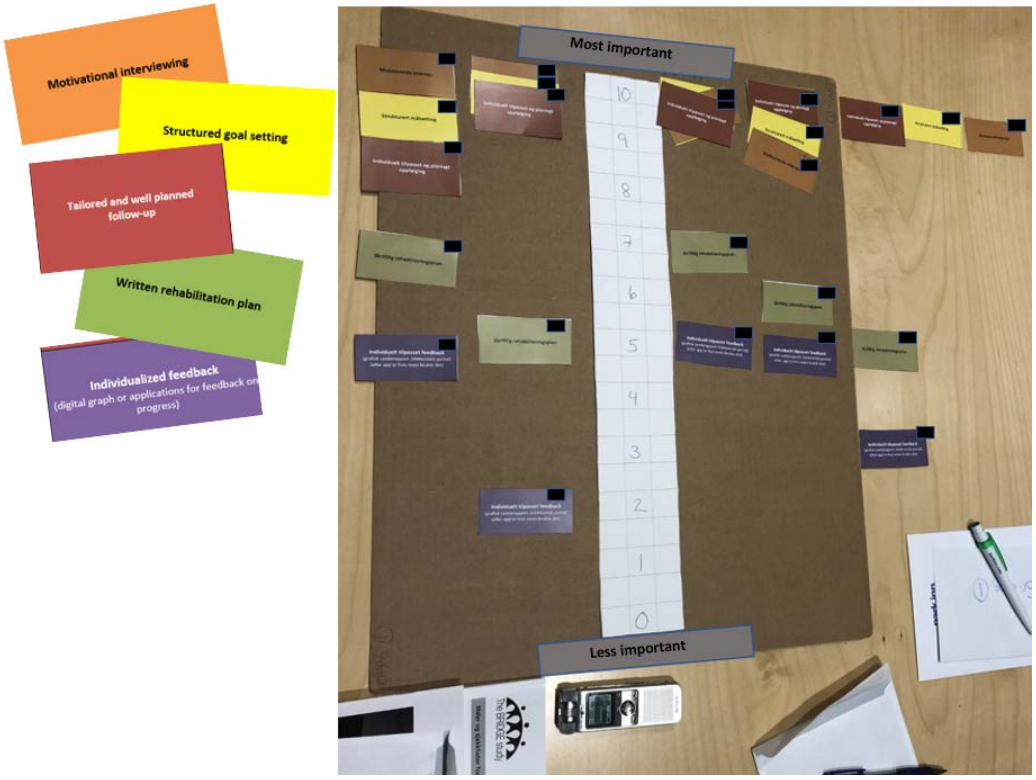
Figure 8 Items in the fidelity checklist developed to reflect the intended delivery of the BRIDGE program. (*Adapted from paper III, with icons reproduced under license from Shutterstock.com)*

4.7 Focus groups

An interview guide [149-151] was developed by the study researchers, a patient research representative and a provider representative. An identical guide was used in all groups, including questions about the providers’ impression of the program and their experiences of translating it into their local teams and setting. The guide comprised opening questions, main questions and wrapping-up questions, as shown in Additional file 3. The use of opening questions allowed the participants to “warm up” and feel comfortable [149]. Also, the opening minutes made it easier to recognize and differentiate the participants’ voices when transcribing the audio-files afterwards.

The included group tasks included use of stimulus material [149] to provide deeper insight in the providers opinions, attitudes, actions and interactions related to components and tasks in the program. During the tasks, the participants could express questions and concerns related to

the program delivery, and reflect on shared experiences and different viewpoints. Picture 1 illustrates task 1, in which the participants got one card for each element in the program. They rated the elements from less to most important to support the patients' rehabilitation process. They placed their cards according to the rating scale on the table, while expressing or discussing their underlying arguments. In task 2, they got one card for each tool in the program, and rated them from less to most useful to support the patients' rehabilitation process. In the scale from 0 to 10, 10 was best, either the most important element in task 1, or the most useful tool in task 2.



Picture 1 Rating task included in the focus groups, to stimulate various expressions about the program delivery.

Each group was facilitated by one moderator (to study researchers and one local project coordinator), and supported by an assistant moderator (members of the steering group). The assistant moderator acted as observer and note-taker, managed the material needed in the group tasks, and photographed the rating of the cards. The FGs were audiotaped and transcribed verbatim.

4.8 Analyses

As software for the analyses, we used Microsoft Office Excel 2019 and STATA/IC version 14.0 (Paper I and III) or 16.0 (Paper II) for numeric data, and NVivo 12 Plus for text data. In statistical tests, we set the level of statistical significance at 0.05.

4.8.1 Descriptive analyses and group comparison

In all papers, depending on the distribution of the variables, we presented continuous variables as mean values with standard deviations (SDs), or medians with minimum and maximum values. If more appropriate, we presented mean changes or median changes between different time points. In Paper II, skewed continuous data were also presented as interquartile ranges. Categorical variables were presented as frequency counts, percentages, or pass rates (calculated as percentages).

In Paper I, we compared the baseline characteristics of patients in the T_1 and T_2-groups, utilizing the independent samples t-test for normally distributed continuous variables, the Mann–Whitney U test for skewed continuous variables, and the Pearson's Chi square test for categorical variables. We also assessed the impact of clustering (centre) in each group, by calculating the intraclass correlation coefficients (ICCs) for primary and secondary outcomes.

4.8.2 Responsiveness, construct-approach

For the QI set, we investigated responsiveness defined by the COnsensus-based Standards for the selection of health status Measurement INstruments (COSMIN) panel as "the ability of an instrument to detect change over time in the construct to be measured" [152, page 742]. As responsiveness are considered as a measure of longitudinal validity, we carried out the study as a longitudinal pre-post-study between T1 and T2.

Since no gold standard was present, we tested the validity of the QI sets' change scores using a construct approach [115]. Three researchers (ALSS, GB, IK) developed a set of a priori hypotheses regarding the expected direction and magnitude of PR changes between T1 and T2. The theoretical rationale underlying the hypotheses included previous research on goal directed rehabilitation programs (presented in Paper I, additional file 3), previous pilot testing of the QI set [10], the content of the BRIDGE guiding booklets and fidelity checklist, and expert opinions. Before testing, we adjusted the hypotheses based on discussions in a research

group with the patient research partners, and colleagues with experience from assessing responsiveness using the construct approach in other projects.

The criteria for the magnitude of change were first defined for the provider-reported quality, as presented in table 11. We thereafter used the same criteria for the magnitude of changes in patient-reported quality.

Table 11 Criteria for the magnitude of change (the absolute change scores)

	No change	Small change	Moderate change	Considerable change
Provide-reported quality (structure indicators)	0 %	change for 1/8 centers, meaning: 1.0%–12.5%	change for 2/8 centers, meaning: 12.6%–25%	change for 3 or more centers, meaning: 25.1%–100%
Patient-reported quality (process- and outcome indicators)	0 %	1.0%–12.5%	12.6%–25%	25.1%–100%

We developed four hypotheses for changes in median summary PRs, and in total 53 hypotheses for PR changes for the single indicators (1-3 hypotheses for each single indicator). In accordance with de Vet et al [115], sufficiently responsiveness was indicated if at least 75% of the hypotheses were confirmed.

4.8.3 Regression analyses

In the BRIDGE trial, the data structure was longitudinal (repeated measurements) with data hierarchically clustered within the following three levels:

Level 1 and 2: repeated measurements (level 1) clustered within patients (level 2)
Level 3: patients clustered within rehabilitation centres

To account for correlations at all levels of clustering, we applied a three-level mixed regression model [140] in Paper II to examine the associations of patient-reported quality of the rehabilitation processes and the subsequent clinical outcomes (goal attainment, physical function, and HRQoL). We used a linear approach in each model, as we had continuous outcome variables (PSFS, 30secSTS, EQ5Dindex, and EQ5Dvas, respectively).

For each outcome, we treated its value assessed at 7 months (T_4) as the depended variable. The fixed effects were its baseline value. Fixed effects at level 2 were nine baseline predictors (age, sex, BMI, weekly training, comorbidity, paid employment, education level, civil status,

and smoking) and a variable capturing elapsed time since study start. At level 3, we included centre as a random effect. The primary independent variable was the summary PR for the process variables.

In a separate analysis, the primary independent variable was replaced by the three summary PR values for the single indicators grouped into categories (Group A-C).

In Paper II, we have also described a preparatory analysis prior to the main analysis in order to investigate the variation of care quality associated with the case-mix, and an additional analysis by replacing A_4-data with data with better proximity to the provided care (A_3). We also described two robustness analysis performed after the main analysis. In the first analysis, we used a likelihood test comparing linear regression models with and without the PR variables. In the second, we applied a mixed logistic regression in order to differentiate between those attaining minimal clinically important difference for the primary outcome (PSFS), and not.

4.8.4 Convergent mixed methods analysis

To develop a better understanding of the BRIDGE QIP, we used a convergent mixed methods (MMs) approach [126], allowing us to relate and combine measurable and interpretable aspects of how the quality improvement program was delivered. We needed to compare knowledge from both quantitative and qualitative approaches, and we developed four guiding research questions, as illustrated in figure 9.

First, data from each source was collected and analysed separately. Second, we conducted a synthesis of findings from questionnaire and focus groups during interpretation and discussion of the results. More specifically, we compared the results from the different data sources, and considered in what ways the results converged, diverged, or expanded each other [126]. We included joint displays in the paper, to illustrate how the data related.

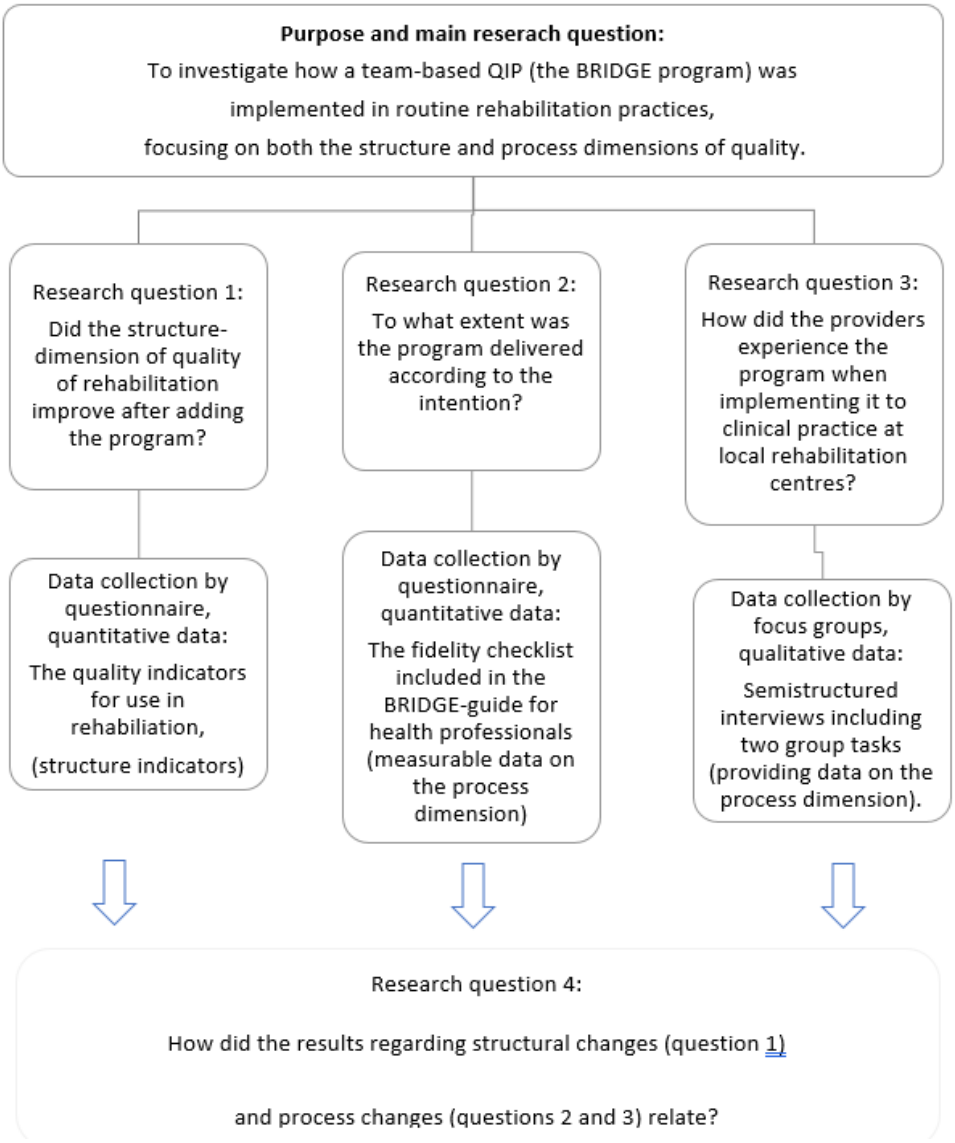


Figure 9 Purpose and included research questions in the mixed methods study. *(QIP=quality improvement program)*

4.8.5 Thematic analysis

Analyses of the FGs were included in the MMs approach. The purpose of the FG analyses was to explore how the providers experienced the program when translating it into the interactions with their patients in different, local rehabilitation units.

The verbal FG data were analysed using a reflexive thematic analysis [153]. We analysed the participants' experiences within a hermeneutic approach [154], allowing us to primarily focus on the *program delivery* as the phenomenon of interest, rather than the providers' subjective

experiences. In line with the research question, we could focus more on what the providers' experiences could inform us about the program delivery, and less on the subjective meanings that the program had for the providers [154].

Data engagement, coding and development of themes followed the six phases of Braun and Clarke's analytic process [153], not as a linear process, but rather as an iterative back- and forth-process between phases. First, a more inductive approach was taken to the analysis, driven by the content of the data itself. Then, expert opinions from our research group, and existing concepts and ideas from relevant literature [128, 155-156], were added to the interpretation process to expand the understanding of the program delivery.

About two hours audiotaped dialogs from each FG (118,132,105 minutes, respectively) were transcribed verbatim by ALSS as the initiating phase of familiarisation with the entire data set. We analysed for recurring patterns across the entire transcript material, and did not differentiate between the three focus groups. The main content of each phase in the analytic process is presented in figure 10.

Figure 10 Phases in the reflexive thematic analysis process.

4.9 Formal requirements and ethical considerations

The BRIDGE trial was registered at clinicaltrials.gov (identifier NCT03102814). All studies reported in Paper I-III were evaluated and approved by the Norwegian Regional Committee for Medical Research Ethics (REK South-East, 2017/665) prior to launch, and carried out in accordance with the principles of the Helsinki declaration. The external funder had no role in the design of the project, in the collection, analysis, and interpretation of data, or in writing the paper manuscripts or thesis.

Written contracts about participation in the trial were established between the local project coordinators, their leaders and the study researchers. Before data collection, both patients included in the trial and providers included in the FGs provided written informed consent to participate, after reading an invitation letter which explained the purpose and processes of the studies. Oral information about the study and participation was also given. All participants were informed about their right to withdraw at any time, without consequences for their access to treatment and healthcare. They were also informed about how privacy regarding personal information would be secured, including storage and management of data from the electronic data collection (patients), the telephone interviews (providers, about the QIs), and the FGs (providers).

As provided care during T1 comprised rehabilitation as usual, and T2 comprised an addition to the traditional programs, no patients received healthcare below the standards delivered at each participating centre at study start.

To protect the confidentiality of centres and providers, we used a different numbering of the clusters when reporting the results in the papers than the numbering according to the sequential intervention rollout in the SW-CRT. For the same reason, we did not link qualitative quotations from the FGs to the providers' gender, age, profession or centre allocation. The providers were compensated for the extra time needed to complete the FG sessions in a BRIDGE-meeting after ended FU conversations with the last patients.

Provider representatives and two patient research partners were members of the trial steering committee and involved at all stages of the studies. This included the development of the BRIDGE program, the material and tools included in the program, and the interview guide used in the FGs. They also influenced the procedures for data collection, analysis and interpretation of data, they revised article drafts and confirmed the final versions.

4.10 The researcher's role and reflexivity

As the validity of this work is not only a matter of the material and methods used, the influence of subjectivity is worth noting. In particular within the qualitative parts, the research was co-created as a joint product of the FG participants, the moderators, and our relationships [153-154]. This section is limited to the position and perspectives of one researcher (ALSS), and therefore written from the first-person-perspective.

4.10.1The researcher's position and perspectives

I approached the study with the following insights and preunderstanding: Considered as a resource, I knew the content of the QIP very well due to my previous role as the central project coordinator in the BRIDGE trial. Also, I could relate the provider-perspective on program delivery to over twenty years' experience as an occupational therapist in different multidisciplinary rehabilitation teams across care levels, and the last ten years delivering a team-based specialized RMD rehabilitation program in a hospital setting.

In the current researcher role, I was conscious of my probably biased attitudes towards the BRIDGE QIP, because I participated in development of the program. Hence, I was not neutral, and probably less critical. However, others in our research team were also aware of the possible influence from their developer positions. Consequently, we asked for different perspectives and critical views from those without a developer position within our research and steering groups.

4.10.2 Subjectivity in the data collection

In the moderator role in one FG, I felt a tension between being a clinician and a researcher, both influencing the moderator-participant relationship. As a clinician who had delivered programs similar to the BRIDGE program, I shared experiences with the participants, allowing me to resonate aspects of my experience with those of the participants. Positioned as familiar with the topics discussed, I could listen and ask follow-up questions based on my pre-understanding. Probably, the honest and rich data from the participants could be attributed to this familiarity, making the participants comfortable and open.

In the researcher role, I was aware of the normative aspects of both the QIs and the fidelity checklist, increasing the risk for response bias and restricted access to data reflecting actual practicing that did not fulfil these norms. As a moderator, I tried to forget the research question and my interest in optimal program delivery, and tried to practice the moderator role without normative attitudes. To do so, I focused on careful listening and curiosity, and asked for different views and perspectives, as if I was unfamiliar with the topic. This approach, which I call an "hypothetical unfamiliar position", was to some degree in conflict with the familiar position based on shared experiences. However, I think this moderator-behaviour from an imagined, unfamiliar position provided a complementary way to generate rich data, in terms of a higher degree of richness in words when the participants expressed their habitual routines and their reasons for why they changed or did not change them.

4.10.3 Subjectivity in analyses and interpretation

Theory about the providers' role in the delivery of complex interventions [128, 157] informed the analysis. Prior to the FGs, I was interested in the behaviour required from those delivering complex interventions, and the balance between standardized recommendations for care and the permitted degree of flexibility when tailoring complex interventions to a particular provider-patient relationship, within a local context. This interest was based on the UK Medical Research Council's (MRC) *"Guidance for developing and evaluating complex interventions"* [157]. From this position, I started the analysis, but without using the MRC guidance as a lens for a deductive approach. Rather, the first analytic approach was more inductive, in terms of immersion in the data, reading and re-reading, using a bottom-up approach to the initial generating of codes and themes. Then, engagement with data and engagement with theory blended together, as a situated interpretative reflexive process [153-154]. This "blending" was a result of theory I read during the analytic process, appearing as important and relevant for further interpretation of the initially generated patterns and shared meaning across the transcripts. Therefore, content from "*The model for Understanding Success in Quality (MUSIQ): building a theory of context in healthcare quality improvement"* [155] and *"The theoretical framework of acceptability"* [156] influenced the use of self, when I sought to interpret rather than simply describe the data. In the further process, I revisited passages, and added and refined codes, subthemes and themes. In line with the chosen approach to reflexive thematic analysis [153-154], this was a situated interpretative process, highly influenced by the attitudes, perspectives and theory I brought in. However, I also

brought others' perspectives into the interpretation phase, as I reviewed preliminary findings in our steering group, and invited a second researcher (HLV) to read, comment and discuss the analysis in more detail. Taken together, my subjectivity during this process was dynamic, as my preunderstanding was influenced and modified by the FG data, theory, and dialogs with other researchers. Accordingly, the generating of results was dynamic, as it was influenced by my subjectivity when I visited, modified, and re-visited the preliminary results in several steps.

5. Summary of results

5.1 Study samples

5.1.1 Centre- and provider characteristics

Eight rehabilitation centres participated in the studies; three located at hospitals and five private rehabilitation centres. The multidisciplinary teams included minimum four different professions. Six centers delivered inpatient stays for 3-4 weeks, and two hospital departments delivered a shorter stay (2 weeks), as either inpatient or outpatient rehabilitation.

In Paper I, we found that the ICCs for the primary and secondary outcomes were small (ICC_{psfs}=0.08, ICC_{30sec}=0.03, $ICC_{EQ5Dindex}$=0.06, $ICC_{EQ5Dvas}$=0.02), indicating a low impact of clustering. Consequently, we pooled patient-reported data from different centers for calculations of total PRs and single indicator PRs. An overview over centre characteristics is given in table 12. The FG-sample included the most typical professions in the teams, except doctors. The composition of the FGs is presented in table 13.

Table 12 Overview over included centre characteristics

	Participating centres	1	2	3	4	5	6	7	8
Healthcare system	Norwegian public healthcare system with equal access to all health care services	x	x	x	x	x	x	x	x
Level of care	Secondary level (specialist health care)	x	x	x	x	x	x	x	x
Type of setting	Hospital department of rheumatology	x	x				x		
	Specialized rehabilitation centre			x	x	x		x	x
Primary diagnoses (1=the biggest group, 5=the smallest)	Inflammatory arthritis	1	1	1	-	2	1	2	1
	Connective tissue diseases	2	2	-	-	4	2	-	2
	Wide spread pain or fibromyalgia	-	-	2	1	3	-	1	3
	Unspecific low back pain, neck- or shoulder pain (persistent>3 months)	-	-	3	2	1	-	2	-
	Osteoarthritis	-	-	2	-	5	-	3	3
	Osteoporosis	-	-	-	-	-	-	-	-
Length of stay	2 weeks		x				x		
	3-4 weeks	x		x	x	x		x	x
Professions in the rehabilitation team	Medical doctor*	x	x	x	x	x	x	x	x
	Physiotherapist	x	x	x	x	x	x	x	x
	Occupational therapist	x	x	x	x	x	x	x	x
	Nurse	x	x	x	x	x	-	x	x
	Social worker	x	x	x	-	x	x	x	x
	Psychologist	-	x	-	-	-	-	-	-
	Nutritionist or dietist	-	x	x	x	x	-	x	x
	Other**	x	x	x	x	x	x	x	x

**rheumatologist or specialist in physical medicine and rehabilitation*
*** other: sport educator, chaplain, assistant nurse*

Table 13 Characteristics of the participants and composition of the focus groups.

Group no.	Partici-pants	Age (years) (min - max)	Rehabilitation site	Profession	Postgraduated studies (completed)(or current) MI (courses or education)	Work experience in somatic rehabilitation (years)
1	5	31 -51	1 hospital 4 rehabilitation institutions	2 OT 2 PhT 1 SE	1 master 1 master (c) 1 postgrad.st 1 postgrad.st MI 3 1-day seminars MI	6 - 26
2	5	36 - 60	2 hospitals 2 rehabilitation institutions	2 0T 2 PhT 1 SW	1 master 3 postgrad.st 1 postgrad.st(c) 1 postgrad.st MI 4 1-day seminars MI	7,5 - 34
3	5	28 - 61	1 hospital 3 rehabilitation institutions	1 N 3 PhT 1 SW	1 postgrad.st 1 basic course MI 4 1-day seminars MI	3 - 30
In total	15	median 41 (28 – 61)	3 hospitals 5 rehabilitation institutions	1 N 4 OT 7 PhT 2 SW 1 SE	2 master 1 master (c) 5 postgrad.st 1 postgrad.st (c)	median 12 (3 -34)

c: current, OT: occupatinal therapist, PhT: Physiotherapist, SE: sport educator, N:nurse, SW:social worker, postgrad.st:postgratuated studies comprising 2 participants with master (completed) in i) public health science (1), ii) physiotherapy (1), 1 participant with master (current) in health science (1), 7 participants with postgraduated studies (completed) in i) multidisciplinary rehabilitation (1), ii) rehabilitation and integrated health (1), iii) evidence-based practice in health (1),iv) cognitive therapy (1), v) vitality training (1), vii) motivational interviewing (MI) (2), and 1 participant with postgraduated study (current) in cognitive therapy (1).

5.1.2 Patient characteristics

A prerequisite for inclusion in this work was the presence of response to the patient-reported QI questionnaire answered 2 months after admission. Prior to the A_3 assessments, some patients included in the BRIDGE trial withdrew or refused to continue in the project. A total of 357 patients remained in the BRIDGE trial at A_3 and were included in the patient sample in Paper I. A total of 293 (78 %) answered the QI questionnaire, and could be included in the patient sample in Paper II. Of the 64 patients who did not respond to the QI questionnaire, two persons in the control group and one in the intervention groups refused to continue a few days after the A_3 assessments were available. For the others, information is missing.

The control and intervention group in Paper I were comparable for all baseline variables except age, diagnosis, and disease duration. The differences in age and disease duration were not considered clinically important, and except for differences in diagnoses, the between-group comparability was considered acceptable. In Paper II, the sample was restricted to those who answered the QI questionnaire. The patients who did or did not complete the QI questionnaire did not differ systematically at baseline.

The patients were referred to rehabilitation most frequently due to inflammatory rheumatic disease (64%) or fibromyalgia syndrome (18%). Median disease duration for the primary diagnosis was 17 years. Fifty percent had other chronic diseases in addition to their primary diagnosis. More details about the patient characteristics are given in table 14.

Table 14 Baseline characteristics for patients included in Paper I and Paper II.

	Paper I sample (n=357)			Paper II sample (n=293)
	T1-group (n = 200)	T2-group (n = 157)	p-value	Cohort
Age, years, mean (min, max)	52 (21,81)	49 (18,77)	0.005[1]	52 (18,81)
Gender, female, n (%)	148 (74)	123(78)	0.341[2]	224 (76)
Diagnosis, n (%)				
Inflammatory rheumatic disease (SpA, PsA, RA, JRA)	143 (72)	85 (54)		188 (64)
Osteoarthritis	8 (4)	5 (3)	<0.001[2]	12 (4)
Connective tissue disease (SLE, SS, PMR, MCTD)	14 (7)	6 (4)		17 (6)
Fibromyalgia syndrome, CWP	20 (10)	51 (32)		54 (18)
Unspecific neck-, shoulder- and low back pain (>3 months)	15 (8)	10 (6)		22 (8)
Osteoporosis	0	0		0
Disease duration, years, median (min, max)	17 (1,67)	13 (0,68)	0.014[3]	17 (0,68)
Comorbidities, n, median (min , max) *	2.5 (0,9)	3 (0,9)	0.334[3]	145 (50)
Medication usage				
NSAIDs, n (%)	80 (43)	76 (53)	0.068[2]	134 (46)
Disease modifying anti-rheumatic drugs (DMARDs), n (%)	68 (37)	51 (36)	0.867[2]	55 (19)
TNF-inhibitors, Biosimilars, JAK-inhibitors n (%)	42 (23)	26 (18)	0.329[2]	102 (35)
Analgesics, n (%)	131 (70)	103 (72)	0.751[2]	194 (66)
Other drugs, n (%)	135 (73)	107 (75)	0.647[2]	201 (69)
BMI (kg/m^2), median (min, max)	28 (17,66)	28 (17,50)	0.662[3]	28 (17,66)
Smokers, n (%)	57 (29)	37 (24)	0.330[2]	69 (24)
Snuff users, n (%)	19 (10)	13 (9)	0.704[2]	21 (7)
Education > 12 years, n (%)	80 (40)	67 (44)	0.558[2]	117 (40)
Paid work, n (%)	85 (43)	69 (45)	0.664[2]	126 (43)
Recipients of social security benefits, n (%)	139 (81)	120 (87)	0.178[2]	213 (73)
Living with partner, n (%)	140 (70)	103 (67)	0.485[2]	201 (69)
Physical exercise ≥ 1 per week, n (%)	123 (62)	81 (53)	0.082[2]	164 (56)
General activity ≥ 1 per week, n (%)	147 (74)	104 (68)	0.220[2]	207 (71)

[1]Independent Samples T-test, [2]Pearson Chi Square test, [3]Mann Whitney U test. SpA: spondyloarthritis, PsA: psoriatic arthritis, RA: rheumatoid arthritis, JRA: juvenile rheumatoid arthritis, SLE: systemic lupus erythematosus, SS: Sjögren syndrome, PMR: polymyalgia rheumatica, MCTD: mixed connective tissue disease, CWP: chronic widespread pain. Disease duration (symptom debut) and comorbidities are self-reported. NSAIDs: nonsteroidal anti-inflammatory drugs, DMARDS include corticosteroids, TNF: tumor necrosis factor, JAK: Janus Kinase. BMI: body mass index (bodyweight/height^2). Physical exercise: increased heart rate and breathing for 30 minutes or longer. General activity: social or cultural activities, hobbies, work.

**For the sample included in paper II, comorbidities are presented in frequency (yes, comorbidity ≥ 1) and percentage.*

5.2 Responsiveness of the QI set (Paper I)

The aim of this study was to assess the responsiveness of the QI set for rehabilitation services for people with RMDs.

A total of 161/200 (80.5%) patients in the T1-group and 132/157 (84%) in the T2-group, completed the QI questionnaire. The response rate from participating centers was 100% at T1 and T2.

Using the construct approach, we found that three out of four (75%) hypotheses for change in median summary PRs were confirmed. Among the hypotheses for change in single indicator PRs, 9 out of the 62 initial hypotheses were not applicable. Of the remaining 53 hypotheses, 44 (83%) were confirmed. Taken together, the observed change scores were consistent with ≥75% (our chosen cut-off value) of the hypotheses, indicating adequate responsiveness of the instrument.

We concluded that the QI set for rehabilitation was sufficiently responsive at T2, meaning that the QI set will provide valid change scores when used to measure changes in quality of rehabilitation before and after efforts to improve the quality.

5.3 Associations between level of quality and clinical outcomes (Paper II)

The aim of this study was to examine the associations between patient-reported level of quality of the rehabilitation process and subsequent clinical outcomes.

A total of 293/374 (78%) patients completed the QI questionnaire at A_3.

Using linear mixed model analyses, we found that higher summary PRs for the process indicators were not associated with improved primary and secondary outcome data measured at A_4. Logistic mixed model analyses with the primary outcome as a dichotomized variable gave the same results.
Neither of the PRs for det main themes in the rehabilitation process (Group A-C) could explain the variance in any of the clinical outcomes. However, an interesting observation was that the PR was lower (median 40%) for individual FU and coordination across levels of care

(Group C), compared to initial assessments (Group A, median >90%) and individual goal setting (Group B, median >90%).

Related to proximity, we found no associations when outcome data at A_4 (7 months after admission) were replaced with data collected at A_3 (2 months).

We concluded that no associations were found between the process PRs and any of the outcome variables, meaning that the variance in goal attainment, physical function or HRQoL (respectively) must be explained by other factors than the perceived quality of a structured, goal-directed rehabilitation program.

5.4 Delivery of a quality improvement program (Paper III)

Det aim of this study was to investigate the delivery of the BRIDGE QIP when implemented into different sites, and how it influenced the structure and process dimensions of quality in rehabilitation services. This was investigated from the provider-perspective, and included data from two questionnaires and three FGs.

5.4.1 Changes measured by structure indicators

All participating centres completed the QI questionnaire at both T1 and T2. At the group level, the median for summary PR increased from 53 to 90 from T1 to T2. After adding the QIP, all centres had high fulfilment of the structure indicators, as illustrated by PR summary ≥90 for each centre.

For single indicators, the highest degree of improvement was observed for the use of standardized instruments in initial assessments, but also during the whole rehabilitation process (admission, discharge, and after 3-6 months). After adding the QIP, the PRs were 100% for all indicators, expect for the two indicators related to attendance in meetings for next of kin or external services (PR ≤ 25).

From this part of the MMs approach, we concluded that after adding the QIP, the structure dimension of quality improved, and all centres had written procedures or method descriptions present and easily accessible, as a foundation for the daily clinical practice. The fulfilment of structure indicators applied to nearly all phases in rehabilitation, but not for asking the patients about attendance in meetings for significant others.

5.4.2 Program delivery according to the intention

The providers completed the fidelity checklist for 156/168 patients (93%) when delivering the QIP. While variation was observed (range 6%-100%), the median summary fidelity score was high (94%).

When we examined fidelity scores for single items, we found that initial goal setting was delivered with higher fidelity compared to tailored follow-up across levels of care. Program components addressing the period after discharge and involvement of external services were delivered with less fidelity, compared to the inpatient parts of the program.

From this part of the MMs approach, we concluded that the providers delivered most of the program components to the majority of their patients. However, the measured program fidelity was lower for use of written plans for rehabilitation, strategies for overcoming potential barriers, feedback on progress, FU and involving of externals.

5.4.3 Providers experiences of the program delivery

The 15 members of the FGs represented all participating centres and five different professions.

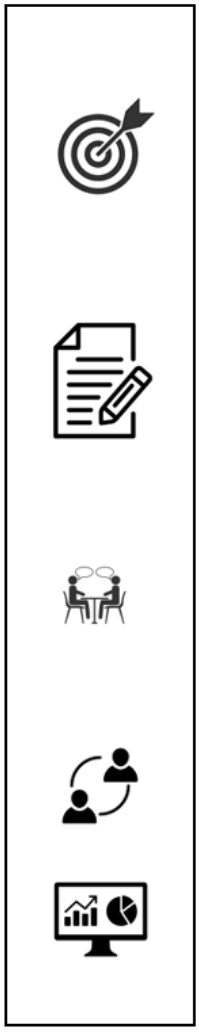
Seen from the perspectives of the providers, optimal program delivery seemed to be supported by institutional and individual efforts, as reflected in four themes generated from the FG material: i) improving my professional skills, ii) paying attention to my professional toolbox, iii) expressing my professional mind, and iv) optimize the organization at my workplace. In other words, the program delivery depended on the degree to which the providers felt confident towards intended components, trained their counselling skills, used available tools to support their practice, and linked their interventions to theoretical concepts, such as the patients' autonomy, responsibility, coping, self-efficacy, and self-management.

At the institutional level, critical features seemed to be organization of time and resources to facilitate dedicated time to goal setting and team work in interaction with the patients, and improved attention to the patients' needs for involvement of next of kin or external services. Additionally, better program delivery seemed to occur if the providers experienced an institutional culture for quality improvement, as being offered education and workshops. In

table 15 we present the main results from the thematic analysis, according to each component in the BRIDGE program.

From this part of the MMs approach, we concluded that the program delivery was inconsistent, and also depended on contextual factors.

Table 15 Main results from the thematic analysis, addressing each component in the BRIDGE program. *(Icons reproduced under license from Shutterstock.com)*



Structured goal setting • *Skills:* The providers could be less comfortable in developing written goals, compared to oral agreements • *Skills:* To become more confident in goal setting, some prepared by reading about goals in the guiding booklet • *Tools:* All the providers implemented "The shoe", mentioned as useful to support the P's rehabilitation process, and to engage different professions in the team • *Tools (and organization):* Some providers forgot the video about rehabilitation goals. Others used it, if compatible with established routines • *Mind:* Some providers linked goal setting to theoretical concepts, such as P's autonomy, motivation, and responsibility • *Organization:* At the team- or institutional level, some leaders organized education sessions, workshops for training goal setting skills, and peer-to-peer-reflections. Some leaders re-organized schedules resulting in better possibility for the providers to pay attention and time to goal setting.
Written rehabilitation plans and strategies to overcome barriers • *Skills:* The providers could be less confident regarding strategies to overcome potential barriers • *Skills: When patients expressed their positive feelings regarding strategies for overcoming barriers, the providers who experienced this, get motivated to implement the component to a higher degree, and to improve their skills in that kind of counselling* • *Tools*: At some centres, the written plans resulted in better and more goal-directed teamwork across professions • *Mind:* Some providers linked written plans to theoretical concepts, such as coping skills, ability to solve problems, feedback on progress, and self-management. Others perceived the written work as less important, or too time-consuming.
Motivational interviewing (MI) • *Skills and tools:* The providers could be less confident regarding MI rating scale, e.g. related to developing the coping plan. • *Skills and tools:* To become more confident in MI, some prepared (e.g. to the FU-conversations on phone) by reading about MI in the guiding booklet • *Mind:* For some providers, the MI rating scale was useful to support the P's process, and the tool was linked to theoretical concepts such as self-efficacy, coping, responsibility. • *Organization:* At the team- or institutional level, some leaders organized dedicated time to practice and develop MI skills, education sessions, workshops, and peer-to-peer-reflections
Tailored follow-up (FU) • *Mind:* The providers perceived the program as a reminder of the P's further process after discharge • *Organization:* At the team- or institutional level, the content of education- or workshops-initiatives seemed to address goal setting and MI, and not tailored FU, progress on feedback or cooperation with next of kin or external services.
Personalized feedback / graphs to monitor the progress • *Mind:* Some providers payed little attention to this component. For those who did, experienced effectiveness was the most prominent reason, and they linked the component to concepts such as self-management, coping skills, ability to solve problems, and self-efficacy. • *Mind:* Higher attention – or new understanding - towards forgotten or omitted tools or components could arise from peer-to-peer-reflections and listening to experienced colleagues, or be reminded just by talking about their practicing.

5.4.4 Integrated results and conclusion of the mixed methods study

As a result of merging the quantitative and qualitative data, we found that the QIP improved both the structure and process dimension of quality in rehabilitation, but that program delivery may have been suboptimal as it depended on contextual factors, such as the providers' skills and competence, and factors within their teams or institutions. Implementation of the QIP

seemed more successful from the perspective generated from a quantitative approach, than from the integrated result based on both quantitative and qualitative approaches.

This study highlighted persistent needs for better quality in the area of follow-up across levels of care, but efforts to reduce undesired variability in delivery of initial parts of the rehabilitation process are also needed.

Based on these results, we concluded that planning and evaluation of program delivery require equal attention to all stages within the rehabilitation process. Leaders and clinicians should discuss efforts to gain a confident and qualified delivery, at the levels of individual providers, teams and institutions. Such approaches may enable the likelihood of successful implementation of quality initiatives, and reduce undesired variability in program delivery across providers and institutions.

6. Discussion

In clinical practice, healthcare providers and patients apply different kinds of reasoning and knowledge to support shared decision making and increase the chance of attaining desired outcomes. In line with this, different kinds of knowledge were used in this thesis to make inferences about evaluation and improvement of quality in the delivery of team-based rehabilitation programs.

In this chapter, the discussions will first focus on methodological strengths and limitations in a broader perspective than the issues already discussed in each paper. Thereafter, the main findings in this thesis will be discussed.

6.1 Methodological considerations

6.1.1 The pragmatic position

The main focus in this thesis was quality of healthcare. By its nature, this concept contains elements that are possible to define and measure, but also elements that are difficult to capture. As described by Donabedian; the quality of healthcare is likely to lie between "*the secret and the glory of our [medical] art*", not possible to measure, and something easy to measure, "*like a sack of potatoes being weighed*" [63]. To navigate this middle course, we used a pragmatic position to identify ways of assessing quality of care and strategies to improve it. Hence, our ontological approach was not restricted to observable aspects of reality, and the epistemological approach comprised aspects of both post-positivism and interpretivism [125-126]. More specific, we applied a multi-perspective on quality of healthcare, and developed evidence from both quantitative and qualitative data.

6.1.2 Study design

The BRIDGE study comprised research questions beyond those included in this thesis, and the study was therefore designed as a multicenter SW-CRT in which the institutions were followed before and after adding the BRIDGE program and patients were followed over a year after admission to a rehabilitation institution [9, 137].

The pre-post evaluation design

In Paper I, we perceived responsiveness as longitudinal validity, requiring a longitudinal design to be evaluated [115, 152]. Nested within the SW-CRT, we evaluated changes in pass rates for quality based on measurements before and after adding the BRIDGE program. Hence, we could use a pre-post longitudinal approach, well fitted to evaluate responsiveness for an instrument [152]. In line with the COSMIN recommendations for responsiveness, we used the construct approach and tested hypotheses about expected change scores of the pass rates before and after adding the new program [152].

A strength of this approach was that we included the content of the BRIDGE program which reflected the core content of recommendations for good rehabilitation practice. Thus, the program could be defined as a quality improvement program, expected to influence true change in quality of rehabilitation. As a consequence, we could describe relevant events likely to occur in the interim period and formulate hypotheses to test the ability of the indicator sets to detect expected changes [115, 152]. We also considered the time point for T2 (6-8 weeks after adding the new program) as appropriate, allowing the new structure to be established and described by the managers at each centre when they responded to the structure indicators the second time [152].

Conducting this study within the SW-CRT design also posed some challenges. Whereas the providers completed the questionnaire twice (before and after adding the new program), each patient completed the questionnaire only once, at two months after admission.
However, our research interest was in the quality of delivered care, as an attribute of each centre and not an attribute of the patients. As the patient groups in the control and intervention period were comparable for most baseline variables, we considered the patient data as two measurements reflecting the patients' perspective on quality of rehabilitation in these two periods. Even if there were some differences in age, disease duration and diagnoses, we do believe that the data reflect the context of routine practice in which the indicators shall be used to measure and monitor quality in rehabilitation. In future routine practice, the provider perspective on quality of structures will be tested before and after efforts to improve the quality, whereas the patient perspective will be measured once from each patient admitted to rehabilitation, as a continuous gauge providing information about the current quality of care.

The prospective cohort-design

In Paper II, we focused on the patient perspective on quality. The aim was to examine associations between patient-reported quality of care and clinical outcomes. The prospective

cohort design was chosen because it is suitable to examine such relationships, and to explore influence of moderators or covariates [140, 158, 159]. The patient sample in the BRIDGE study was therefore analyzed as one cohort, regardless of group allocation. A strength of this approach was that it provided a large sample size with a large variety of perceived quality, allowing us to examine if this variance was associated with varieties within the scores of each clinical outcome.

In separate analyses, we included outcomes (dependent variables) reflecting goal attainment, physical function and HRQoL measured at baseline and after 7 months. A limitation may be that we did not use the other outcomes available in the BRIDGE study, such as functioning in daily activities, social participation, mental health, pain and fatigue. However, these aspects may be covered by the included variables for goal attainment, physical function, and HRQoL. In particular, the EQ-5D covers a broad perspective, including mobility, self-care, usual activities, pain/discomfort, anxiety and depression, and the general health state captured by the EQ5D-vas score [146]. Another limitation may be the time interval from baseline to the chosen endpoint after rehabilitation in specialized healthcare. In the BRIDGE trial, seven months after admission was chosen as the primary end point to provide sufficient time for the patients to establish new habits and self-management strategies in their daily routines. The long interval may have challenged the recommended proximity of the outcomes to the received processes of care, in particular in cases in which no supported FU was established. Therefore, we performed additional analyses in which outcomes measured at 7 months were replaced by similar data measured at 2 months. However, the results remained the same.

The mixed methods design

In Paper III, the research problem called for a MMs design, as we explored the providers' perspectives on both measurable and interpretable aspects of how the BRIDGE quality improvement program was delivered. This design allowed us to collect, analyze and integrate both qualitative and quantitative data in response to the research questions [126]. Since the quantitative and qualitative methods occurred concurrently, but separate within the intervention phase of the BRIDGE study, we used a convergent MMs design to integrate the results. This integration was carried out in the last part of the analyses phase and during the interpretation phase, and placed equal emphasis on both stands (noted as QUANT + QUAL) [126].

An alternative MMs approach could have been to use an explanatory sequential design, noted as QUANT→qual [126]. If so, we would have started with collection and analysis of quantitative data, and thereafter used these results to develop a question guide for the focus groups, designed to elaborate on the initial quantitative results [126]. However, in our study, we had an equal interest in both the quantitative and qualitative stand from start, and therefore needed to use both approaches in parallel to expand our understanding of the complex phenomenon of quality of healthcare.

6.1.3 Analytical considerations

The pre-post evaluation of responsiveness

The development of a rationale for each hypothesis posed some challenges. On the one hand, results from the pilot testing of the QI-set in a similar context indicated that at least some of the rehabilitation centres had a potential to improve on the construct to be measured. Thus, hypotheses regarding aspects of quality likely to change were developed based on the results from that study and other previous research [10, 31, 109, 141, 160-162], including both expected direction and magnitude of change [115, 152]. On the other hand, the research evidence was limited. Therefore, equally important for the rationale and the ability to develop predefined hypotheses, were expert opinions from patient research partners, clinicians with different professional backgrounds, and researchers with experience from evaluating measurement properties of other QI sets. However, due to uncertainty about expected changes, we could not know for sure whether all hypotheses were valid. Although unavoidable, this uncertainty represents a limitation of this study.

Regression models used in the prospective cohort-design

The independent variable (QI pass rates) and the dependent variable (clinical outcomes) were essential components in the multivariable regression models. The main interest was to evaluate to what degree we can perceive the level of quality as a modifiable target for interventions to improve the patients' desired outcomes [158-159]. A wide range of a priori defined baseline predictors were included in the models. In the analyses, a relatively high degree of complexity was introduced by the SW-CRT design, the examination of the PRs both as summary and grouped values, the examination of the primary outcome both as a continuous and dichotomous value, and the robustness analysis. The complexity may reduce the possibility for others to evaluate or replicate these analyses, and may therefore represent a limitation of this study [158-159].

The integration phase in the mixed methods analyses.

A strength of this study is that quantitative and qualitative data were collected for the same purpose of enhanced quality and insight on the program delivery, and that the clinicians who completed the fidelity checklists and provider QI-set also participated in the focus groups. Hence, the respondents had experiences from the same program delivery, and parallel concepts were present across the qualitative and quantitative data sets, which is considered as good strategies in MMs in order to draw valid inferences from the integrated data [126].

However, while the researchers in our group were skilled and experienced in both quantitative and/or qualitative designs, we were less experienced in conducting MMs. Initially, the merging tended to fit only the more descriptive parts of the focus group analysis, at the expense of data generated from the more interpretative perspectives. However, by efforts and training, we attained a better balance between the different approaches.

6.2 Main findings

6.2.1 Responsiveness of the quality indicator set for use in rehabilitation

The results from testing the responsiveness (Paper I) confirmed the quality indicator set's ability to detect changes over time in the quality of team-based rehabilitation for patients with RMDs.

We considered the responsiveness to be good, as only a small portion (≤ 25%) of the a priori hypotheses were rejected. This applied to the scores from both the provider and patient perspectives, as well as the summary scores and scores for single indicators.

Previous data to compare the results with do not exist, as the current evaluation of responsiveness was the first and can be considered as part of the field testing for this newly developed instrument. Prior to our study, the indicator set was proven feasible, with satisfactory face- and content validity. Future studies should investigate the reliability of the set, as this measurement property reflects the stability and consistency of repeated measures [115]. With regard to patient's response to the indicators, the relevant issue would be intrarater agreement. For provider's response, assessing interrater reliability would also be relevant, as different managers or team leaders may complete the questionnaire in routine practice, and lowest possible response variability between raters is wanted. In our study, the same person responded to the indicators before and after the intervention at each centre. Still,

the lack of knowledge about the test-retest reliability of this instrument represents a limitation. On the other hand, one can argue that the reliability most likely is good because a quality indicator, by its nature, reflects measurable aspects of quality, such as the presence of written goals (yes/no) or a template for rehabilitation plans (yes/no). This is in contrast to other kind of measures requiring complex procedures or higher degrees of interpretation from patients or providers [115, 163]. Thus, we assumed the reliability to be acceptable, and used the instrument in our studies.

The current findings regarding responsiveness provide evidence for the validity of the change scores, indicating that the set can be recommended for detecting change over time in quality of delivered rehabilitation within or across care levels in multidisciplinary settings. Although this was confirmed in the particular group of non-traumatic, non-surgical RMDs, there is a high probability that the set will be found responsive for people with other long-term diseases in need of team-based goal directed rehabilitation, supported self-management and follow-up.

The QI-set can be used for different purposes. Based on the findings from the current study, the QI set can be used to assess the effectiveness of quality improvement initiatives addressing either the full spectre of the included indicators, or a smaller selected sample. In daily practice, managers and clinicians can use the indicators to measure the level of quality before and after local improvement initiatives, or as response to public demands of documented level of quality and changes over time. Both improved and maintained level of quality can be captured by this instrument, providing useful information to patient advisory boards, leaders and other involved in quality improvements within the provider system.

Comprising two separate questionnaires, the indicator set allows for monitoring and comparing changes in quality from both a patient and a provider perspective [10]. This is valuable, as these perspectives may differ, and inputs from both sides are highlighted as important in efforts to improve the quality of care [52, 60]. Public data on quality of healthcare delivery can inform patients' choice of providers, as well as health authorities' planning for future management of rehabilitation.

With 19 structure-, 11 process-, and three outcome indicators, the QI set is relatively extensive. Despite its proven feasibility and the indicators being distributed in two shorter questionnaires, it may be relevant in future studies to review each indicator and consider possible redundancy. As pointed out by others, including many detailed questions in a set may

undermine its ability to provide an overview of the quality services [49-51]. Moreover, a shorter set may be combined with other indicators to monitor more disease specific aspects of the management and rehabilitation [164].

However, as there is a lack of indicators reflecting the core elements of multidisciplinary rehabilitation for patients with RMDs, we consider the current set as important and useful to raise awareness and establish benchmarks on good quality in delivery of such services. Further, the present work contributes with knowledge about measurement properties, and provides support for the use of this indicator set in clinical practice and research in order to monitor the level of quality over time, evaluate the effectiveness of quality initiatives, and address unwarranted differences in healthcare delivery.

6.2.2 Associations between process and outcome indicators

In Paper II, there were no associations between the patients-reported pass rates for the process indicators and any of the outcome variables, indicating that the variance in patient reported outcomes most likely is explained by other factors than the perceived quality of the delivered rehabilitation processes. These findings will in the following be discussed in light of the results from the SW-CRT.

In the main study of the BRIDGE project, the effectiveness of the program was evaluated on patient reported goal attainment, physical function and HRQoL. No significant effects of the added program were found for either of the clinical outcomes measured 7 months after admission [137-138].

In the main study, the control group comprised patients who received the traditional program, while the intervention group comprised those receiving the added BRIDGE program. However, while clinical trials provide good estimates of average effects, it is recognized that the treatment effects are not necessarily the same for everyone receiving the same treatment [165, 166]. This may be related to the statistical problem of heterogeneity of treatment effects [166]. Accordingly, the average effects may reflect a mixture of prominent benefits for some, small for many, and none for others [166]. Researchers therefore acknowledge that clinical outcomes may reflect tradeoffs between the treatment in each group, timing of events, patient's values and preferences, and other contextual factors [166]. Among such factors, the

potential influence of the patient perspective on quality of the received processes was focus in Paper II in this thesis. We considered all patients as one cohort, instead of performing separate analyses for each group, and found that patients who reported higher quality of the received rehabilitation process did not report better outcomes after 7 months, compared to those reporting lower quality of the rehabilitation process. As a consequence, we concluded that the quality of rehabilitation processes was not associated with the subsequent clinical outcomes.

It is possible that performing regression analyses for the intervention group only, could have given more specific knowledge about the BRIDGE program and the lack of proven effectiveness. However, such a focus would have been too narrow for the research question in paper II, in which the primary interest was the patient-reported quality of the process dimension per se, and its potential associations with clinical outcomes, independent of patients' affiliation to control or intervention group.

Compared to previous research on RMDs and other indicator sets, the lack of associations between processes and outcomes may be related to strengths and weaknesses of each dimension, as explained in the following.

Outcomes

Within the field of health services research, it is proposed that outcomes capture the downstream effects of the provided healthcare processes [167]. In contrast, the evidence of the associations between processes and outcomes are inconsistent, and many studies have found minimal or no associations between the two dimensions [99, 117-122]. Still, in a report on quality of health from the OECD, the use of patient outcomes is clearly stated as important to ensure delivery of programs that are responsive to patients' needs [43]. In particular, the use of PROMs is highlighted as useful tools to engage patients in decisions, prioritizing, and planning related to their healthcare, and as a mean to deliver patient-centred care [43]. On the one hand, differences in outcomes may reflect differences in quality of delivered care, for example due to underuse of appropriate evidence-based interventions, or the team-members skills and competences [116]. Therefore, outcomes are of relevance as quality indicators. On the other hand, several outcomes are likely to be affected by factors beyond the provided care [73, 117, 167]. Such factors limit the value of outcomes as indicators of quality, if not complemented with accompanying process indicators [116, 167].

It can be discussed if outcome measures intended for use in clinical trials or routine practice are the most suitable for evaluating the quality of provided care [167]. An issue for future

research may therefore be to address the choice, or development, of outcomes more specified and suitable for monitoring the quality of care.

Process

Process indicators has been proposed as valuable in rehabilitation, as direct measures of core components in complex interventions. The process indicators can be considered as real time measures, as longer periods of time are often necessary to establish the desired patient outcomes, resulting in more influence by contextual factors, such as lifestyle and socio-economic circumstances [116-117, 167]. Another advantage is that process indicators convey information about which parts of the rehabilitation process that work well and where there is a potential for improvements. In other words, compared to outcomes, the process indicators are more informative about challenges related to delivery of care [116, 167-170]. As an example, we found lower pass rates for the domain of follow-up and coordination, compared to initial assessments and tailored goal setting (Paper II).

Comparing current practice to norms captured by the indicators appears as valuable for the purpose of identifying and reducing unwarranted variations in delivery of care. Information collected by the use of indicators can inform dialogs between the parties involved in processes of problem-solving and agreements on adequate strategies to improve clinical practice. In several cases, the appropriate strategies include efforts at other levels of practice delivery than the everyday processes conducted by clinicians and teams [45, 123]. At the level of leaders of health services, quality initiatives include the issues of redesigning systems and budgeting, better use human and material resources, integrated services, information technology, room- and time planning, workflow sheets, provider education and supportive performance feedback, learning collaboratives, and better models of referral and information flow within and between institutions and care levels [45,123, 171]

Considerations for unwarranted variations can be addressed in research by statistical analyses prior to regression analyses exploring the associations between service delivery and patient outcomes [172-173]. Also, a more interpretive stance can be used to explore the issue of warranted and unwarranted provider practice, for example by using observation of practice trajectories, interviews with leaders of institutions or teams, or focus groups with clinicians who deliver the interventions [45, 124, 173]. In this thesis, we supplemented the information gained in the current association study with insights into the provider perspective on program

delivery, developed by combining results from questionnaires and focus groups in the MMs approach (Paper III).

6.2.3 Delivery of the BRIDGE quality improvement program

In the following, the results regarding follow-up and clinicians' behaviour changes in the MMs study (Paper III) are highlighted and discussed.

Follow-up

The area of FU was the most challenging part of the BRIDGE program delivery, despite its explicit intention of bridging the gaps between healthcare levels. Few patients were asked if they wanted attendance of next of kin or external services in the rehabilitation meetings (Paper II), and few institutions had written procedures for their daily routines addressing the same issue (Paper III). After adding the BRIDGE program, all centres had procedures for involving externals in planning the FU (Paper III), but most likely, this was explained by the written BRIDGE material distributed to each centre, and not necessarily due to new procedures developed and included in their local procedure systems. Despite written material, the practicing of involving externals were suboptimal across centres, as shown by lower fidelity scores for the items addressing collaboration and dialog with externals or next of kin before and after discharge (Paper III).

The need for self-management support and FU are clearly documented for patients with RMDs [174-180]. Our findings therefore reflect unwarranted practice. It is known from previous research that patients' needs are wide-ranging, and comprise informational, emotional, social and practical support given by professional services or significant others. Most likely, the patients' needs relate to services provided by the general practitioners, physiotherapists and other professions in the municipality, but also labour and welfare services, and support from colleagues, family, and other patients [174-180]. Previous research has shown that multidisciplinary rehabilitation improves the short-term outcomes for people with RMDs, but the benefits tend to decline quickly [161, 181]. Therefore, supportive interventions after discharge should be considered to sustain these beneficial rehabilitation effects for longer time [161, 181].

Plausible explanations for the lack of coordination in our study, may relate to both the structure and process dimension of program delivery. Based on the FGs, it seems like educational initiatives from the leaders addressed the issues of goal setting and motivational

interviewing, whereas there were little efforts to maintain self-management and establish necessary FU after discharge. Institutional efforts to improve the information flow or coordination with others, was not mentioned in the focus groups. A few mentioned the involvement of externals through meetings or phone calls, but this was not the typical pattern found in our study. Despite the characteristics of rehabilitation as grounded in each patient's everyday life, our results imply that their needs for support in the home setting may be ignored or not sufficiently ensured. Hence, services across care levels seem to operate independently of each other, and not as coordinated pathways. Such fragmented services is also described in the OECD report covering several international studies [43].

In their "Lessons learnt" report from 15 reviews of health are quality, the OECD calls for stakeholders' courage to challenge the existing way to work, and enable better coordinated services across health and social systems [43]. Accordingly, future research may include development of new models capturing where and how multidisciplinary rehabilitation is provided [43]. Recommended strategies to improve the structure include technical efforts to build better information systems to ensure effective communication and collaboration between providers in primary care, municipalities, hospitals and other institutions [43, 113]. The use of financial incentives is another strategy [43]. The Norwegian system for public reimbursement reflects measures taken to ensure that providers within secondary healthcare services collaborate with relevant services beyond their institution, and also that written plans are developed for how to involve primary care and the general practitioners in the follow-up [182, page 54-55]. It is an important issue for future research to explore how the leaders of health institutions implement such regulations in routine practice delivery.

In a systematic review of the quality of primary care for osteoarthritis, as measured by quality indicators, more than two-thirds of the included studies had overall pass rates below 50%, implying a notable potential for improvement [183]. The knowledge-gap in the municipalities are also described in a report from Norway, in which a high portion of leaders and general practitioners in primary care answered that the rehabilitation competence in their unit was below the desired level [184]. This points to the responsibility of professionals in secondary care to provide guidance and advice to municipalities, both related to individual patients and in general [185]. It also points to both levels' responsibility of proper work with required qualifications [186]. International recommendations for quality improvements, include initiatives to establish a culture of change, competence, and mutual trust between providers, in

order to enable genuine collaboration and effective integration between primary and secondary care [43]. We suggest that this issue should be addressed in future research.

Clinicians' behaviour changes

The clinicians' behaviours and reasoning were highlighted in Paper III, as influential parts of the healthcare delivery. The quality and practicing of several parts of the BRIDGE program depended on the provider's skills, experiences, attention to available tools, and theoretical reasoning.

While the issue of behaviour change is present in the existing literature on rehabilitation, there is remarkable less research addressing the providers' behaviour change counselling, compared to theory and evidence about modifiable health behaviours and change at the level of patients [187]. This gap is notable, as the issue of patient's behaviour change certainly is essential in self-management of chronic diseases. Even if barriers exist, there is evidence supporting that the patients' behaviour change is possible for various health behaviours, such as smoking, inactivity, poor diet, insufficient sleep, and medication nonadherence [187]. However, evidence developed at the level of populations cannot directly be translated to standardized counselling for the individual patient regarding changes towards healthy behaviour [188]. Within rehabilitation and self-management theory, the issue of personalised care is highlighted as important, meaning that changes have to be based on the individual patient's choice and control over goals and plans for self-management. In addition, what is planned and delivered should be guided by the individual patient's strengths, needs, and capacities, as well as their communities and environment at home [188]. Hence, competent clinicians are needed to provide skilled counselling addressing comprehensive aspects of the patient's behaviour change, along each step within the process from planning to effectuating, adjusting and maintaining desired changes [130-132,189]. Time and efforts invested in goal setting and inpatient care, is likely to be wasted if the further process of implementing and adjusting the process is not sufficiently planned for and supported until the attainment of desired goals [130-132,189].

Important findings in Paper III pointed to the potential divergence between what was delivered (measured by the fidelity checklist) and how it was delivered (explored in the focus groups). The latter captured a possible variation in program delivery due to differences in the professionals' development or update of knowledge and skills needed to deliver the BRIDGE program as intended (Paper III). As part of their professional behaviours, clinicians stated that

the most challenging issues were counselling related to patients' potential barriers to behaviour change and how to overcome them, feedback on progress, and appraisal and guiding based on patients' self-efficacy and confidence in actions included in coping and rehabilitation plans (Paper III). While previous research has highlighted that such provider competence is important within rehabilitation [131], it could be proposed that too little attention to training and education of clinicians may have undermined the effectiveness of behaviour change interventions [187, 190-192].

Interestingly, the clinicians in our FGs mentioned various means to improve professional skills and pay attention towards theory driven practice, such as institutional education groups, unformal workmate discussions, sharing their own reasoning and practice, reading bullet points in the guiding booklets before the next patient encounter, and use of provider reminders reflecting the core activities intended to be delivered (Paper III). However, the quality of program delivery seemed to depend on the extent to which such possibilities were present and used in the local team and institution. In the literature, clinicians' self-efficacy is emphasized as important for high-quality program delivery, reflecting the confidence that they can perform the behaviours and tasks required to deliver each component in a complex intervention [155-156]. Equally important is their theoretical understanding of the intervention and the intended aim of it [155-156]. Accordingly, successful implementation of quality improvements, depends on how leaders systematically support and facilitate local educative initiatives, workmate reflections, skill training, or other efforts to guide and develop clinicians' confidence and understanding of the intended care [155-156].

Taken together, our findings in Paper III point to the importance of a culture of improvement at the level of institutions and teams. It also points to the willingness of institutions, teams and individual clinicians to be transparent about their routine practice performance and their clinical reasoning. Such willingness is of vital importance to identify potentials of improvement, and choose appropriate strategies to improve the delivery [43].

7. Conclusion

7.1 Answers to the objectives

The purpose of this thesis was to explore and evaluate ways to measure, monitor and improve quality in rehabilitation services over time, focusing on the longitudinal measurement properties of a QI set, associations between improved quality and clinical patient outcomes, and the delivery of a team-based quality improvement program. The following summarize and conclude the answers to the specific objectives stated in chapter 3:

- The quality indicator set for use in rehabilitation was found to be responsive when applied in team-based rehabilitation services for adults with various RMDs. This was the first evaluation of responsiveness for this instrument. The results indicate that the instrument can be used to evaluate changes in quality over time, from both the provider and patient perspective. Our findings added important information regarding its measurement properties to previous knowledge about proven feasibility, and good face- and content validity for this new indicator set developed for multidisciplinary rehabilitation for people with RMDs.

- Associations between the patient-reported quality of the rehabilitation processes and the subsequent clinical outcomes of team-based rehabilitation were not found. The pass rate values for the process indicators were not associated with improvements in either patient-specific goal attainment, physical function or HRQoL reported by patients at home, 2 and 7 months after admission to rehabilitation in secondary healthcare. This was the first examination of associations between the quality of rehabilitation processes and clinical outcomes based on the quality indicator set for use in RMDs rehabilitation. We believe that these findings will inform future discussions and research on structure, process and outcomes as complementary dimensions, and increase awareness of the risk of misleading inferences about quality of delivered care if only one dimension is used.

- Overall, after adding the BRIDGE quality improvement program, the rehabilitation centres fulfilled most of the structure indicators, and the providers delivered most of the program components to a majority of their patients. However, the quality of delivery was higher for components addressing goal setting and inpatient parts of the processes, compared to personalized counselling on behaviour change, supported self-management,

involvement of family and external services, and follow-up after discharge. We found that the success of the program delivery depended on several contextual factors, such as the leadership at each site, the providers' competence and professional development, all parties' attention to the longitudinal rehabilitation processes requiring continuity and coordinated services, the organization of time, work-, and information flow, and the local culture of provider support, education, and quality improvement within the teams and institutions.

7.2 Implications and future perspectives

In concordance with The Norwegian Directorate of Health's white paper on management and quality improvement, appropriate improvements in structure and/or processes include leadership and service management, the organisation of work- and information flows, the development of cultures addressing quality improvement within and across institutions, and the clinicians' competence and practical skills [49].

First, when using QIs, areas of unwarranted variation in the program delivery may be revealed. However, a recommended approach to quality improvement is first to consider what kind of unwarranted variation is present before making decisions on strategies and efforts to reduce it [45,47,49]. Unwarranted variances may be attributed to different causes, such as structural constraints, restricted knowledge base, or low adherence to recommended delivery. Hence, a qualified and systematic assessment of potential causes is needed to agree on effective strategies for improvements which may address modifiable factors at the level of local institutions and teams, but also stakeholders beyond the institution, such as local, regional, or national policymakers.

Notably, at the local level, the use of QIs and QIPs imply willingness to transparency and change regarding norms, habits, and routines established by leaders and team members. Changes of such issues require time, good leadership and management to ensure confidence for all the involved parties in discussions on their own program delivery and clinical reasoning [43,49,193]. Future research should therefore focus on development and evaluation of strategies applied at different levels to enhance quality in rehabilitation services.

Second, stronger embedding of self-management- and behavioural change interventions within routine rehabilitation practice has been highlighted as urgent and important, as

concluded in a systematic review on self-management support published in 2019 [195], and in recommendations published from the European Alliance of Associations for Rheumatology, EULAR, in 2020 and 2021 [194, 196]. Qualifying professionals in rehabilitation requires raised knowledge and skill training addressing how clinicians can collaborate with patients regarding action plans and coping strategies, follow-up with tailored feedback, monitoring of progress on goals and desired outcomes, and how clinicians can guide and help patients towards higher self-efficacy and confidence to self-manage. This apply for education initiatives provided to professionals in both primary and secondary healthcare, and ideally include guidance from health psychologists or people having similar competence, to ensure continuous learning and professional development as specialized rehabilitation workers [188, 191, 194-195, 196]. In the immediate future, municipalities, institutions and educational facilities should plan and act for improved competence and implementation of self-management recommendations in routine practice.

Establishing networks for learning among providers across institutions and countries may also be important to improve the quality of care [198]. One such initiative is the “RehabNytte” project, where 17 rehabilitation institutions in specialist care have collaborated in a large research project led by the National Advisory Unit on Rehabilitation in Rheumatology [199]. The development of the research design, collection of data and now ongoing analyses of the results have been a continuous learning process for all involved parties, and have, among others, led centres to established routines for electronic solutions for data collection and systematic assessments of clinical outcomes over time, and use of QIs to monitor the quality of rehabilitation. To enhance collaboration across healthcare levels, such learning networks should also include relevant partners in primary care.

Third, the wider perspective on shared responsibility between levels of the healthcare systems should be discussed. Despite more than a decade with national health reforms, financial incentives, and regulations by laws, the challenges with continuity and coordination in rehabilitation between specialist and primary care still exist [110, 112, 113]. As a consequence, both quality and efficiency are negatively affected [113, 43]. Future development within the Norwegian rehabilitation system should therefore consider if new models of shared responsibility are needed, as services are still fragmented.

One challenge in the current Norwegian model concerns the mental and geographical distance between a specialized rehabilitation centre and the individual patient’s home setting. An

inpatient rehabilitation stay over several weeks leaves little room for trying out new self-management strategies in the patient's home setting before discharge, and may add to patients' experience of rehabilitation as a valuable sanctuary from everyday life, creating challenges in transferring learning from rehabilitation in specialist care to their everyday lives [200]. The geographical distance and the wide admission areas are also barriers to establish good cooperation with the municipal health service around the individual patient.

Suggested new models include centres situated in primary care, which provide a range of services and gather multidisciplinary representatives from secondary and primary healthcare, social care, and labour and welfare administration [43]. Such centres may very well be a cooperation between several municipalities. Another option may be for rehabilitation institutions to establish weekly outpatient clinics in surrounding municipalities where patients can receive follow-up, including meeting with primary care givers.

Effective communication and collaboration between involved parties require digital dialog- and information systems and strong infrastructures that are linked between services [43]. In the evaluation of the Escalation Plan for Habilitation and Rehabilitation [113], the Norwegian Directorate of Health recommends more use of video-consultations with patients as a mean for FU after discharge from secondary care. The Covid-pandemic has accelerated the use of digital solutions in both individual consultations and meetings across professions and care levels for transfer of information, planning of FU and integrated care. Future research is needed to investigate feasibility, effectiveness and cost benefit of such solutions.

In addition, Norwegian Health authorities have recommended the establishment of a data register for habilitation and rehabilitation that enables an assessment of the scope and quality of services, and further work to establish national QIs for rehabilitation [112, 113, 119]. A register requires the identification of key indicators, and also establishing of a system that provides incentives for more uniform reporting from municipalities, health trusts and other actors. Such a register would allow for evaluating and comparing the benefit of different interventions across patient groups, centres, municipalities, health regions and levels of care. It would also enable cost-benefit analyses with assessments of societal benefits of different patient pathways, and of different solutions for the distribution of responsibilities and tasks between municipalities, hospitals and private rehabilitation institutions.

In the immediate future, the proportion of patients in need of rehabilitation will increase, and efforts are needed to develop sustainable and integrated care. The previous mention evaluation of the escalation plan for rehabilitation, and several involved providers and patient organizations, recommend far more rehabilitation research and funding that are earmarked for this purpose, to provide a stronger and more up-to-date knowledge base that will facilitate efficient and uniform delivery of services [113, 184].

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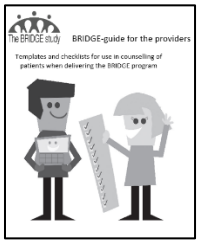
9. Additional files

Additional file 1 Components of the BRIDGE program

Component in the BRIDGE program	Tools available to support the process
Structured goal setting. Preparation: At admission, the HP informed the P about goal setting in rehabilitation and handed out a BRIDGE patient booklet for guidance throughout the rehabilitation process. The clinicians invited the P to prepare for goal setting, using one or several of the following tools: a tutorial video on rehabilitation goals, written information in the patient booklet, a reflection task called «The shoe» to stimulate the development of individual goals. Setting goals: P and the team agreed on 1-5 rehabilitation goals during a goal setting meeting at one of the first days after admission. Written goals were structured as SMART-goals, and recorded both in the patient booklet and in the PSFS-form in the digital assessment solution.	Guiding booklet* for P Guiding booklet* for HP A video about rehabilitation goals A reflection task, «The shoe»
Written rehabilitation plans, including strategies to overcome potential barriers Based on the content of the goals, specific interventions were included in the program, such as physical training, guided activity pacing or pain management. P and the team developed a written rehabilitation plan including the goal-directed actions and sources of support. The plan included strategies to overcome potential barriers in following rehabilitation process. Prior to the intervention phase, the clinicians were introduced to – and practiced the use of - a MI rating scale, meant to guide the P's reflections on their levels of willingness, confidence and readiness for discussed or planned actions and changes in daily life.	Templates in the guiding booklets MI rating scale to adjust plans according to the P's confidence
Tailored follow-up Before discharge, P and the team developed FU-plans according to the P's needs and available resources in the home setting. Sources to potential support were listed in the guiding booklets and in the digital assessment solution, such as general practitioner, primary health professions, health lifestyle centres, local branch of patients' organisations, the local labour and welfare agency concerning employment and social benefits, or support from employees' leader or health service. One month after discharge, P received one telephone FU-conversation from HP from the rehabilitation centre. HP could carry out up to four additional phone calls in the FU-period, addressing goal progress, adjustments of actions- and coping-plans, and supporting P in establishing necessary contact and support from primary health or others instances.	Guiding booklet* for P Guiding booklet* for HP
Personalized feedback using graphs to monitor the progress Within the digital assessment solution, a personalized feedback by graphs was available for the P after each assessment time point. The graphs were based on the nine clinical outcomes that the program intended to improve, and enabled Ps to monitor their own progress, for motivation or new decision-making in dialog with HP in primary care or important others. Also, a list of smartphone-applications suitable for feedback and maintenance of various health-related behaviour changes was available for HP, and an appropriate application could be introduced to P.	The digital assessment solution Listed applications for behaviour-change
Motivational interviewing Attitudes, questions, and conversation approach during the rehabilitation process was based on MI. In the HP booklets, there were a conversation guide for MI-based interactions with patients in goal setting and follow-up, and a checklist for HP's self-monitoring of MI-skills.	Guiding booklet* for HP MI-rating scale
P: patient, HP: health professional, FU: follow-up, MI: motivational interviewing. *The booklets included brief, educational material regarding phases in the rehabilitation process, templates for action- and coping plans, and suggestions for necessary support from externals after discharge. Content and wording were tailored to the HP-group and the P-group, respectively.	
The BRIDGE program was based on theories on goal setting [130-132], health related behaviour change [133, motivational interviewing [134-135], and SMART goals [136]. More details on theoretical approaches underlying the BRIDGE program has previously been described by Berdal et al [137]].	

Additional file 2 Extracts from the providers' guiding booklet



The front page of the booklet.

Extracts from the guiding booklet: voluntary reflections on the provider's own practice (not mandatory to fill inn, and not used in analyses)

At discharge for this particular patient:

To what extent was the delivered rehabilitation process based on the individual patient's own goals?

0	1	2	3	4	5	6	7	8	9	10
0=not at all degree										*10=in high*

To what extent was the conversation with the patient based on motivational interviewing?

0	1	2	3	4	5	6	7	8	9	10
0=not at all degree										*10=in high*

Regarding your therapeutic skills when delivering the program:What do you want to improve at the next opportunity?
Write some notes to yourself.

Self-inspection regarding this particular patient: **In dialogs related to P's desired or planned changes, I …**	Nearly never	More often than never	Mostly
…attended to P's change talk, and used opportunities to encourage the change talk			
…avoided an emphasis on P's language in favour of no change (status quo)			
…used simple or complex reflections in order to invite P to explore more deeply regarding the change talk			
…affirmed P's strengths, values, positive skills, competence, actions, efforts and past successes related to desired changes and goals			
…used open questions or other types of quering to stimulate P's reflections related to his or her reasons for change /or arguments against change			
…used empathy and showed warm understanding of P's points of view, emphasizing P's autonomy			
…avoided the expert role, and did not persuade			
…asked if P was interested before I gave information, advices or my points of view			
…used MI rating scales to explore importance of change, readiness for change or degree of self-efficacy related to goal attainment			

Development of this evaluation tool was inspired by ideas presented by Moyers, T.B., Manuel, J.K., & Ernst, D. (2014): Motivational Interviewing Treatment Integrity Coding Manual 4.1. Unpublished manual [134].

Additional file 3 Interview guide for the focus groups

Opening questions

Please introduce for each other:

Your name, your current workplace, profession and the location for your healthcare education.

Information to moderator: Explain the purpose / "helping the researchers to recognize your voices when transcribing the audio-files".

Please share with each other:

In your own words, can you describe your associations to the word r*ehabilitation*; what is it?

Information to moderator: invite to open reactions and the first associations

Main questions

Please share with each other:

When delivering the BRIDGE-program, what was your role in the team and your area (tasks) of responsibility?

How did you cooperate with your colleges in order to deliver the BRIDGE-program at your institution?

How did the BRIDGE-program affect your everyday work? Did the program change your typical ways of doing your job?

How did the BRIDGE-program change the routines, organisation, and/or multidisciplinary interactions at your workplace?

Please explain to each other (reflect and discuss):

In your own words, how will you describe the content of the BRIDGE-program?

In your opinion, in what ways did the program affect the patients' rehabilitation process? Did it facilitate something? Did it inhibit something?

What is your general impression of this way to deliver a rehabilitation program (using the BRIDGE program)?

Group task 1

Information to assistant moderator: i) the group members get a set of five cards; one card for each element in the program, ii) put the first rating scale on the table, from 0-10, 10=most important

Please, consider the different elements in the BRIDGE program. Which elements of the program are most important to support the patients' rehabilitation process?

Please, rate the elements according to this rating scale.

Information to moderator: allow the members to work on their rating task as long as they need

Please, present your rating, and share some reasons or examples underlying your rating.

Group task 2

information to the assistant moderator: i) the group members get a set of six cards; one card for each tool in the program, ii) put the second rating scale on the table, from 0-10, 10=most useful

Please, consider all the available tools in the BRIDGE program. Which tools do you consider as most useful to support the patients' rehabilitation process?

Please, rate the tools according to this rating scale.

information to moderator: allow the members to work on their rating task as long as they need

Please, present your rating, and share some reasons or examples underlying your rating.

Wrap-up questions

Is there anything else you would like to add, that we have not asked?

Do you have any ideas or suggestions for future planning of rehabilitation research?

Paper I

Sand-Svartrud AL, Berdal G, Azimi M, Bø I, Dager TN, Eppeland SG, Fredheim GO, Hagland AS, Klokkeide Å, Linge AD, Tennebø K, Valaas HL, Aasvold AM, Dagfinrud H, Kjeken I. A quality indicator set for rehabilitation services for people with rheumatic and musculoskeletal diseases demonstrates adequate responsiveness in a pre-post evaluation. *BMC Health Services Research 2021 Feb 20;21(1):164*

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BMC Health Services Research

RESEARCH ARTICLE Open Access

A quality indicator set for rehabilitation services for people with rheumatic and musculoskeletal diseases demonstrates adequate responsiveness in a pre–post evaluation

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Abstract

Background: Quality of care is gaining increasing attention in research, clinical practice, and health care planning. Methods for quality assessment and monitoring, such as quality indicators (QIs), are needed to ensure health services in line with norms and recommendations. The aim of this study was to assess the responsiveness of a newly developed QI set for rehabiliation for people with rheumatic and musculoskeletal diseases (RMDs).

Methods: We used two yes/no questionnaires to measure quality from both the provider and patient perspectives, scored in a range of 0–100% (best score, 100%). We collected QI data from a multicenter stepped-wedge cluster-randomized controlled trial (the BRIDGE trial) that compared traditional rehabilitation with a new BRIDGE program designed to improve quality and continuity in rehabilitation. Assessment of the responsiveness was performed as a pre–post evaluation: Providers at rehabilitation centers in Norway completed the center-reported QIs ($n = 19$ structure indicators) before (T1) and 6–8 weeks after (T2) adding the BRIDGE intervention. The patient-reported QIs comprised 14 process and outcomes indicators, measuring quality in health services from the patient perspective. Pre-intervention patient-reported data were collected from patients participating in the traditional program (T1), and post-intervention data were collected from patients participating in the BRIDGE program (T2). The patient groups were comparable. We used a construct approach, with a priori hypotheses regarding the expected direction and magnitude of PR changes between T1 and T2. For acceptable responsivess, at least 75% of the hypotheses needed to be confirmed.

(Continued on next page)

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(Continued from previous page)

Results: All eight participating centers and 82% of the patients (293/357) completed the QI questionnaires. Responsiveness was acceptable, with 44 of 53 hypotheses (83%) confirmed for single indicators and 3 of 4 hypotheses (75%) confirmed for the sum scores.

Conclusion: We found this QI set for rehabilitation to be responsive when applied in rehabilitation services for adults with various RMD conditions. We recommend this QI set as a timely method for establishing quality-of-rehabilitation benchmarks, promoting important progress toward high-quality rehabilitation, and tracking trends over time.

Trial registration: The study is part of the larger BRIDGE trial, registered at ClinicalTrials.gov (Identifier: NCT03102814).

Keywords: Rehabilitation, Musculoskeletal disease, Quality indicator, Health care, Responsiveness

Background

In recent decades, new knowledge has led to earlier diagnosis and more effective pharmacological and surgical treatment for people with rheumatic and musculoskeletal diseases (RMDs) [1]. Nevertheless, many in this population experience a suboptimal effect of such treatments and need rehabilitation services in primary and secondary health care [2, 3]. Unmet needs are often related to persistent or fluctuating symptoms such as pain, fatigue, stiffness, and joint swelling [4] and can be reflected in individual rehabilitation goals. These goals may span several areas, including physical or mental functioning, personal activities of daily living, social participation, education, and work productivity [5–7].

The wide range of rehabilitation needs calls for individualized interventions, a multidisciplinary approach, and coordination across levels of care to ensure continuity in rehabilitation pathways. Furthermore, sufficient time is needed for individuals to establish new habits and lifestyle changes beyond the institutional setting [8–10]. The same requirements also characterize good quality in rehabilitation [11]. However, important gaps persist between these recommendations and current delivery of rehabilitation services [12]. In Norway, measures to improve the quality of rehabilitation have been recommended particularly to address the documented lack of coordination and communication across care levels and the lack of patient involvement in planning of follow-up interventions after rehabilitation [13, 14].

Although "quality" is a rather abstract term, the use of quality indicators (QIs) may enable practical evaluation and improvement of quality [15]. A QI can be defined as "a measurable element of practice performance for which there is evidence or consensus that it can be used to assess the quality, and hence change in the quality, of care provided" ([16], p. 104). QIs often are related to Donabedian's model of quality in health care and the interplaying triad of structure, process, and outcomes of care [15, 17–20].

An expert group of researchers, patient research partners, and clinicians in Norway has recently developed a set of QIs for monitoring, evaluating, and improving the quality of rehabilitation in RMDs [21]. The QI set consists of two separate questionnaires: one for rehabilitation providers (addressing structure QIs) and one for patients (addressing process and outcome QIs) [21]. Developers and users of the instrument used the Rand/UCLA Appropriateness Method to agree on content validity [21]. In the pilot testing, the QI set was appraised as feasible for monitoring quality in rehabilitation in primary and secondary care, and face validity was regarded as good [21], but further investigation of measurement properties was suggested. Especially, the QI set's ability to detect change over time (responsiveness) was of interest for its use in measuring quality improvement in rehabilitation services. Thus, the aim of our study was to assess the responsiveness of a quality indicator set for rehabilitation for people with RMDs [21].

Methods

Study design and clinical settings

We tested the QI set in the multicenter stepped-wedge, cluster-randomized controlled BRIDGE trial [22], which aimed to improve continuity and quality in rehabilitation for people with RMDs. The National Advisory Unit on Rehabilitation in Rheumatology recruited participating rehabilitation centers ($n = 8$) in different regions of Norway. The centers started the trial simultaneously and acted as controls (delivering traditional rehabilitation programs) until an allocated point in time for each center to switch to the intervention phase (adding the new BRIDGE program to the traditional programs). Assessment of the responsiveness of the QI set was performed as a pre–post evaluation, before and after the addition of the new BRIDGE program.

Health professionals at the centers recruited patients at admission to rehabilitation. Patient-reported data were collected at admission and discharge from rehabilitation in secondary care and in the subsequent follow-

up period at home (2, 7, and 12 months after admission). Eligible patients were aged ≥18 years and admitted to rehabilitation with one of the following diagnoses: inflammatory rheumatic diseases, systemic connective tissue diseases, osteoarthritis, osteoporosis, fibromyalgia or widespread pain, or non-specific low back, neck, or shoulder pain (persistent for more than 3 months). Because the electronic data collection and questionnaires were available only in Norwegian, patients needed to be proficient in Norwegian and to have a personal electronic credential for secure identification online. Further, they needed internet connection, and a personal computer, tablet computer, or smartphone. Patients with fracture(s), cognitive impairment, or severe psychiatric disorder(s) were excluded. Eligible patients received verbal and written information about the study. Those who decided to participate provided written informed consent. The study was approved by the Norwegian Regional Committee for Medical Research Ethics (REK South-East, 2017/665).

The BRIDGE program

The main elements of the BRIDGE program are described in Table 1. At each center, the providers used a fidelity check list to monitor whether they delivered the program according to the BRIDGE protocol.

Data collection and measurements

At two time points, the head of each center completed the center-reported QI questionnaire in telephone-based interviews conducted by the central project coordinator (ALSS). The first interview was performed at the beginning of the study while the centers were still delivering traditional programs (T1). Using an interview guide based on the Scandinavian Team Arthritis Register-European Team Initiative for Care Research (STAR-ETIC) rehabilitation framework [25], the head of each center also gave detailed information about the content and organization of the rehabilitation program delivered at T1. The second interview took place 6–8 weeks after the addition of the BRIDGE program (T2).

Two months after the rehabilitation stay, all patients completed the patient-reported QI questionnaire. We collected patient-reported T1 data from patients participating in traditional rehabilitation programs (the T1-group) and T2 data from patients participating in the BRIDGE program (the T2-group). In this manner, we measured quality of rehabilitation services (at the institutional level) at T1 and T2 from the perspective of the users.

A QI set for the rehabilitation of people with RMDs

Providers completed a questionnaire addressing 19 structure indicators of quality. These indicators measured organizational aspects in which the rehabilitation occurs, e.g., whether written procedures, method descriptions, and/or checklists are currently available and part of the daily routine.

Patients responded to another questionnaire, comprising 14 indicators regarding process and outcome indicators of quality. Process indicators ($n = 11$) measure factors related to giving and receiving care, in the form of actions and interactions between providers and patients in the actual clinical setting [20, 21]. Outcome indicators ($n = 3$) measure the effects of rehabilitation on defined outcomes, related to attainment of rehabilitation goals, improvements in function, and/or improvements in health-related quality of life [20, 21]. Taken together, the main themes covered by the QI set are as follows: 1) patient participation in goal setting and the rehabilitation process; 2) follow-up plan and continuity across levels of care; and 3) assessment, outcomes, and time-points of evaluation. The QI set is presented in Table 2. The content of many structure indicators matches the

Table 1 Elements of the BRIDGE program, aimed at strengthening the quality of rehabilitation services

Structured goal-setting	Patients developed 1–5 individual rehabilitation goals in collaboration with clinicians. The goals were recorded in the Patient-Specific Functional Scale [23, 24], and scored according to experienced difficulty at every reporting time point in the trial.
A written rehabilitation plan	A written rehabilitation plan for each patient included the individual goals and corresponding goal-directed interventions.
A tailored follow-up, including plans for self-management	The patient and the rehabilitation team developed a plan for tailored follow-up in the first period after discharge. One month after discharge, all participants received a telephone call from the rehabilitation center, addressing 1) progress towards goals, 2) adherence to self-management strategies (plans for self-management), and 3) whether necessary contact with caregivers in the patient's home setting was established. The follow-up interventions were tailored according to patient's needs and available resources in their municipality.
Individualized written feedback	Digital self-reporting enabled individualized graphic feedback throughout the whole rehabilitation period. Data reported in a rehabilitation core set of questionnaires were presented as clinical graphs showing current status and development over time. Participants could use the graphs to monitor their own progress and share information with important caregivers across levels of care.
Motivational interviewing	Motivational interviewing was used in the goal-setting talks and the telephone follow-up calls, in accordance with guiding booklets designed for both clinicians and patients.

Table 2 Main themes and indicators in a quality indicator set for use in rehabilitation [21]

Main themes	Structural quality indicators/center-reported:		Process quality indicators/patient-reported:	
	I	Question (yes/no)	I	Question (yes/no)
Patient participation in goal setting and rehabilitation process	**C01**	C1. P shall participate in setting rehab goals	**P04**	P4. Were you actively involved in setting specific goals for the rehab period?
	C02	C2. P shall participate in planning his/her rehab process.		
	C03	C3. A template is used to prepare an individual rehab plan for P.	**P03**	P3. Was a written plan developed for the rehab period (comprising your rehab goals, what you should practice, etc.)?
			P05	P5. Were you actively involved in preparing a specific written plan for the rehab period (mentioned in q. 3)?
	C04	C4. P shall participate in evaluating his/her ongoing process.	**PO6**	P6a. Did you participate in at least two meetings with the team[a] during which your goal(s) and goal attainment so far were discussed?
	C05	C5a. There are at least two meetings between P and the team[a].		
Follow-up plan and continuity across levels of care	**C09**	C7a. P shall participate in preparing a specified written follow-up plan (aside from the epicrisis) for the follow-up process after the rehab period. This plan shall also include P's own efforts to maintain or improve function/health.	**P09**	P7. Apart from regular epicrisis, was a written plan developed for the period after rehab, including what you were expected to work on yourself? *(if you have answered "yes" to q. 7, go to q. 8. If you have answered "no" to q. 7, go to q. 9)*
			P10	P8a. Did you participate in developing the plan (q. 7)?
	C10	C7b. If there is a need for health care support after the rehab period, the relevant personnel are to be informed about the plan or participate in the development of the follow-up plan.	**P11**	P8b. As a part of this plan, were you consulted about whether you needed follow-up from external personnel[b] after the rehab. Period?
	C06	C5b. P is asked before meetings if he/she wants his/her next of kin to attend any of the meetings.	**P07**	P6b. Were you asked if you wanted your next of kin to attend any of the meetings?
	C07	C5c. P is asked before meetings if he/she wants some of the external professionals[b] he/she will relate to after the rehab. to attend any of the meetings.	**P08**	P6c. Were you asked if you wanted professionals[b] you will relate to after the rehab period to attend any of the meetings?
Assessment, outcomes, and time-point of evaluation	**C08**	C6. The rehab unit uses reliable[c] questionnaires and/or functional tests to assess physical, mental, and/or social conditions. P's goal/goal attainment is to be assessed …	**P01**	P1. Were your health condition and life situation assessed during the first days of your rehab period? (Answer "no" if both aspects were not assessed) *(If you have answered "yes" to question number 1, go to question number 2. If you have answered "no" to question number 1, go to question number 3).*
	C11	C8a … .with a reliable[c] instrument.		
	C12	C8b. … at the beginning and the end of the rehab period.		
	C13	C8c. … 3–6 months after the rehab period. P's function is to be registered …	**P02**	P2. Did the assessments include both a physical examination and questions about mental and social conditions, network, home situation, and – if relevant – your work situation?
	C14	C9a … using a reliable[c] instrument.		
	C15	C9b. … at the beginning and the end of the rehab period.	**Outcome quality indicators/patient-reported:**	
	C16	C9c. … 3–6 months after the rehab period. P's health-related quality of life is to be assessed …	**P12**	P9. As a result of the rehab period, have you achieved one or several goals that are important to you?
	C17	C10a. … using a reliable[c] instrument.		
	C18	C10b. … at the beginning and the end of the rehab period.	**P13**	P10. As a result of the rehab period, have you achieved an improvement in your physical, mental, and/or social functioning that is important to you?
	C19	C10c. … 3–6 months after the rehab period.		
			P14	P11. As a result of the rehab period, do you think your quality of life has improved?

I Indicator number, *Cx* Center-reported + question number, *Px* Patient-reported + question number, *P* The patient/user, *rehab* Rehabilitation, *q* question number, [a]the team = the interdisciplinary team, or a professional representing the team; [b]external professionals = external personnel, such as a physiotherapist, general practitioner, or – if relevant – the labor and welfare administration or a person from patient's workplace; [c]reliable = quality-assured/validated questionnaires or tests

content of process and/or outcome indicators, which allows for measuring quality in rehabilitation services from the system and user perspectives, respectively.

Because the elements in the BRIDGE program (Table 1) to a large degree mirror the items in the QI set (Table 2), we expected that the QI set would capture improved or maintained quality of rehabilitation between T1 and T2 (Fig. 1). *Maintained* quality was favorable if the quality at T1 already was in line with the normative standards reflected in the quality indicators. If not, *improved* quality was favorable.

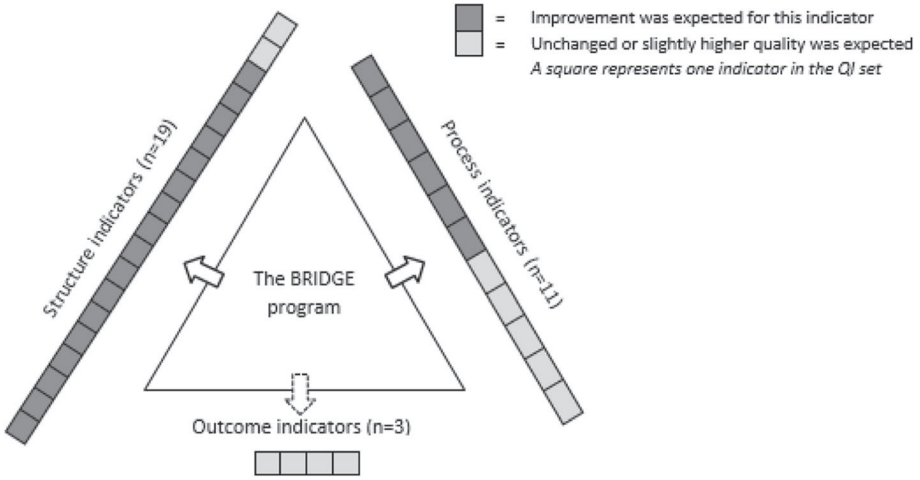

Fig. 1 Expected influence of the BRIDGE program on "A quality indicator set of rehabilitation for RMDs"

Response options and scoring alogrithm Achievements (yes/no) of items in the QI set were measured using pass rates (PRs). Based on responses from the participant (provider or patient), calculations comprised single indicator PRs and total PRs. Single indicator PRs were calculated as the total number of participants who answered "yes" for a particular indicator divided by the total number of participants who answered "yes" or "no" for the same indicator. The scores were normalized to 100 to allow PRs to be reported as percentages.

Single indicator PRs range from 0 to 100% (100% = all eligible participants answered "yes" to this indicator). Total PRs represent the total of "yes" answers from a participant divided by eligible QI items (denominator) for the same participant. Eligible QI items in the center-reported questionnaire are always $n = 19$. Eligible QI items in the patient-reported questionnaire are at least $n = 11$ out of 14 but can vary. As an example: A patient who answers "yes" to question 1 (P1) goes to the additional question 2 (P2) (as seen in Table 2), resulting in n = 11 + 1 for a denominator of 12. In the same way, an answer "yes" to question 7 (P7) makes questions 8a (P8a) and 8b (P8b) eligible, resulting in n = 11 + 2, for a denominator of 13. Finally, "yes" answers to both questions 1 and 7 result in n = 11 + 1 + 2, for the maximum denominator of 14. Total PRs also range from 0 to 100%, with 100% indicating the best quality in rehabilitation score, implying that the participant answered "yes" to all eligible items in the particular questionnaire.

The STAR-ETIC rehabilitation framework

The STAR-ETIC framework was developed for describing complex rehabilitation interventions and comparing the content of rehabilitation programs across different sites [25, 26]. We used the framework to collect information about content and organization of the rehabilitation program delivered at T1. The framework covers clinical setting; type of professions in the rehabilitation team; standards for family involvement and follow-up-management; use of rehabilitation goals, assessments, and evaluations; interventions (content and modalities); and outcomes.

Other measurements We obtained demographic data about the patients at baseline. To assess the impact of data clustering from the multicenter design, we also used baseline data for the primary and secondary outcomes in the BRIDGE trial. The primary outcome was goal attainment, as measured by the Patient-Specific Functional Scale (PSFS) [23, 24]. Secondary outcomes were physical function, measured by the 30-s sit-to-stand test (30 secSTS) [27–29], and health-related quality of life (HRQoL), measured by the EuroQoL 5D- 5L-health-related quality of life (EQ. 5D-index and EQ. 5D-vas) [29, 30]). Norwegian versions of all instruments, translated following international guidelines, have been tested for psychometric properties with satisfactory results in RMD populations in rehabilitation settings in primary and secondary care [29].

On the PSFS (open-ended categories), patients report up to five activites that they currently find difficult to perform because of their health condition. Each activity is scored according to experienced performance on an 11-point scale (0–10, with 0 indicating "unable to perform") [24, 29]. In the EQ. 5D-index, patients report their level of perceived problems in five dimensions of health (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression; 5 levels, with 1 indicating no problems and 5 indicating extreme problems). In the EQ. 5D-vas, patients rate their current health state on a 100-mm visual analog scale (0–100, with 0 indicating

"*The worst health you can imagine*" and 100 indicating "*The best health you can imagine*") [29, 30]. In the performance-based test (30 secSTS), the patient, seated in a chair, rises to a full standing position and then sits down again. According to specific performance instructions, patients complete as many full stands as possible within 30 s [28, 29].

Responsiveness

Responsiveness has been defined by the COnsensus-based Standards for the selection of health status Measurement INstruments (COSMIN) panel as "the ability of an instrument to detect change over time in the construct to be measured" ([31], p. 742). In this study, we used a construct approach to examine responsiveness [32] because no gold standard is available. Based on current evidence, previous pilot testing [21], and the BRIDGE fidelity checklist, three of the authors (IK, GB, and ALSS) developed a priori hypotheses regarding the expected direction and magnitude of PR changes between T1 and T2. We discussed our hypotheses in a research group with nurses, patient research partners, and a physiotherapist. In accordance with de Vet [33], high responsiveness was indicated if at least 75% of the predefined hypotheses were confirmed.

The rationales for the hypotheses were based on results from the pilot study, other previous research, expert opinions, and fidelity checklist and guiding booklets available in the BRIDGE trial. The rationales are given in detail in Additional file 3. In short, we developed four hypotheses for median total PRs and 1–3 hypotheses for PR changes for each single indicator. Regarding total PR changes, we included hypotheses for the largest diagnose groups in our trial (inflammatory rheumatic disease, and fibromyalgia/widespread pain, respectively). We expected the change score for total PR to be small to moderate for both subgroups, applied to process and outcome indicators, respectively. Regarding single indicators, we expected improved PRs for QIs that were addressed by the BRIDGE program: patient participation in 1) setting goals, 2) developing a written rehabilitation plan, 3) meeting(s) where goals and/or ongoing rehabilitation process were discussed, 4) consultation(s) about needs for the follow-up period, 5) developing a written follow-up plan, and 6) involvement of externals in planning follow-up. Concerning assessments and time-points of evaluation, we expected improved PRs for 1) use of reliable questionnaires/tests, 2) evaluation of goal attainment, function, and HRQoL at the start and end of the rehabilitation intervention in specialist care, and 3) 3–6 months after discharge (structure). We expected no change for QIs regarding initial bio-psycho-social assessment (process) and no change or little improvement for QIs regarding patient's outcomes. Involving externals (i.e., next of kin or services in primary care) was expected as part of the follow-up plan, but invitations to meetings for next of kin or external services were not included in the BRIDGE program. Hence, we did not expect changes in QIs regarding invitation to meetings for next of kin or external services.

Data analysis

We used STATA IC v14 for statistical analysis. To compare the baseline characteristics of patients in the T1- and T2-groups, we used the independent samples t-test, Pearson's Chi square test, and the Mann–Whitney U test. We set the significance level at 0.05. To assess the impact of clustering in each group, we calculated intraclass correlation coefficients (ICCs) for primary and secondary outcomes.

In testing hypotheses regarding responsiveness, we used descriptive statistics to examine the median PR values and change scores for total PRs and single indicator PRs, respectively.

Based on absolute changes, we used the following criteria for indicating the magnitude of changes: 1) 0%, no change; 2) 1.0–12.5%, small change (change for 1/8 participating centers); 3) 12.6–25%, moderate change (change for 2/8 participating centers); and 4) 25.1–100%, considerable change (change for 3 or more participating centers). We used the same criteria for the magnitude of changes in patient-reported quality: 1.00–12.5%, small change; 12.6–25%, moderate change; and 25.1–100%, considerable change.

Returned QI questionnaires were considered incomplete and not included in further analyses if more than 50% of the QI items had not received a "yes" or "no" response.

Results

Rehabilitation at participating centers

All eight centers were organized in secondary care (specialized rehabilitation), with a minimum of four different professions in the multidisciplinary teams. The teams included physicians, physiotherapists, occupational therapists, nurses, and social workers in all centers except center 6 (no nurse) and center 4 (no social worker). Additionally, the teams included a nutritionist or dietitian at six centers, a sport educator at three centers, and a psychologist at one center. Most centers delivered inpatient stays for 3–4 weeks, and two hospital departments delivered a shorter stay (2 weeks), as either inpatient (center 2) or outpatient (center 6) rehabilitation. Length of stay was predetermined, but postponed discharge was allowed in cases of vacancy (centers 1, 3, 4, 8). The rehabilitation programs were developed for different patient groups. The primary group was inflammatory arthritis at all the hospital departments and 2/5

rehabilitation centers, fibromyalgia/widespread pain at centers 4 and 7, and unspecific low back, neck, or shoulder pain at center 5 (see Additional file 1).

At all centers, the content of rehabilitation comprised a combination of group sessions, individual sessions, and self-training. The treatment sessions were comprehensive, including topics like training, physical activity, activities of daily living, pacing, planning and adaptations. Further, counseling regarding coping (pain, fatigue, sleep, or stress), lifestyle changes (physical activity, exercise, weight control, smoking), disease information and medical treatments. Topics like family and other social relationships, work and work adaptations, social services and rights were also included, as well as mindfulness and relaxation.

Patient participants

The study included 357 participants (200 in the T1-group, 157 in the T2-group), and their characteristics are summarized in Additional file 2. The groups were comparable for all baseline variables except age, diagnosis, and disease duration (Additional file 2). The differences in age and disease duration were not considered clinically important, and except for differences in diagnoses, the between-group comparability was considered acceptable. Most patients had inflammatory rheumatic disease (72% in the T1-group, 54% in the T2-group), or fibromyalgia/widespread pain (10, 32%). For other patients the primary diagnose was unspecific low back-, neck-, or shoulder pain, connective tissue disease, or osteoarthritis. None of the included patients had osteoporosis as the primary diagnose (see Additional file 2).

The patients who did not complete the QI questionnaire did not differ systematically by baseline.

Assessment of responsiveness

The ICCs for the outcomes of interest were small ($ICC_{psfs} = 0.08$, $ICC_{30sec} = 0.03$, $ICC_{EQ5Dindex} = 0.06$, $ICC_{EQ5Dvas} = 0.02$), indicating a low impact of clustering. Consequently, we pooled patient-reported data from different centers for calculations of total PRs and single indicator PRs.

A total of 161/200 (80.5%) patients in the T1-group and 132/157 (84%) in the T2-group, completed the QI questionnaire. The response rate from participating centers was 100% (no missing items).

Among 62 predefined hypotheses for change in single indicator PRs, 9 (14.5%) were not applicable because of the observed distribution of answers at T1. For three structure indicators, there were no "yes" answers at T1, so that hypotheses about "*all centers who answered 'yes' at T1 are expected to answer 'yes' at T2*" were not applicable ($n = 3$). For three other structure indicators, there were zero "no" answers at T1, so that the following hypotheses were not applicable: "*all centers who answered 'no' at T1 are expected to answer 'yes' at T2*" (n = 3 hypotheses), and "*the change score for this indicator is expected to be [magnitude of change is described]*" ($n = 3$).

Of the remaining 53 hypotheses for single indicators, 44 (83%) were confirmed. Regarding change scores in median total PRs, three of four hypotheses were confirmed. Taken together, the observed change scores were consistent with ≥75% of the predefined hypotheses, indicating adequate responsiveness for the rehabilitation QI set. These findings are presented in more detail in Table 3 and Additional file 3.

Direction of change

As hypothesized, the changes in total PRs were in the direction of improvement for all dimensions of quality in rehabilitation (structure, process, and outcomes), with the largest improvements for structure indicators. The center-reported quality at T2 was high and comparable across all participating centers (PR total ranging from 90 to 95%), in spite of differences at T1 (PR total ranging from 16 to 68%) (Fig. 2). All but two hypotheses for single indicators were also confirmed. However, there was a negative direction for two out of three hypotheses concerning outcomes, for which a positive was expected: $H_{single}60$ (achieved important goals) and $H_{single}62$ (improved quality of life; see Table 3).

Magnitude of change

The expected magnitudes of change were confirmed for each structure indicator, with four exceptions (Table 3): observed improvement was smaller than expected for C12 (patient's goal/goal attainment is to be assessed with a reliable instrument at the beginning and the end of the rehabilitation period), and observed improvements were larger than expected for C03 (use of a template to prepare a rehabilitation plan for the patient), C04 (patient participation in evaluation of their ongoing process), and C09 (patient participation in preparing a written follow-up plan), respectively. In contrast to the results for C03, the observed improvements were smaller than expected for the matching process indicators P03 and P05 (patient participation in developing and use of a written rehabilitation plan). Smaller improvement than expected was also found for the process indicator P06 (participating in at least two meetings with team member(s)).

As hypothesized, PRs were particularly low for indicators concerning access to meetings for next of kin or external personnel at T1 and T2, respectively (Fig. 3). At both points in time, PR values below 16% were observed for both process indicators (P07, P08) and the matching structure indicators (C06, C07) (Fig. 3).

Table 3 Expected and observed change scores for quality indicators

a. Changes in median total pass rates

	Hypo-theses	Confirmed direction[1] of change	Expected magnitude of change	Observed magnitude of change	Confirmed hypothesis
Structural QIs (center-reported, $n = 8$)	H_{total} 1	yes	moderate to high	high	1/1
Process and outcome QIs (patient-reported, $n = 132–161$)	H_{total} 2	yes	small to moderate	small	1/1
Process QIs in subgroups (subgroup1 = inflammatory rheumatic disease, $n = 74–114$) (subgroup2 = fibromyalgia or chronic widespread pain, $n = 14–40$)	H_{total} 3	yes	small to moderate (both groups)	small (both groups)	1/1
Outcome QIs in subgroups (subgroup1 = inflammatory rheumatic disease, $n = 74–114$) (subgroup2 = fibromyalgia or chronic widespread pain, $n = 14–40$)	H_{total} 4	yes	zero to small	zero (subgroup1) moderate (subgroup2)	0/1
IN TOTAL (changes in median total pass rates)					**3/4 confirmed**

b. Changes in single items pass rates

Structural QIs (center-reported, marked C) **Process QIs (patient-reported, marked P)**	Hypo-theses	Confirmed direction[1] of change	Expected magnitude of change	Observed magnitude of change	Confirmed hypothesis
Patient participation in goal setting and rehabilitation process					
C01. P shall participate in setting rehab goals.	H_{single} 1	yes	All (100%)	All (100%)	
	H_{single} 2	yes	small to moderate	moderate	2/2
P04. Were you actively involved in setting goals for the rehab period?	H_{single} 3	Yes	Similar or small	small	1/1
C02. P shall participate in planning his/her own rehab process.	H_{single} 4	yes	All (100%)	All (100%)	
	H_{single} 6	yes	small to moderate	moderate	2/2
C03. A template is used to prepare an individual rehab plan for P.	H_{single} 5	yes	All (100%)	All (100%)	
	H_{single} 7	yes	small to moderate	high	1/2
P03. Was a written plan developed for the rehab period (comprising your rehab goals, what you should practice, etc.)?	H_{single} 8	Yes	moderate	small	0/1
P05. Were you actively involved in preparing the written rehab plan?	H_{single} 9	Yes	moderate	small	0/1
C04. P shall participate in evaluating his/her ongoing process.	H_{single} 13	yes	All (100%)	All (100%)	
	H_{single} 14	yes	small to moderate	high	1/2
C05. There are at least two meetings between P and the team[a].	H_{single} 10	yes	All (100%)	All (100%)	
	H_{single} 11	yes	small to moderate	small	2/2
P06. Did you participate in at least two meetings with the team[a] at which your goal(s) and goal attainment so far were discussed?	H_{single} 12	Yes	moderate	small	0/1
Follow-up plan and continuity across levels of care					
C09. P shall participate in preparing a specific written follow-up plan (aside from the epicrisis) for the follow-up process after the rehab period. This plan shall also include P's own efforts to maintain or improve function/health.	H_{single} 15	yes	All (100%)	All (100%)	
	H_{single} 16	yes	small to moderate	high	1/2

Table 3 Expected and observed change scores for quality indicators *(Continued)*

C10. If there is a need for health care support after the rehab period, the relevant personnel are to be informed about the plan or participate in the development of the follow-up plan.	H_{single} 17	yes	All (100%)	All (100%)	
	H_{single} 18	yes	moderate to high	high	2/2
P09. Was a written plan developed for the period after rehab, including what you were expected to work on yourself?	H_{single} 19	Yes	small to moderate	moderate	1/1
P10. (if "yes" to q. 7): Did you participate in developing the plan (in q. 7)?	H_{single} 20	Yes	small to moderate	small	1/1
P11. As part of this plan, were you consulted about whether you needed follow-up from external personnel after the rehab period?	H_{single} 21	Yes	small to moderate	moderate	1/1
C06. P is asked before meetings if he/she wants his/her next of kin to attend any of the meetings.	H_{single} 22	yes	All (100%)	All (100%)	
	H_{single} 23	yes	zero to small	zero	2/2
P07. Were you asked if you wanted your next of kin to attend any of the meetings?	H_{single} 24	Yes	zero to small	small	1/1
C07. P is asked before meetings if he/she wants some of the professionals[b] he/she will relate to after the rehab to attend any of the meetings.	H_{single} 25	n.a.	All (100%)	n.a.	n.a.
	H_{single} 26	yes	zero to small	small	1/1
P08. Were you asked if you wanted external personnel[b] to attend any of the meetings?	H_{single} 27	Yes	zero to small	small	1/1
Structural QIs (center-reported, marked C) **Process QIs (patient-reported, marked P)**	**Hypo-theses**	**Confirmed direction[1] of change**	**Expected magnitude of change**	**Observed magnitude of change**	**Confirmed hypothesis**
Assessment, outcomes, and time-points of evaluation					
P01. Were your health condition and life situation assessed during the first days of your rehab period?	H_{single} 28	Yes	zero to small	small	1/1
P02. (if "yes" to q. 1): Did the assessments (in q. 1) include both a physical examination, and q.about mental, and social conditions, network, home situation and – if relevant – your work situation?	H_{single} 29	Yes	zero to small	small	1/1
C08. The rehab unit uses reliable[c] questionnaires and/or functional tests to assess physical, mental, and/or social conditions.	H_{single} 30	yes	All (100%)	All (100%)	1/1
	H_{single} 34	n.a.	All (100%)	n.a.	n.a.
	H_{single} 38	n.a.	small to moderate	n.a.	n.a.
P's goal/goal attainment is to be assessed …					
C11. … with a reliable instrument	H_{single} 31	yes	All (100%)	All (100%)	
	H_{single} 35	yes	All (100%)	All (100%)	
	H_{single} 39	yes	moderate to high	high	3/3
C12. … at the beginning and the end of the rehab period	H_{single} 42	yes	All (100%)	All (100%)	
	H_{single} 45	yes	All (100%)	All (100%)	
	H_{single} 48	yes	moderate to high	small	2/3
C13. … 3–6 months after the rehab period	H_{single} 51	yes	All (100%)	All (100%)	
	H_{single} 54	yes	All (100%)	All (100%)	
	H_{single}	yes	moderate to	high	3/3

Table 3 Expected and observed change scores for quality indicators *(Continued)*

	57		high		
P's function is to be registered …					
C14. … using a reliable instrument	H_{single} 32	yes	All (100%)	All (100%)	1/1
	H_{single} 36	n.a.	All (100%)	n.a.	n.a.
	H_{single} 40	n.a.	small	n.a.	n.a.
C15. … at the beginning and the end of the rehab period	H_{single} 43	yes	All (100%)	All (100%)	1/1
		n.a.			
	H_{single} 46	n.a.	All (100%)	n.a.	n.a.
	H_{single} 49		small	n.a.	n.a.
C16. … 3–6 months after the rehab period	H_{single} 52	n.a.	All (100%)	n.a.	n.a.
	H_{single} 55	yes	All (100%)	All (100%)	
	H_{single} 58	yes	moderate to	high	2/2
P's health-related quality of life is to be assessed …					
C17. … using a reliable instrument	H_{single} 33	yes	All (100%)	All (100%)	
	H_{single} 37	yes	All (100%)	All (100%)	3/3
	H_{single} 41	yes	moderate to high	high	
C18. … at the beginning and the end of the rehab period	H_{single} 44	yes	All (100%)	All (100%)	
	H_{single} 47	yes	All (100%)	All (100%)	
	H_{single} 50	yes	moderate to high	high	3/3
C19. … 3–6 months after the rehabperiod	H_{single} 53	n.a.	All (100%)	n.a.	n.a.
	H_{single} 56	yes	All (100%)	All (100%)	
	H_{single} 59	yes	moderate to high	high	2/2
As a result of the rehab					
P12. … have you achieved one or several goals that are important to you?	H_{single} 60	No	zero to small	small	0/1
P13. … have you achieved an improvement in your physical, mental, and/or social functioning that is important to you?	H_{single} 61	Yes	zero to small	small	1/1
P14. … do you think your quality of life has improved?	H_{single} 62	No	zero to small	small	0/1
IN TOTAL (changes in single item scores)					**44/53 confirmed**

1 expected direction is positive or stable for all the hypotheses , *QI* quality indicator, *Htotalxx* hypotheses concerning change in total pass rates, followed by hypothesis number, *Hsinglexx* hypotheses concerning change in single indicator pass rates, followed by hypothesis number, *rehab* rehabilitation, *q* question; [a]the team = the interdisciplinary team or a professional representing the team; [b]external personnel, such as a physiotherapist, general practitioner, or – if relevant – the labor and welfare administration or a person from work; [c]quality-assured/validated questionnaires or tests, *n.a.* Not applicable

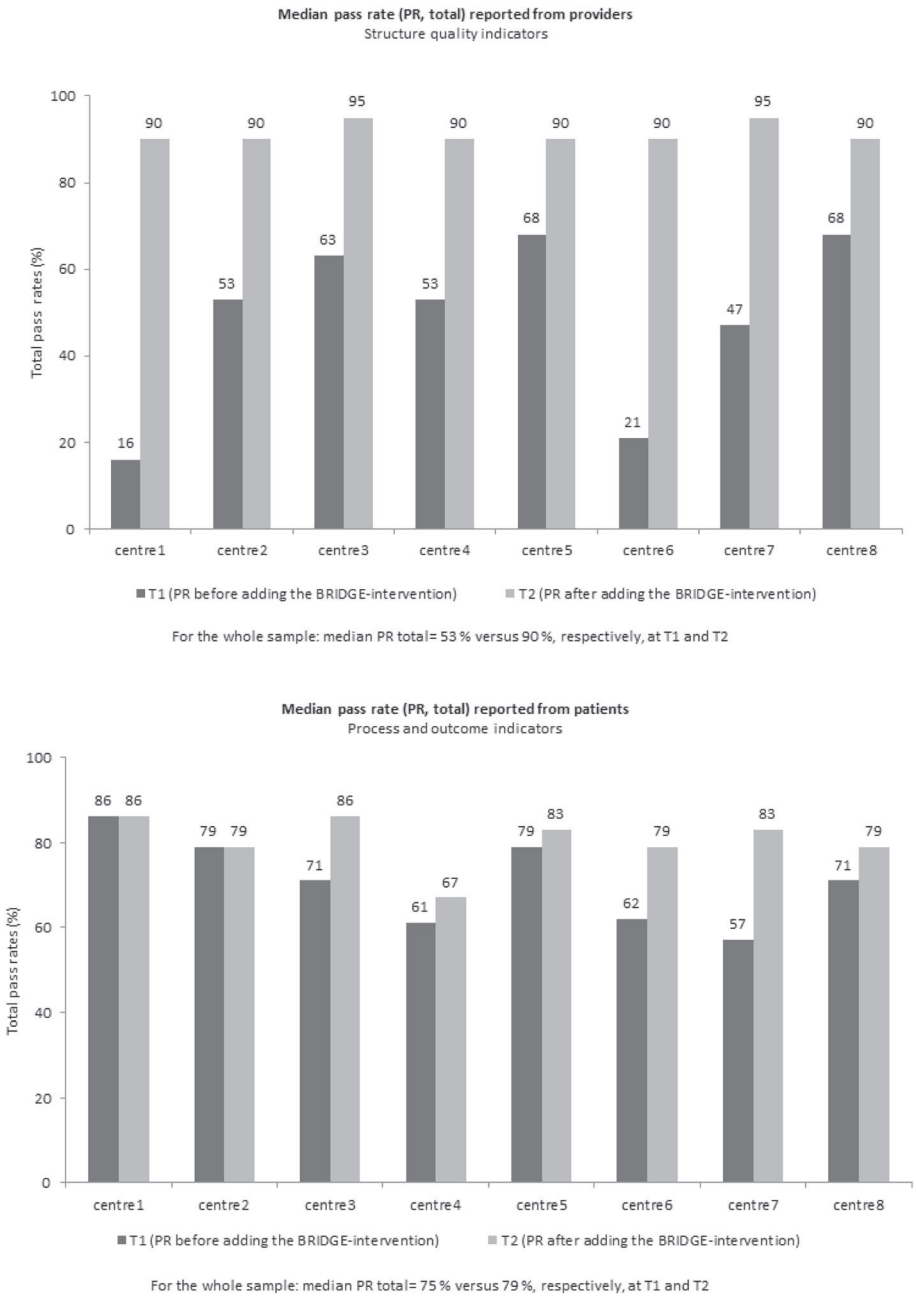

Fig. 2 Longitudinal changes in total pass rates in the time interval from T1 to T2

From both the service and the user perspectives, the largest improvements from T1 to T2 were related to externals involved in planning the follow-up (Fig. 3). The change scores were 62.5% for the structure indicator (C10) and 20% for the matching process indicator (P11) (Additional file 3). The magnitude of these improvements confirmed the predefined expectation (Table 3, Additional file 3).

Discussion

In this study, we evaluated the responsiveness of a newly developed QI set for rehabilitation services for people with RMDs. A construct approach was used, with predefined hypotheses regarding expected changes in QI pass rates after the addition of a new rehabilitation intervention to the traditional programs delivered at eight rehabilitation centers in specialist care. The results show

Fig. 3 Longitudinal changes in single indicator pass rates in the time interval from T1 to T2

adequate responsiveness, with more than 75% of the predefined hypotheses being confirmed.

Although most of the hypotheses were confirmed, some reasons for unconfirmed hypotheses are worth noting. First, the change scores were larger than expected for three of the structure indicators. When developing the hypotheses, we assumed that implementation of written procedures, which is required for a shift from "no" to "yes" on structure indicators, would be difficult to achieve for the centers. However, more respondents answered "yes" at T2 than expected. One reason may be that providers regarded the BRIDGE booklets for patients and providers as written procedures. Whether the centers continued to use these booklets after the research period would be interesting to explore in a follow-up study.

Second, the change scores were smaller than expected for three of the process indicators, likely because quality was already in line with normative standards at T1. Indeed, we found surprisingly high PR values for the three indicators at T1 (93, 88, and 86%, respectively), and the potential for change in these indicators was therefore negligible. For other indicators, we had several hypotheses ($n = 16$) regarding maintenance of good quality from T1 to T2, which were confirmed. Consequently, our data suggest that the QI set will capture efforts to improve or prove good quality over time, implying the double intention when monitoring quality: In addition to measuring quality improvements, it is important to know whether established good quality is maintained.

Third, we expected stable or improved outcome indicators both after the traditional rehabilitation program (T1) and after the BRIDGE intervention (T2). In line with these expectations, we found that PR values at T1 and T2 were equal for P13 (improved physical mental, and/or social functioning), whereas the change scores for P12 (reached important goals) and P14 (improved HRQoL) were slightly negative (– 3% and – 8%, respectively). Also, when considering the outcome indicators for one of the subgroups, the observed change score for total PR differed from what we hypothesized. Many factors may have influenced these results, such as variation in patient groups among centers, and factors not captured by the chosen baseline characteristics, such as motivation, ability to be compliant, and individual decisions about when to focus on different goals and issues through the follow-up period. As others have highlighted [19, 20, 34–36], structure and processes of provided care explain only a portion of what influences outcomes. Nevertheless, patient-reported clinical outcomes should remain relevant for monitoring quality because of the expected interplay among all dimensions in the concept of quality [15, 34–37]. However, further research is needed regarding the kind of outcomes that are most sensitive to detecting differences in quality of care and the evidence for potential links among structure, process, and outcome indicators [15, 20, 35–37].

Strengths and limitations

The strengths of this study include a methodology guided by the COSMIN checklist [32], a large patient sample size, and high data quality with a response rate of 100% for center-reported QIs and more than 80% for patient-reported QIs. However, the use of questionnaires in Norwegian may have induced a sample bias of having few participants from ethnic minority groups. Apart from this, we believe that the study group was representative and that the results may apply to the broad RMD population receiving specialized rehabilitation in Norway [38]. The most important limitation in our study is the modest number of rehabilitation units. However, this manageable sample enabled us to offer tailored guidance to prepare for high fidelity when adding the new BRIDGE program at each center. Moreover, the number of Norwegian institutions in specialized care delivering rehabilitation services for people with RMDs is limited, and our sample include both rehabilitation institutions and hospital rehabilitation departments across rural and urban regions. Still, the indicator set might function differently within rehabilitation services and funding systems abroad. Therefore, responsiveness should be further tested in studies in different countries and levels of care.

Finally, in our evaluation of responsiveness, all hypotheses counted equally. This choice can be questioned because we did not form the same number of hypotheses for each indicator. The greater number of hypotheses for the structure indicators may have led to an unbalanced evaluation of the interplaying triad of structure, process, and outcome indicators. However, we note that we assessed responsiveness for the QI set in its entirety and not for separate subscales. Although center- and patient-reported QIs are separate questionnaires, we recommend that they be used simultaneously to cover the concept of quality from both the service and patient perspectives.

Implications

Quality of care is receiving increasing emphasis and interest in research, clinical practice, and public documents [12–15]. For different stakeholders, such as patients, health professionals, researchers, and policy makers, it is important to have tools for delivering and demanding optimal rehabilitation [39]. This QI set offers a timely opportunity to establish quality-of-rehabilitation benchmarks, promote important steps toward high-quality rehabilitation, and track trends over time. As far as we know, this QI set is the first indicator set developed for use in rehabilitation for people with RMDs, covering structure, process, and outcome quality [21]. In the pilot study, the QI set was proven feasible, with satisfactory face and content validity [21]. Our results support that the QI set also can be used in longitudinal evaluations of quality in or between rehabilitation services. Such information may be useful for providers in evaluating local quality improvement initiatives or continuing efforts to keep the service in line with the recommendations. Additionally, the information may be useful for policy makers, funders, and researchers in following trends over time and trajectories across care levels and identifying potential problems or issues to consider when planning for future management of rehabilitation. A further important application is the facilitation of patients' choice of providers, by producing information about the quality of rehabilitation available.

Conclusion

We found that this QI set for rehabilitation was responsive when applied in rehabilitation services for adults with various RMD conditions. The QI set holds potential as an important tool for capturing changes or monitoring maintenance in the multidimensional arena of quality in rehabilitation. Our results support the use of this QI set in clinical practice and research when the intention is to evaluate quality over time from both the system and user perspectives. This QI set may be useful for quality improvement and benchmarking in and between rehabilitation services.

Supplementary Information

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Additional file 1. Organization of rehabilitation programs at participating centers.

Additional file 2. Baseline characteristics of patients in the BRIDGE trial when the QI set was distributed.

Additional file 3. Predefined hypotheses with rationale and results.

Abbreviations

QI: Quality indicator; RMD: Rheumatic and musculoskeletal disease; STAR-ETIC: Scandinavian team-arthritis register – european team initiative for care research; PR: Pass rate; PSFS: Patient-specific functional scale; 30secSTS: The 30-s sit-to-stand test; EQ-5D: EuroQoL 5D-5L-health related quality of life; COSMIN: Consensus-based standards for the selection of health measurement instruments; ICC: Intraclass correlation coefficient; PT: Physiotherapist; OT: Occupational therapist

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Authors' contributions

All authors were involved in drafting the article or revising it critically for important intellectual content. All authors approved the final version to be submitted for publication. Study conception or design: ALSS, GB, IK, HD, MA, IB, TD, SGE, GOF, ASH, ÅK, ADL, KT, HLV, and AMA. Acquisition of data: IB, SGE, GOF, ASH, ÅK, ADL, KT, HLV, and AMA. Analysis and interpretation of data: ALSS, GB, HD, and IK. ALSS had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The study was approved by the Norwegian Regional Committee for Medical Research Ethics (REK South-East, 2017/665). All participants provided a written informed consent. Our study was performed in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Publisher's Note

Additional file 1 Organization of rehabilitation programs at participating centres

	Participating centres	1	2	3	4	5	6	7	8
	Organization (the same for both T1 and T2):								
Healthcare system	Norwegian public healthcare system with equal access to all health care services	x	x	x	x	x	x	x	x
Level of care	Secondary level (specialist health care)	x	x	x	x	x	x	x	x
Type of setting	Hospital department of rheumatology	x	x				x		
	Specialized rehabilitation institution			x	x	x		x	x
Primary diagnoses (1=the biggest group, 5=the smallest)	Inflammatory arthritis	1	1	1	-	2	1	2	1
	Connective tissue diseases	2	2	-	-	4	2	-	2
	Wide spread pain or fibromyalgia	-	-	2	1	3	-	1	3
	Unspecific low back pain, neck- or shoulder pain (persistent>3 months)	-	-	3	2	1	-	2	-
	Osteoarthritis	-	-	2	-	5	-	3	3
	Osteoporosis	-	-	-	-	-	-	-	-
Length of stay	2 weeks		x				x		
	3-4 weeks	x		x	x	x		x	x
Professions in the rehabilitation team	Medical doctor*	x	x	x	x	x	x	x	x
	Physiotherapist	x	x	x	x	x	x	x	x
	Occupational therapist	x	x	x	x	x	x	x	x
	Nurse	x	x	x	x	x	-	x	x
	Social worker	x	x	x	-	x	x	x	x
	Psychologist	-	x	-	-	-	-	-	-
	Nutritionist or dietist	-	x	x	x	x	-	x	x
	Other	x	x	x	x	x	x	x	x
	Further information about organization at T1 (before adding the BRIDGE program):								
Communication form in the rehabilitation team	A single team meeting during the stay (the whole team)						x		
	Weekly team meetings (once a week or more frequent)	x	x	x	x	x	-	x	x
	Other meetings when needed (formal or informal)	x	x	x	x	x	x	x	x
Patient participation (PP)	PP in team meetings at admission and discharge	x	x	-	-	-	-	-	-
	PP in all team meetings (the whole team)	-	x	-	-	-	-	-	-
	PP in regular meetings with a representative of the team	x	x	-	x	x	-	-	x
	Group-based PP in team meetings	-	-	-	-	-	-	x	-
Family involvement	Standard for family involvement	-	-	x	-	-	-	-	-
	Family involvement based on indication	x	-	x	-	-	x	x	x
Follow-up Goals	Standard for follow-up management	-	x	x	-	x	x	x	-
	Individual goals defined together with team member(s)	x	x	x	x	x	x	x	x
	Standardized assessment of individual goals	-	-	-	-	x	-	-	-
Standardized assessment	On admission	x	x	x	x	x	x	x	x
	At discharge (evaluation)	x	x	x	x	x	x	-	x
Treatment by health professionals	On individual levels	x	x	x	x	x	x	x	x
	In group sessions	x	x	x	x	x	x	x	x
Self-training	Gym, weights-lifting, swimming or outdoor training	x	x	x	x	x	x	x	x
Outcomes	Body function	x	x	x	x	x	x	-	x
	Activity	x	x	x	x	x	x	x	x
	Participation	-	x	-	-	x	-	-	-
	Health-related quality of life	-	-	-	x	-	-	-	x
	Goal attainment	-	-	-	-	x	-	-	-
	Patient satisfaction	x	-	x	-	x	-	-	-

*T1/T2=first/second time point in evaluation of responsiveness, x=present (provided), -=not present (not provided), *rheumatologist or specialist in physical medicine and rehabilitation.*

Additional file 2 Baseline characteristics of patients in the BRIDGE-trial when the QI-set was distributed (n=357)

	T1-group (n = 200)	T2-group (n = 157)	p-value
Age, years, mean (min, max)	52 (21,81)	49 (18,77)	0.005[1]
Gender, female, n (%)	148 (74)	123(78)	0.341[2]
Diagnosis, n (%)			
Inflammatory rheumatic disease (SpA, PsA, RA, JRA)	143 (72)	85 (54)	
Osteoarthritis	8 (4)	5 (3)	<0.001[2]
Connective tissue disease (SLE, SS, PMR, MCTD)	14 (7)	6 (4)	
Fibromyalgia syndrome, CWP	20 (10)	51 (32)	
Unspecific neck-, shoulder- and low back pain (>3 months)	15 (8)	10 (6)	
Osteoporosis	0	0	
Disease duration, years, median (min, max)	17 (1,67)	13 (0,68)	0.014[3]
Comorbidities, n, median (min , max)	2.5 (0,9)	3 (0,9)	0.334[3]
Medication usage			
NSAIDs, n (%)	80 (43)	76 (53)	0.068[2]
Disease modifying anti-rheumatic drugs (DMARDs), n (%)	68 (37)	51 (36)	0.867[2]
TNF-inhibitors, Biosimilars, JAK-inhibitors n (%)	42 (23)	26 (18)	0.329[2]
Analgesics, n (%)	131 (70)	103 (72)	0.751[2]
Other drugs, n (%)	135 (73)	107 (75)	0.647[2]
BMI (kg/m^2), median (min, max)	28 (17,66)	28 (17,50)	0.662[3]
Smokers, n (%)	57 (29)	37 (24)	0.330[2]
Snuff users, n (%)	19 (10)	13 (9)	0.704[2]
Education > 12 years, n (%)	80 (40)	67 (44)	0.558[2]
Paid work, n (%)	85 (43)	69 (45)	0.664[2]
Recipients of social security benefits, n (%)	139 (81)	120 (87)	0.178[2]
Living with partner, n (%)	140 (70)	103 (67)	0.485[2]
Physical exercise ≥ 1 per week, n (%)	123 (62)	81 (53)	0.082[2]
General activity ≥ 1 per week, n (%)	147 (74)	104 (68)	0.220[2]

[1]Independent Samples T-test, [2]Pearson Chi Square test, [3]Mann Whitney U test. SpA: spondyloarthritis, PsA: psoriatic arthritis, RA: rheumatoid arthritis, JRA: juvenile rheumatoid arthritis, SLE: systemic lupus erythematosus, SS: Sjögren syndrome, PMR: polymyalgia rheumatica, MCTD: mixed connective tissue disease, CWP: chronic widespread pain. Disease duration (symptom debut) and comorbidities are self-reported. NSAIDs: nonsteroidal anti-inflammatory drugs, DMARDS include corticosteroids, TNF: tumor necrosis factor, JAK: Janus Kinase. BMI: body mass index (bodyweight/height^2). Physical exercise: increased heart rate and breathing for 30 minutes or longer. General activity: social or cultural activities, hobbies, work.

Additional file 3, in the manuscript:

A quality indicator set for rehabilitation services for people with rheumatic and musculoskeletal diseases demonstrates adequate responsiveness in a pre–post evaluation

Additional file 3. Predefined hypotheses with rationale and results.

PART ONE Changes in median TOTAL PASS RATES (PRs)					
	Indicator	H_{total} number	**Hypotheses (H)**	**Proportion / PR /change (Δ)**	**Confirmed (Yes/No)**
Center-reported QIs (structure)	C 01-C 19	1	For center-reported QIs, a moderate to high change score is expected for median total PR between T1 and T2.	$medianPR_{totalT1}$=53% $medianPR_{totalT2}$=90% Δ_{T2-T1}=37%- points	**yes**
Patient-reported QI (process and outcomes)	P 01-P 14	2	For patient-reported QIs, a small to moderate change score is expected for median total PR between T1 and T2.	$medianPR_{totalT1}$=75% $medianPR_{totalT2}$=79% Δ_{T2-T1}=4%- points	**yes**
Patient-reported QIs (process in subgroups)	P 01-P 11	3	For process QIs, the change score for median total PR is expected to be small to moderate for both group 1 (inflammatory rheumatic disease) and group 2 (fibromyalgia) between T1 and T2. (n_{group1}=74-114) (n_{group2}=14-40)	$medianPR_{processT1group1}$=73% $medianPR_{processT2group1}$=82% $\Delta_{T2-T1group1}$=9%- points $medianPR_{processT1group2}$=70% $medianPR_{processT2group2}$=73% $\Delta_{T2-T1group2}$=3%- points	**yes**
Patient-reported QIs (outcomes in subgroups)	P 12-P 14	4	For outcome QIs, the change score for the median total PR is expected to be zero or small for both group 1 (inflammatory rheumatic disease) and group 2 (fibromyalgia) between T1 and T2. (n_{group1}=74-114) (n_{group2}=14-40)	$medianPR_{outcomeT1group1}$=100% $medianPR_{outcomeT2group1}$=100% $\Delta_{T2-T1group1}$=no change $medianPR_{outcomeT1group2}$=50% $medianPR_{outcomeT2group2}$=67% $\Delta_{T2-T1group2}$=17%- points	no
Group 1= participants registered in the BRIDGE-trial with inflammatory rheumatic disease at admission. Group 2= participants registered in the BRIDGE-trial with fibromyalgia or chronic widespread pain at admission.					
RATIONA	Assumptions about the T1-situation Seven out of 8 centers in the BRIDGE trial participated in the pilot study (1) concerning quality indicators in rehabilitation. The T1-situation may be similar to the situation in the pilot study as regards quality indicators (QIs) in rehabilitation. The results from the pilot study (1) showed: • C01-C19_For structure items measured in specialist care, the median sum PR was 63%, ranging from 21% to 100% (answered by providers in the beginning of the test period). One among 15 units in specialist care reached a 100% sum PR. (This unit was not among participating units in the BRIDGE-trial) • P01-P14_For process and outcome items measured in specialist care, the mean sum PR was 72% (answered by patients one to two months after completion of a rehabilitation program at 14 units) (there were no patients from the last unit). Among the centers in the pilot, the value of the mean sum PR ranged from 36 to 89%. Looking separately on process and outcome items, the mean sum PR				

L E	for process items (P01-P11) was 70% in specialist care. Box plots from the pilot study illustrate that the data concerning process QIs was not tightly grouped, but spread along a wide spectrum from zero to 100. For outcome items (P12-P14) the mean sum PR was 83% in specialist care. Data concerning outcome QIs was spread from zero to top, as well, but skewed towards the interval 67-100%. • In the pilot study, less optimal quality was found for both structure and process domains. Potential for improvement was found for important quality domains such as goal-directed evaluation along the rehabilitation process, individual planning of follow-up, involving external personnel, and use of validated assessment instruments at admission, discharge and 3-6 months after rehabilitation. • The largest diagnose groups in the BRIDGE-trial was inflammatory rheumatic disease (group 1) and fibromyalgia syndrome/chronic widespread pain (group2). Previous studies have shown that immediately after, or few weeks after, completion of similar multidisciplinary rehabilitation studies, improvements were found for both groups regarding health related quality of life, goal attainment and function (2, 3). In the pilot study, PRs for the outcome items were considerable high for both group 1 and group 2 (1) *The table continues…*
R A T I O N A L E	<u>Expected influence of the BRIDGE-intervention on the total pass rates for quality in rehabilitation:</u> • In our study, providers of the BRIDGE-intervention are expected to strive for improved continuity in the whole rehabilitation process. Thus, the structural domain of quality in rehabilitation is expected to be influenced in form of providers who emphasize patient participation and information to externals, regarding individual goal setting, goal-directed rehabilitation plan and follow-up plan, evaluation using validated outcome measures and feedback. However, in order to tick "yes" for a structural item, two requirements have to be met: i) *included in the written procedures of the rehabilitation center*, and ii) *in daily use*. For some units, the development of new written procedures may appear as large changes and difficult to fulfill. When both requirements are not fulfilled, a unit is not allowed to change answer from "no" to "yes". • Further, the process domain is expected to be influenced as well, in form of improved clinical practice at each unit reflected in the patients' experiences. Patients report their experiences in the patient-reported QI-form. Compared to T1, we expect a small to moderate higher proportion of patients at T2 answering "yes" regarding experienced influence on their own goal setting, rehabilitation plan, follow-up plan, evaluation and feedback. <u>Summed up:</u> Elements in the BRIDGE-intervention match important quality indicators which were identified in the pilot study as with potential for improvement. Changes should be reflected in both system and user perspective of quality in rehabilitation. We therefore expect small to moderate changes between T1 and T2 in total mean pass rates for both questionnaires in the quality indicator set. For the subgroups (group 1 and group 2, respectively), we expect changes in process and outcomes to be comparable.

PART TWO Single indicator pass rate (PR) change

a) **PATIENT-PARTICIPATION IN GOAL SETTING AND REHABILITATION PROCESS**

QI no.	**H no.**	**Hypotheses (H)** (H_{single})	**Proportion / N /change (Δ)**	**Confirmed (Yes/No)**
C01	The user/patient shall participate in setting rehabilitation goals.			
P04	Were you actively involved in setting specific goals for the rehabilitation period?			
	1	C01: All participating centers who answered "yes" at T1 are expected to answer "yes" at T2.	$N_{T1=yes}$=6 $N_{yes\_sustained\_T1toT2}$=6 $Proportion_{sustained}$=100%	**yes**
	2	C01: The proportion of participating centers having a shift from "no" at T1 to "yes" at T2 is expected to be <u>small to moderate.</u>	$N_{T1=no}$=2 $N_{improved}$=2 $\Delta_{absolute}$=25% (2/8)	**yes**
	3	P04: The proportion of patients answering "yes" at T2 is expected to be <u>similar or slightly higher</u> than proportion of patients answering "yes" at T1. *(Proportion=$N_{participants\ who\ checked\ "yes"}$/$N_{participants\ who\ checked\ "yes"\ or\ "no"}$)*	$Proportion_{T1}$=159/162 $Proportion_{T2}$=131/132 Δ_{T2-T1}=99.2%-98.2%=1%	**yes**
R A T	<u>Assumptions about the T1-situation</u> • C01_Results from the pilot study (1), PRs (providers in specialist health care) = 93% • P04_Results from the pilot study (1), PRs (patients in specialist heath care) = 97%			

I O N A L E	• C01_Six out of eight participating centers in the BRIDGE-study participated in previous studies involving goal setting in rehabilitation. Previous studies were the PRAISE study (center 7), The BRIDGE pilot study (centers 2, 5, 6 and 8), and both the PRAISE and the BRIDGE pilot study (center 4). Consequently, we have yet another reason for expecting patient involvement in goal setting as clinical practice already in the T1-situation. However, the request for patient involvement in goal setting as established in written procedures, may be more difficult to fulfill. We expect PRs higher than 6% when it comes to patient involvement in goal setting from the provider perspective at T1. • C01_Prior to the PRAISE study, 6/6 rehabilitation sites reported individual goals to be defined as part of regular practice, and at 5/6 of those sites, the goals were developed in collaboration between the patient and team member(s) (reported by the providers) (4, p 149) • C01_5/5 rehabilitation sites in Norway reported individual goals to be defined / developed together with team member(s) (5). As such, we have reasons to believe that this reflected also the regular clinical practice, but not necessarily the written procedures. *The table continues…*
R A T I O N A L E	<u>Expected influence of the BRIDGE-intervention on this specific area of quality in rehabilitation:</u> Patient participation in goal setting at admission and discharge is included in the BRIDGE-intervention. At baseline, patient-specific rehabilitation goals will be developed by the patient together with the multidisciplinary team or the local coordinator. At discharge, patient-specific rehabilitation goals are developed in the same way, but now the contents in goals are facing the follow-up period at home (6, 7 (checklist item no. 3, 4, 6, 10)). Development of written procedure at each center does not directly follow from written guiding booklets for use in the restricted BRIDGE time period. Therefore, we do not expect high influence on the structural domain. <u>Summed up:</u> The clinical practice of providers is likely to be affected by the intervention (T2) in the form of goal setting dialogues with every patient, but we do not know whether written procedures (if lacking) are developed (structural factors) as a consequence of the BRIDGE-intervention. Further, we do not know if all patients want to be involved in goal setting in the T2-situation, even if invited to participate. Because of expected high PRs already at T1, we consider C01 and P04 less likely to be further affected by the BRIDGE-intervention.
C02	The user/patient shall participate in planning his /her own rehabilitation process.
C03	A template is used to prepare an individual rehabilitation plan for the user/patient.
P03	Was a written plan developed for the rehabilitation period (comprising your rehabilitation goals, what you should practice etc.)?
P05	Where you actively involved in preparing a specific written plan for the rehabilitation period (mentioned in question 3)?

	H no.	**Hypotheses (H)** (H_{single})	**Proportion / N /change (Δ)**	**Confirmed (Yes/No)**
	4	C02: All participating centers who answered “yes” at T1 are expected to answer “yes” at T2	$N_{T1=yes}$=6 $N_{yes\_sustained\_T1toT2}$=6 $Proportion_{sustained}$=100%	**yes**
	5	C03: All participating centers who answered “yes” at T1 are expected to answer “yes” at T2	$N_{T1=yes}$=5 $N_{yes\_sustained\_T1toT2}$=5 $Proportion_{sustained}$=100%	**yes**
	6	C02: The proportion of participating centers having a shift from “no” at T1 to “yes” at T2 is expected to be <u>small to moderate</u>.	$N_{T1=no}$=2 $N_{improved}$=2 $\Delta_{absolute}$=25% (2/8)	**yes**
	7	C03: The proportion of participating centers having a shift from “no” at T1 to “yes” at T2 is expected to be <u>small to moderate</u>.	$N_{T1=no}$=3 $N_{improved}$=3 $\Delta_{absolute}$=37.5% (3/8)	no
	8	P03: Proportion of patients answering “yes” at T2 is expected to be <u>moderate higher</u> than proportion of patients answering “yes” at T1.	$Proportion_{T1}$=148/161 $Proportion_{T2}$=125/132 Δ_{T2-T1}=94.7% -91.9%=2.8%	no
	9	P05: Proportion of patients answering “yes” at T2 is expected to be <u>moderate higher</u> than proportion of patients answering “yes” at T1.	$Proportion_{T1}$=140/160 $Proportion_{T2}$=123/132 Δ_{T2-T1}=93.2%-87.5%=5.7%	no

(Proportion=$N_{participants\ who\ checked\ "yes"}$/$N_{participants\ who\ checked\ "yes"\ or\ "no"}$)

The table continues…

RATIONALE	Assumptions about the T1-situation • C02_Results from the pilot study (1), PRs (providers in specialist health care) = 93% • C03_Results from the pilot study (1), PRs (providers in specialist health care) = 79% • P03_Results from the pilot study (1), PRs (patients in specialist heath care) = 82% • P05_Results from the pilot study (1), PRs (patients in specialist heath care) = 76% • C02 _Prior to the PRAISE study, 2/6 rehabilitation sites reported patient involvement in development, adjustment and evaluation of rehabilitation plans (4, p 149). • C03 _ Prior to the PRAISE study, 3/6 rehabilitation sites reported use of individual rehabilitation plans with goals, action plan and cooperative agreements (4, p 149). • C03_5/5 rehabilitation sites in Norway reported that they included an individual rehabilitation plan. Data concerning patient involvement in preparing this plan is not included in the paper (5). This reflects the clinical practice, but not necessarily written procedures. Expected influence of the BRIDGE-intervention on this specific area of quality in rehabilitation: In the BRIDGE-intervention, the patient and the team member(s) develop a plan for actions and efforts for reaching patient-specific goals and improve the function. The planning comprises plans for self-management, as well as support from health care providers, next of kin or important others. A written individual rehabilitation plan is included in the BRIDGE-intervention. The template is available in the patients' guiding booklets. The plan is developed by the patient and the team (or a professional who represents the team), and comprises the goals, appurtenant goal-directed interventions, responsible person/instance, and strategies for potential obstacles. (6, 7 (checklist item no. 7, 11, 12, 13)). We do not know if written material for use in the research period, results in written procedure at the actual centers. Summed up: Patient involvement in planning the rehabilitation period as well as clinical use of a template of a rehabilitation plan, are likely to be affected by the BRIDGE-intervention (T2). However, the influence may be better reflected in process indicators than structural indicators.
C05	There are at least two meetings between the user/patient and the interdisciplinary team, or between the user/patient and a professional who represents the interdisciplinary team.
P06	Did you participate in at least two meetings with the interdisciplinary team or a professional representing the team during which your goal(s) and goal attainment so far were discussed?

	H no	**Hypotheses (H)** (H_{single})	**Proportion / N /change (Δ)**	**Confirmed (Yes/No)**
	10	C05: All participating centers who answered "yes" at T1 are expected to answer "yes" at T2	$N_{T1=yes}$=6 $N_{yes\_sustained\_T1toT2}$=6 $Proportion_{sustained}$=100%	**yes**
	11	C05: The proportion of participating centers having a shift from "no" at T1 to "yes" at T2 is expected to be small to moderate.	$N_{T1=no}$=2 $N_{improved}$=2 $\Delta_{absolute}$=25% (2/8)	**yes**
	12	P06: Proportion of patients answering "yes" at T2 is expected to be moderate higher than proportion of patients answering "yes" at T1. *(Proportion=$N_{participants\ who\ checked\ "yes"}$/$N_{participants\ who\ checked\ "yes"\ or\ "no"}$)*	$Proportion_{T1}$=138/160 $Proportion_{T2}$=127/131 Δ_{T2-T1}=97%-86.3%=10.7%	no

RATIONALE	Assumptions about the T1-situation • C05_Results from the pilot study (1), PRs (providers in specialist health care) = 71% • P06_Results from the pilot study (1), PRs (patients in specialist heath care) = 77% • C05 _Prior to the PRAISE study, 2/6 rehabilitation sites reported some patient participation in team meetings (4, p 149). • C05 _5/5 rehabilitation sites in Norway included patient participation in team meeting at admission/discharge (5). This reflects the clinical practice, but not necessarily written procedures. Expected influence of the BRIDGE-intervention on this specific area of quality in rehabilitation:

L E	In the BRIDGE-intervention, a goal-setting conversation between the patient and the multidisciplinary team (or a professional who represents the team) is mandatory. A telephone-based consultation in the follow-up period is mandatory, as well, addressing progress towards goals, adherence to self-management and, if applicable, necessary contacts and support from primary health (6, 7(checklist item no. 4, 18)). *The table continues…* Additionally, meetings between the patient and the team (or a professional who represents the team) are expected in order to develop written rehabilitation plans, self-management plans and a plan for follow-up (6, 7 (checklist item no. 7, 11, 12, 13)). Summed up: Meetings between the patient and team member(s) are likely to be affected by the BRIDGE-intervention (T2). We expect this to be reflected in positive change score for both provider-reported and patient-reported QIs. However, the influence on provider-reported change score may be less due to the requirement concerning development of written procedure (beyond the written guiding booklets meant for the research period). Further, the influence on patient-reported change score may be less due to complex formulation of that question (how do the respondent understand the question?).			
C04	The user/patient shall participate in evaluating his/her ongoing process.			
	H no.	**Hypotheses (H)** (H_{single})	**Proportion / N /change (Δ)**	**Confirmed (Yes/No)**
	13	C04: All participating centers who answered "yes" at T1 are expected to answer "yes" at T2	$N_{T1=yes}$=5 $N_{yes\_sustained\_T1toT2}$=5 $Proportion_{sustained}$=100%	**yes**
	14	C04: The proportion of participating centers having a shift from "no" at T1 to "yes" at T2 is expected to be small to moderate.	$N_{T1=no}$=3 $N_{improved}$=3 $\Delta_{absolute}$=37.5% (3/8)	no
R A T I O N A L E	Assumptions about the T1-situation • C04_Results from the pilot study (1), PRs (providers in specialist health care) = 93% • C04 _Prior to the PRAISE study, 2/6 rehabilitation sites reported patient involvement in evaluation during the stay (4, p 149). Expected influence of the BRIDGE-intervention on this specific area of quality in rehabilitation: According to the protocol, the BRIDGE trial is expected to empower patients to monitor and evaluate their health, function and their rehabilitation progress / goal progress over time (6). In the BRIDGE-intervention, the patient and the multidisciplinary team evaluate the ongoing goal process, and they make adjustments (if needed) during the rehabilitation stay. The patient and a member of the team make a new evaluation of the goal process during the mandatory telephone-based consultation in the follow-up period. Agreed adjustments of plans, efforts or actions are implemented (if needed) (6, 7 (checklist item no.9, 14, 18-21)). Additionally, patients can monitor their own progress when they log in to an electronic portal and complete the rehabilitation core set of outcomes five times over a one-year period. An auto-generated digital report visualizes the participant's current status in health and function, and changes over time at each of the five reporting times (7 (checklist items 15-17). Summed up: Patient participation in ongoing evaluation of the goal-directed rehabilitation process is likely to be affected by the BRIDGE-intervention (T2). However, the influence on the structural domain may be less due to the requirement concerning development of written procedure (beyond the written guiding booklets). Consequently, we expect low to moderate (instead of moderate to high) influence.			

b) **FOLLOW-UP PLAN AND CONTINUITY ACROSS LEVELS OF CARE**

QI no.	
C09	The user/patient shall participate in preparing a specified written follow-up plan (aside from the epicrisis) for the follow-up process after the rehabilitation period. This plan shall also include the user's / patient's own efforts to maintain or improve function/health.
C10	If there is a need for healthcare support after the rehabilitation period, the relevant personnel are to be informed about the plan or participate in the development of the follow-up plan.
P09	Apart from regular epicrisis, was a written plan developed for the period after rehabilitation, including what you were expected to work on yourself? (if you have answered "yes" to question number 7, go to question number 8. If you have answered "no" to question number 7, go to question number 9)

P10	Did you participate in developing the plan (question number 7)? *(AL: the written follow-up plan)*			
P11	As a part of this plan, were you consulted as to whether you needed follow-up from healthcare or vocational professionals (NAV) or other personnel after the rehabilitation period? *The table continues…*			
	H no.	**Hypotheses (H)** (H_{single})	**Proportion / N /change (Δ)**	**Confirmed (Yes/No)**
	15	C09: All participating centers who answered "yes" at T1 are expected to answer "yes" at T2	$N_{T1=yes}$=5 $N_{yes\_sustained\_T1toT2}$=5 $Proportion_{sustained}$=100%	**yes**
	16	C09: The proportion of participating centers having a shift from "no" at T1 to "yes" at T2 is expected to <u>be small to moderate.</u>	$N_{T1=no}$=3 $N_{improved}$=3 $\Delta_{absolute}$=37.5% (3/8)	no
	17	C10: All participating centers who answered "yes" at T1 are expected to answer "yes" at T2	$N_{T1=yes}$=3 $N_{yes\_sustained\_T1toT2}$=3 $Proportion_{sustained}$=100%	**yes**
	18	C10: The proportion of participating centers having a shift from "no" at T1 to "yes" at T2 is expected to be <u>moderate to high</u>.	$N_{T1=no}$=5 $N_{improved}$=5 $\Delta_{absolute}$=62.5% (5/8)	**yes**
	19	P09: Proportion of patients answering "yes" at T2 is expected to be <u>slightly to</u> <u>moderate higher</u> than proportion of patients answering "yes" at T1.	$Proportion_{T1}$=110/159 $Proportion_{T2}$=107/132 Δ_{T2-T1}=81.1%-69.2% =11.9%	**yes**
	20	P10: Proportion of patients answering "yes" at T2 is expected to be <u>slightly to moderate higher</u> than proportion of patients answering "yes" at T1.	$Proportion_{T1}$=106/110 $Proportion_{T2}$=105/107 Δ_{T2-T1}=98.1%-96.4% =1.7%	**yes**
	21	P11: Proportion of patients answering "yes" at T2 is expected to be <u>slightly to moderate higher</u> than proportion of patients answering "yes" at T1.	$Proportion_{T1}$=55/110 $Proportion_{T2}$=74/106 Δ_{T2-T1}=69.8%-50% =19.8%	**yes**
(Proportion=$N_{participants\ who\ checked\ "yes"}$/$N_{participants\ who\ checked\ "yes"\ or\ "no"}$)				
RATIONALE	<u>Assumptions about the T1-situation</u> • C09_Results from the pilot study (1), PRs (providers in specialist health care) = 36% • C10_Results from the pilot study (1), PRs (providers in specialist health care) = 36% • P09_Results from the pilot study (1), PRs (patients in specialist heath care)= 71% • P10_Results from the pilot study (1), PRs (patients in specialist heath care)= 83% • P11_Results from the pilot study (1), PRs (patients in specialist heath care)= 23% • C09 and C10 _Prior to the PRAISE study, 0/6 rehabilitation sites reported use of a standard for follow-up management (4, p 149). • C09 and C10 _0/5 rehabilitation sites in Norway reported use of a standard for follow-up management (5). <u>Expected influence of the BRIDGE-intervention on this specific area of quality in rehabilitation:</u> In the BRIDGE-intervention, the patient and team member(s) plan relevant follow-up care according to patient's need and available resources in the municipality (6). An individual specified written follow-up plan is included in the BRIDGE-intervention (6, 7 (checklist item no. 13)), as well as a plan for the patient's self-management (6, 7 (checklist item no.12)). The follow-up plan is tailored according to patient's needs and available resources in the municipality (6). Patient participation in development of a follow-up plan and plan for self-management is included in the BRIDGE-intervention (6, 7 (checklist item 12-13)). Potential follow-up care is proposed in the protocol, as well as in electronic portal (multiple choice list for ticking off the most relevant services for each individual), and in the guiding booklets for health personnel and patients. Options to consider are: health services from primary care (like general practitioner, physiotherapy/occupational therapist), the patient's employer / employees' health services, the Norwegian Labour and Welfare Administration (NAV/concerning employment and benefits), Healthy Life Centers and local branches of various Patient Associations. (6, 7 (checklist item		

	no. 13), 8). Special note about C10: There is no item in the checklist concerning information about the follow-up plan to relevant personnel subsequent the rehabilitation stay / participation for relevant follow-care in development of the follow-up plan. *The table continues…* However, the BRIDGE-intervention aims to enhance communication and continuity in rehabilitation across levels of care. In consequence, we expect that considerations of dialogue and collaboration with follow-up care are implicit in checklist item no.11 (rehabilitation plan for the first period in the home setting), no.13 (planned follow-up care), no.20 (evaluate necessary follow-up in local environment), and no. 21 (ensuring necessary contacts and support in the patient's home setting is established) (7). Need of follow-up care are expected to vary in the patient group. Some patients with complex conditions and/or life situations are associated with follow-up plans developed in close collaboration with primary health care. Cases with minor complexity are associated with a plain, informative referral to follow-up care (further dialogue is not needed). Some patients contact relevant follow-up care by themselves, others need support from personnel from secondary care to ensure necessary contact and support from primary care. For others, the mandatory telephone call is sufficient follow-up for maintaining goal-directed rehabilitation plan and self-management (6). <u>Summed up:</u> Patient participation in developing a written follow-up plan and plan for self-management is likely to be affected by the BRIDGE-intervention (T2). We also expect shared decision-making in the evaluation of needs from necessary services after the rehabilitation period (T2), and information to relevant personnel about the follow up plan. However, in some cases the health professionals may evaluate the need for follow-up without including the patient perspective. In other cases, some patients do not need external services and only include support from the rehabilitation unit in the follow-up plan. Additionally, the influence on the structural domain may be less due to the request concerning development of written procedure (beyond the written guiding booklets).		
C06	The user/patient is asked before meetings if he/she wants their next of kin to attend any of the meetings.			
P07	Were you asked if you wanted your next of kin to attend any of the meetings?			
	H no.	**Hypotheses (H)** (H_{single})	**Proportion / N /change (Δ)**	**Confirmed (Yes/No)**
	22	C06: All participating centers who answered "yes" at T1 are expected to answer "yes" at T2	$N_{T1=yes}$=1 $N_{yes\_sustained\_T1toT2}$=1 $Proportion_{sustained}$=100%	**yes**
	23	C06: The proportion of participating centers having a shift from "no" at T1 to "yes" at T2 is expected to be <u>zero or small.</u>	$N_{T1=no}$=7 $N_{improved}$=0 $\Delta_{absolute}$=0 (0/8)	**yes**
	24	P07: Proportion of patients answering "yes" at T2 is expected to be <u>equal or slightly higher</u> than proportion of patients answering "yes" at T1. *(Proportion=$N_{participants\ who\ checked\ "yes"}$/$N_{participants\ who\ checked\ "yes"\ or\ "no"}$)*	$Proportion_{T1}$=16/160 $Proportion_{T2}$=20/131 Δ_{T2-T1}=15.3%-10% =5.3%	**yes**
RATIONALE	<u>Assumptions about the T1-situation</u> • C06_Results from the pilot study (1), PRs (providers in specialist health care) = 57% • P07_Results from the pilot study (1), PRs (patients in specialist heath care) = 16% • C06 _Prior to the PRAISE study, 1/6 rehabilitation sites reported standard for family involvement (4, p 149). • C06 _0/5 rehabilitation sites in Norway reported standard for family involvement, but all the sites (5/5) reported family involvement based on indication (5). <u>Expected influence of the BRIDGE-intervention on this specific area of quality in rehabilitation:</u> No items in the checklist comprise invitation to meetings for family/friends (7). On the other hand, efforts and actions to ensure necessary contacts and support in the patient's home setting are emphasized in the BRIDGE-trial protocol (6). In the protocol and in the guiding booklet for clinicians, family and friends are described as *important others* and *relevant support* to facilitate self-management-strategies, lifestyle changes and goal directed rehabilitation process (6, 8). Further, "planned support from others" is included as an item in the template for the written rehabilitation plan (6, 8). <u>Summed up:</u> Involvement of next of kin in meetings is less likely to be affected by the BRIDGE-program. We expect similar or slightly higher PRs for indicator C06 and P07, respectively, due to the BRIDGE-intervention. The influence of BRIDGE-intervention may be moderated down due to dominance from health professionals who may make decisions about patients' need of involvement from next of		

	kin, without asking the patients about it (reflected in expected low pass rate for P07). Additionally, the influence on the structural domain (C06) may also be moderated down due to the request concerning development of written procedure (beyond the written guiding booklets). *The table continues…*			
C07	The user/patient is asked before meetings if he/she wants some of the professionals he/she will relate to after the rehabilitation to attend any of the meetings. This may include a physiotherapist, general practitioner or a person from work if participating in vocational rehabilitation.			
P08	Were you asked if you wanted professionals you will relate to after the rehabilitation period to attend any of the meetings, such as physiotherapist, your general practitioner, the labour and welfare administration (NAV) or a person from work, if you are participating in vocational rehabilitation?			
	H no.	**Hypotheses (H)** (H_{single})	**Proportion / N /change (Δ)**	**Confirmed (Yes/No)**
	25	C07: All participating centers who answered "yes" at T1 are expected to answer "yes" at T2	$N_{T1=yes}$=0 $N_{yes\_sustained\_T1toT2}$=0 $Proportion_{sustained}$=0	*Not applicable hypotheses*
	26	C07: The proportion of participating centers having a shift from "no" at T1 to "yes" at T2 is expected to be <u>zero to small.</u>	$N_{T1=no}$=8 $N_{improved}$=1 $\Delta_{absolute}$=12.5% (1/8)	**yes**
	27	P08: Proportion of patients answering "yes" at T2 is expected to be <u>equal or slightly higher</u> than proportion of patients answering "yes" at T1. *(Proportion=$N_{participants\ who\ checked\ "yes"}$/$N_{participants\ who\ checked\ "yes"\ or\ "no"}$)*	$Proportion_{T1}$=8/160 $Proportion_{T2}$=17/131 Δ_{T2-T1}=13%-5% =8%	**yes**
RATIONALE	<u>Assumptions about the T1-situation</u> • C07_Results from the pilot study (1), PRs (providers in specialist health care) = 57% • P08_Results from the pilot study (1), PRs (patients in specialist heath care) = 16% • C07 _Prior to the PRAISE study, 0/6 rehabilitation sites reported standard for follow-up management (4, p 149). • C07 _0/5 rehabilitation sites in Norway reported standard for follow-up management (5). <u>Expected influence of the BRIDGE-intervention on this specific area of quality in rehabilitation:</u> No items in the checklist comprise invitation to meetings for important others from primary health/other relevant services or instances. On the other hand, efforts and actions to ensure necessary contacts and support in the patient's home setting are emphasized in the BRIDGE-trial protocol. Several instances and resources in the municipality are mentioned in the protocol as relevant support, for instance general practitioner, physiotherapy/occupational therapy in primary health care, the patient's employer / employees' health services, the Norwegian Labour and Welfare Administration (NAV/concerning employment and benefits), Healthy Life Centers and local branches of various Patient Associations (6). Contact with important professionals for the rehabilitation process after discharge is expected, but probably through phone calls or written referrals, and only extraordinarily through meetings. <u>Summed up:</u> *As for involvement of next of kin:* Involvement of external professionals/important others in meetings is less likely to be affected by the BRIDGE-program. We expect similar or slightly higher PRs for indicator C07 and P08, respectively, due to the BRIDGE-intervention. The influence of BRIDGE-intervention may be moderated down due to dominance from health professionals who may make decisions about patients' need of involvement from external professionals/important others, without asking the patients about it (reflected in expected low PR for P08). Additionally, the influence on the structural domain (C07) may also be moderated down due to the request concerning development of written procedure (beyond the written guiding booklets), and also due to other contact forms than meetings.			

c) **ASSESSMENT, OUTCOMES AND TIME-POINTS OF EVALUATION**

QI no.	
P01	Where your health condition and life situation assessed during the first days of your rehabilitation period? (Answer "no" if both aspects were not assessed) (If you have answered yes to question number 1, go to question number 2. If you have answered no to question number 1, go to question number 3).

P02	Did the assessments include both a physical examination and questions about mental and social conditions, network, home situation and – if relevant – your work situation? *The table continues…*			
	H no.	**Hypotheses (H)** (H_{single})	**Proportion / N /change (Δ)**	**Confirmed (Yes/No)**
	28	P01: Proportion of patients answering "yes" at T2 is expected to be <u>similar or slightly higher</u> than the proportion of patients answering "yes" at T1. *(Proportion=$N_{participants\ who\ checked\ "yes"}$/$N_{participants\ who\ checked\ "yes"\ or\ "no"}$)*	$Proportion_{T1}$=153/162 $Proportion_{T2}$=125/132 Δ_{T2-T1}=94.7%-94.4% =0.3%	**yes**
	29	P02: Proportion of patients answering "yes" at T2 is expected to be <u>similar or slightly higher</u> than the proportion of patients answering "yes" at T1. *(Proportion=$N_{participants\ who\ checked\ "yes"}$/$N_{participants\ who\ checked\ "yes"\ or\ "no"}$)*	$Proportion_{T1}$=136/153 $Proportion_{T2}$=115/124 Δ_{T2-T1}=92.7%-88.9% =3.8%	**yes**
RATIONALE	<u>Assumptions about the T1-situation</u> • P01_Results from the pilot study (1), PRs (patients in specialist heath care) = 98% • P02_Results from the pilot study (1), PRs (patients in specialist heath care) = 87% • All participating centers in the BRIDGE-trial provide the rehabilitation service through multidisciplinary teams. • Prior to the PRAISE study, 6/6 rehabilitation sites reported rehabilitation teams involving 4 professionals or more, and 6/6 rehabilitation sites reported standardized assessment on admission. (4, p 149). • 5/5 rehabilitation sites in Norway reported standardized assessment at admission in the paper of Grotle (5). This standardized assessment includes comprehensive, bio-psycho-social assessment and evaluation at rehabilitation sites for people with rheumatic and musculosekleta disesases (RMDs) in Norway (5, 9). Typical assessment includes various outcomes, such as health status, symptoms, body function/structure, activity and participation, personal factors and health related quality of life (5, 9) <u>Expected influence of the BRIDGE-intervention on this specific area of quality in rehabilitation:</u> No items in the checklist comprise recommended content of the assessment of health condition and life situation during the first days of the rehabilitation stay. On the other hand, the BRIDGE-trial is based on a biopsychosocial understanding of health and functioning, implying complex interactions between a person's body structure and functions, activity performance, social participation, and the individual personality and environment (6). As a consequence, a holistic and systematic approach to the analysis of a patient's disability is emphasized in the BRIDGE-trial protocol (6), and the relevance of physical, mental and social conditions are reflected in the rehabilitation core set outcome measures used in the BRIDGE-trial (a mandatory core set (10) , included in the electronic portal). Following domains are central in the BRIDGE-trial for providing information about current status, development over time, and for evaluating rehabilitation: physical function, pain, fatigue, mental health, social participation, daily activities, health-related quality of life, coping, motivation, and goal attainment. Rehabilitation interventions tailored to patient-specific goals and the individual's unique home setting and life situation are emphasized in the BRIDGE-trial protocol (6). Interventions tailored to patient's needs and available resources in the community imply a comprehensive assessment approach (6). However, a bio-psycho-social assessment is expected also at T1. <u>Summed up:</u> The BRIDGE-intervention facilitates an initial bio-psycho-social assessment, but the same approach to multidisciplinary, holistic assessment of health condition and life situation is expected also at T1.			
C08	The rehabilitation unit uses reliable*** questionnaires and/or functional tests to assess physical, mental and/or social conditions. (***Reliable questionnaires and/or functional tests = quality assured/validated questionnaires and/or functional tests)			
C11	The user's/patient's goal / goal attainment is to be assessed with a reliable instrument.			
C14	The user's/patient's function is to be registered using a reliable instrument.			
C17	The user's/patient's health-related quality of life is to be assessed using a reliable instrument.			
	H no.	**Hypotheses (H)**	**Proportion / N /change (Δ)**	**Confirmed (Yes/No)**
	30	C08: All participating centers who answered "yes" at T1 are expected to answer "yes" at T2.	$N_{T1=yes}$=8 $N_{yes\_sustained\_T1toT2}$=8 $Proportion_{sustained}$=100%	**yes**
	31	C11: All participating centers who answered "yes" at T1 are expected to answer "yes" at T2.	$N_{T1=yes}$=1 $N_{yes\_sustained\_T1toT2}$=1	**yes**

			$Proportion_{sustained}$=100%	
				The table continues…
	32	C14: All participating centers who answered “yes” at T1 are expected to answer “yes” at T2.	$N_{T1=yes}$=8 $N_{yes\_sustained\_T1toT2}$=8 $Proportion_{sustained}$=100%	**yes**
	33	C17: All participating centers who answered “yes” at T1 are expected to answer “yes” at T2.	$N_{T1=yes}$=2 $N_{yes\_sustained\_T1toT2}$=2 $Proportion_{sustained}$=100%	**yes**
	34	C08: All of the participating centers who answered “no” at T1 are expected to answer “yes” at T2.	$N_{T1=no}$=0 $N_{improved}$=0 $Proportion_{improved}$=0	*Not applicable hypotheses*
	35	C11: All of the participating centers who answered “no” at T1 are expected to answer “yes” at T2.	$N_{T1=no}$=7 $N_{improved}$=7 $Proportion_{improved}$=100%	**yes**
	36	C14: All of the participating centers who answered “no” at T1 are expected to answer “yes” at T2.	$N_{T1=no}$=0 $N_{improved}$=0 $Proportion_{improved}$=0	*Not applicable hypotheses*
	37	C17: All of the participating centers who answered “no” at T1 are expected to answer “yes” at T2.	$N_{T1=no}$=6 $N_{improved}$=6 $Proportion_{improved}$=100%	**yes**
	38	C08: The change-score for C08 is expected to be small to moderate.	PR_{T1}=100% PR_{T2}=100% $\Delta_{absolute}$=0	*Not applicable hypotheses*
	39	C11: The change-score for C11 is expected to be moderate to high.	PR_{T1}=12.5% PR_{T2}=100% $\Delta_{absolute}$=87.5%	**yes**
	40	C14: The change-score for C14 is expected to be small.	PR_{T1}=100% PR_{T2}=100% $\Delta_{absolute}$=0	*Not applicable hypotheses*
	41	C17: The change-score for C17 is expected to be moderate to high.	PR_{T1}=25% PR_{T2}=100% $\Delta_{absolute}$=75%	**yes**

RATIONALE

Assumptions about the T1-situation

- C08_Results from the pilot study (1), PRs (patients in specialist heath care) = 86%
- C11_Results from the pilot study (1), PRs (patients in specialist heath care) = 43%
- C14_Results from the pilot study (1), PRs (patients in specialist heath care) = 93%
- C17_Results from the pilot study (1), PRs (patients in specialist heath care) = 43%
- Prior to the PRAISE study, 6/6 rehabilitation sites reported standardized assessment on admission (4, p 149).
- 5/5 rehabilitation sites in Norway reported standardized assessment at admission in the paper of Grotle (5).

Expected influence of the BRIDGE-intervention on this specific area of quality in rehabilitation:

The digital assessment solution provides a controlled use of assessment tools in BRIDGE. The assessment plans are identical for all participating rehabilitation units.
Selected assessment tool in the BRIDGE-trail is a Norwegian core set of patient-reported outcome measures for use in multidisciplinary rehabilitation (10).

	The table continues… The core set covers aspects of physical, mental and social function and consists of one performance-based test for physical function (30-second Sit to Stand test) and the following patient reported outcome measures: Numeric rating scale of fatigue and pain, Patient-Specific Functional Scale (patient's goal and goal attainment), Hannover Functional Questionnaire, Effective Musculoskeletal Consumer Scale, Hopkins Symptoms Checklist 5-item version, the social participation score from the COOP/WONCA, and the 5-level EuroQol 5 Dimensions (health related quality of life) (10). All instruments in the core set are reliable and validated in RMDs population (10) (6, 7 (checklist item no. 6,10,15,16)) <u>Summed up:</u> Use of quality assured/validated questionnaires and/or functional tests are likely to be affected by the BRIDGE-intervention, due to a controlled use of assessment tools in the electronic portal.			
C12	The user's/patient's goal / goal attainment is to be assessed with a reliable instrument at the beginning and the end of the rehabilitation period.			
C15	The user's/patient's function is to be registered using a reliable instrument at the beginning and the end of the rehabilitation period.			
C18	The user's/patient's health-related quality of life is to be assessed using a reliable instrument at the beginning and the end of the rehabilitation period.			
	H no.	**Hypotheses (H)** (H_{single})	**Proportion / N /change (Δ)**	**Confirmed (Yes/No)**
	42	C12: All participating centers who answered "yes" at T1 are expected to answer "yes" at T2.	$N_{T1=yes}$=7 $N_{yes\_sustained\_T1toT2}$=7 $Proportion_{sustained}$=100%	**yes**
	43	C15: All participating centers who answered "yes" at T1 are expected to answer "yes" at T2.	$N_{T1=yes}$=8 $N_{yes\_sustained\_T1toT2}$=8 $Proportion_{sustained}$=100%	**yes**
	44	C18: All participating centers who answered "yes" at T1 are expected to answer "yes" at T2.	$N_{T1=yes}$=2 $N_{yes\_sustained\_T1toT2}$=2 $Proportion_{sustained}$=100%	**yes**
	45	C12: All of the participating centers who answered "no" at T1 are expected to answer "yes" at T2.	$N_{T1=no}$=1 $N_{improved}$=1 $Proportion_{improved}$=100%	**yes**
	46	C15: All of the participating centers who answered "no" at T1 are expected to answer "yes" at T2.	$N_{T1=no}$=0 $N_{improved}$=0 $Proportion_{improved}$=0	*Not applicable hypotheses*
	47	C18: All of the participating centers who answered "no" at T1 are expected to answer "yes" at T2.	$N_{T1=no}$=6 $N_{improved}$=6 $Proportion_{improved}$=100%	**yes**
	48	C12: The change-score for C12 is expected to be <u>moderate to high</u>.	PR_{T1}=87.5% PR_{T2}=100% $\Delta_{absolute}$=12.5%	no
	49	C15: The change-score for C15 is expected to be <u>small</u>.	PR_{T1}=100% PR_{T2}=100% $\Delta_{absolute}$=0	*Not applicable hypotheses*
	50	C18: The change-score for C18 is expected to be <u>moderate to high</u>.	PR_{T1}=25% PR_{T2}=100% $\Delta_{absolute}$=75%	**yes**
R A T I	<u>Assumptions about the T1-situation</u> • C12_Results from the pilot study (1), pass rates (patients in specialist heath care) = 43% • C15_Results from the pilot study (1), pass rates (patients in specialist heath care) = 93% • C18_Results from the pilot study (1), pass rates (patients in specialist heath care) = 36%			

O - N A L E	*The table continues…* Expected influence of the BRIDGE-intervention on this specific area of quality in rehabilitation: In the BRIDGE-trial, the instrument *Patient-Specific Functional Scale (PSFS)* is primary outcome, used to evaluate patient's goals and goal attainment. 5-level EuroQol 5 Dimensions is secondary outcome, used to evaluate health related quality of life. 30-second Sit to Stand test is secondary outcome, used to evaluate physical function. Further, the following instruments complete the standardized assessment and evaluation in the BRIDGE-trial; Numeric rating scale of fatigue and pain, Hannover Functional Questionnaire, Effective Musculoskeletal Consumer Scale, Hopkins Symptoms Checklist 5-item version, and the social participation score from the COOP/WONCA. All instruments in the core set are reliable and validated in RMDs population (10). Patients complete the core set at admission and discharge of the rehabilitation stay, and after 2, 7 and 12 months (6, 7 (checklist item no. 6, 10, 16)). Summed up: Use of quality assured/validated questionnaires and/or functional tests at the beginning and end of the rehabilitation period, are likely to be affected by the BRIDGE-intervention, due to a controlled use of assessment tools in the electronic portal.			
C13	The user's/patient's goal / goal attainment is to be assessed with a reliable instrument 3-6 months after the rehabilitation period.			
C16	The user's/patient's function is to be registered with a reliable instrument 3-6 months after the rehabilitation period.			
C19	The user's/patient's health-related quality of life is to be assessed using a reliable instrument 3-6 months after the rehabilitation period.			
	H no.	**Hypotheses (H)** (H_{single})	**Proportion / N /change (Δ)**	**Confirmed (Yes/No)**
	51	C13: All participating centers who answered "yes" at T1 are expected to answer "yes" at T2.	$N_{T1=yes}$=1 $N_{yes\_sustained\_T1toT2}$=1 $Proportion_{sustained}$=100%	**yes**
	52	C16: All participating centers who answered "yes" at T1 are expected to answer "yes" at T2.	$N_{T1=yes}$=0 $N_{yes\_sustained\_T1toT2}$=0 $Proportion_{sustained}$=0	*Not applicable hypotheses*
	53	C19: All participating centers who answered "yes" at T1 are expected to answer "yes" at T2.	$N_{T1=yes}$=0 $N_{yes\_sustained\_T1toT2}$=0 $Proportion_{sustained}$=0	*Not applicable hypotheses*
	54	C13: All of the participating centers who answered "no" at T1 are expected to answer "yes" at T2.	$N_{T1=no}$=7 $N_{improved}$=7 $Proportion_{improved}$=100%	**yes**
	55	C16: All of the participating centers who answered "no" at T1 are expected to answer "yes" at T2.	$N_{T1=no}$=8 $N_{improved}$=8 $Proportion_{improved}$=100%	**yes**
	56	C19: All of the participating centers who answered "no" at T1 are expected to answer "yes" at T2.	$N_{T1=no}$=6 $N_{improved}$=6 $Proportion_{improved}$=100%	**yes**
	57	C13: The change-score for C13 is expected to be moderate to high.	PR_{T1}=12.5% PR_{T2}=100% $\Delta_{absolute}$=87.5%	**yes**
	58	C16: The change-score for C16 is expected to be moderate to high.	PR_{T1}=0 PR_{T2}=100% $\Delta_{absolute}$=100%	**yes**
	59	C19: The change-score for C19 is expected to be moderate to high.	PR_{T1}=0 PR_{T2}=100% $\Delta_{absolute}$=100%	**yes**

The table continues…

RATIONALE	Assumptions about the T1-situation • C13_Results from the pilot study (1), PRs (patients in specialist heath care) = 21% • C16_Results from the pilot study (1), PRs (patients in specialist heath care) = 29% • C19_Results from the pilot study (1), PRs (patients in specialist heath care) = 21% Expected influence of the BRIDGE-intervention on this specific area of quality in rehabilitation: No items in the checklist comprise recommendations concerning data collection for clinical assessments 3-6 months after the rehabilitation stay. On the other hand, item 16 in the check list underlines that providers of rehabilitation have to ensure that patients know how to log in to electronic portal for new assessments after 2, 7 and 12 months, from home (7). Further, support and follow-up more than 3 months are emphasized in the BRIDGE-protocol in order to obtain successful rehabilitation, explained by the nature of life-style changes and behavior changes (6). Health-related lifestyle changes often involve both cognitive and behavioral elements. The rehabilitation process may be characterized as unclear and fragile in the first months. Many patients need support over a longer time period to be able to settle new habits in everyday life (6). The point of longer time frames is also reflected in the mandatory follow-up consultation by phone about 4 weeks after discharge, with the possibility of 3 further consultations by phone during the first 6 months at home (6, 7 (item 14, 18-19)). Summed up: Use of quality assured/validated questionnaires and/or functional tests 3-6 months after the rehabilitation period, is likely to be affected by the BRIDGE-intervention, due to a controlled use of assessment tools in the electronic portal.
P12	As a result of the rehabilitation period, have you achieved one or several goals that are important to you?
P13	As a result of the rehabilitation period, have you achieved an improvement in your physical, mental and/or social functioning that is important to you?
P14	As a result of the rehabilitation, do you think your quality of life has improved?

	H no.	**Hypotheses (H)** (H_{single})	**Proportion / N /change (Δ)**	**Confirmed (Yes/No)**
	60	P12: Proportion of patients answering "yes" at T2 is expected to be equal to (or slightly higher than) proportion of patients answering "yes" at T1.	$Proportion_{T1}$=139/161 $Proportion_{T2}$=110/132 Δ_{T2-T1}=83.3%-85.7% = -2.4% (negative change)	no
	61	P13: Proportion of patients answering "yes" at T2 is expected to be equal to (or slightly higher than) proportion of patients answering "yes" at T1.	$Proportion_{T1}$=124/161 $Proportion_{T2}$=102/132 Δ_{T2-T1}=77.3%-77%=0.3%	**yes**
	62	P14: Proportion of patients answering "yes" at T2 is expected to be equal to (or slightly higher than) proportion of patients answering "yes" at T1.	$Proportion_{T1}$=129/161 $Proportion_{T2}$=95/132 Δ_{T2-T1}=72%-80.1% = -8.1% (negative change)	no

(Proportion=$N_{participants\ who\ checked\ "yes"}$/$N_{participants\ who\ checked\ "yes"\ or\ "no"}$)

RATIONALE	Assumptions about the T1-situation • P12_Results from the pilot study (1), PRs (patients in specialist heath care)= 92% • P13_Results from the pilot study (1), PRs (patients in specialist heath care)= 89% • P14_Results from the pilot study (1), PRs (patients in specialist heath care)= 77% • At discharge in the PRAISE-study, a significant treatment effect was found on health related quality of life. After six or twelve months, the positive changes after rehabilitation gradually declined. However, the outcome values were maintained at higher levels in the follow up period compared to baseline. This was the situation for both the control-group and the intervention group in the PRAISE-study (3). Expected influence of the BRIDGE-intervention on this specific area of quality in rehabilitation: Elements in the BRIDGE-program may influence and improve goal attainment, physical function, health-related quality of life, emotional status and other psychosocial outcomes. The elements are likely to facilitate self-regulation strategies and promote health-related behavior changes (6). However, we expect this type of influence also at T1. Summed up: Two months after start of the rehabilitation stay, we expect patients' outcomes to be likely affected by the BRIDGE-intervention. However, a similar influence is expected at T1 as well.

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Paper II

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RESEARCH

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Associations between quality of health care and clinical outcomes in patients with rheumatic and musculoskeletal diseases: a rehabilitation cohort study

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Abstract

Background: The quality of provided health care may be an important source of variation in rehabilitation outcomes, increasing the interest in associations between quality indicators (QIs) and improved patient outcomes. Therefore, we examined the associations between the quality of rehabilitation processes and subsequent clinical outcomes among patients with rheumatic and musculoskeletal diseases (RMDs).

Methods: In this multicentre prospective cohort study, adults with RMDs undergoing multidisciplinary rehabilitation at eight participating centres reported the quality of rehabilitation after 2 months and outcomes after 2, 7, and 12 months. We measured perceived quality of rehabilitation by 11 process indicators that cover the domains of initial assessments, patient participation and individual goal-setting, and individual follow-up and coordination across levels of health care. The patients responded "yes" or "no" to each indicator. Scores were calculated as pass rates (PRs) from 0 to 100% (best score). Clinical outcomes were goal attainment (Patient-Specific Functional Scale), physical function (30 s sit-to-stand test), and health-related quality of life (EuroQoL 5D-5L). Associations between patient-reported quality of care and each outcome measure at 7 months was analysed by linear mixed models.

Results: A total of 293 patients were enrolled in this study (mean age 52 years, 76% female). Primary diagnoses were inflammatory rheumatic disease (64%), fibromyalgia syndrome (18%), unspecific neck, shoulder, or low back pain (8%), connective tissue disease (6%), and osteoarthritis (4%). The overall median PR for the process indicators was 73% (range 11–100%). The PR was lowest (median 40%) for individual follow-up and coordination across levels of care. The mixed model analyses showed that higher PRs for the process indicators were not associated with improved goal attainment or improved physical function or improved health-related quality of life.

Conclusions: The quality of rehabilitation processes was not associated with important clinical outcomes. An implication of this is that measuring only the outcome dimension of quality may result in incomplete evaluation

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and monitoring of the quality of care, and we suggest using information from both the structure, process, and outcome dimensions to draw inferences about the quality, and plan future quality initiatives in the field of complex rehabilitation.

Trial registration: The study is part of the larger BRIDGE trial (ClinicalTrials.gov NCT03102814).

Keywords: Quality of health care, Quality indicators, Health services research, Rehabilitation, Musculoskeletal disease

Background

Rheumatic and musculoskeletal diseases (RMDs) are major contributors to the overall need for rehabilitation services worldwide [1]. In the last few decades, the globally estimated number of years lived with disability has increased substantially due to the ageing of populations, the effects of unhealthy lifestyles, and other epidemiological and demographic factors [1]. Furthermore, patients with RMDs do not always receive sufficient benefit from medical treatment strategies. Consequently, some patients experience long-term declines in physical, psychological, or social functioning and may need rehabilitation services one or several times in their lives [1–4].

Rehabilitation is frequently described as a patient-centred process, reflecting how patients and health professionals engage with each other and collaborate towards the best possible function for the patients in interaction with their environments [5, 6]. A general consensus has been reached on the key components of high-quality rehabilitation, such as agreement on goals that are important to the patient, organized multidisciplinary delivery of goal-directed action plans, and coordinated care across care levels and institutions over time [5, 6]. Yet, the current delivery of these quality norms is suboptimal and varies across providers and geographic regions [7–9].

Progress towards more optimal delivery of rehabilitation may be aided by quality indicators (QIs), as these measures are designed to compare actual patient care to norms or ideal criteria [10]. Several QI sets are based on the expected relationships between three dimensions of quality: structure, process, and outcomes [10–15]. Structure indicators relate to the organization of the health service, available resources, and procedures [16, 17]. Process indicators relate to the actual provision and reception of the health service (activities and tasks), whereas outcomes are states of health, functioning, or wellbeing that follow the provided care and processes [16, 17]. However, we need more knowledge about the associations between structure, process, and outcomes in clinical contexts [17, 18]. As the quality of provided care may be an important source of variation in clinical outcomes, interest is growing regarding associations between the fulfilment of process indicators and the likelihood of improved patient outcomes [18–20].

In the field of RMDs, the relationship between process and outcome is inconsistent [21–27], and there are few studies from the specific area of rehabilitation. Therefore, our aim was to examine the associations between level of quality of the rehabilitation processes and subsequent clinical outcomes among patients with RMDs. More specifically, we aimed to explore whether higher quality as measured by patients' responses to process indicators from a QI set for rehabilitation [11] is associated with better patient-reported outcomes in terms of goal attainment, physical function, and health-related quality of life (HRQoL).

Methods

Study design

This study was part of a large multi-centre study, the BRIDGE trial, which aimed to improve the quality, continuity, and coordination of rehabilitation for patients with RMDs [28]. In the trial, the effects of a new rehabilitation programme on patients' goal attainment, physical function, and HRQoL were evaluated at admission, discharge, and after 2, 7, and 12 months. For this purpose, the BRIDGE trial was designed as a stepped-wedge, cluster-randomized, controlled trial comparing an intervention group (adding the new BRIDGE programme to the traditional programmes) with a control group (the traditional programmes) at eight participating rehabilitation centres in secondary health care in Norway. In short, elements in the BRIDGE programme were motivational interviewing, structured goal-setting, use of a written rehabilitation plan, tailored follow-up including plans for self-management, and individualized digital feedback and tools that patients could use to monitor their own progress and cooperate with others after discharge [28, 29].

In the present study, we analysed the patient sample as one cohort regardless of group allocation. This approach was considered to be the most suitable design for our study because it provided a larger variety of responses to the process indicators, as reported by the participants in the BRIDGE trial.

Study population and recruitment

Eligible patients were ≥ 18 years old and admitted to 2–4 weeks of multidisciplinary rehabilitation care (inpatient at 7 centres, outpatient at 1 centre) due to

inflammatory rheumatic diseases, systemic connective tissue diseases, osteoarthritis, fibromyalgia syndrome or chronic widespread pain, osteoporosis, or unspecific neck, shoulder, or low back pain (persistent for > 3 months). Further inclusion criteria were the ability to read and understand questionnaires in Norwegian and access to a smartphone or equivalent device for digital data collection, including a personal electronic credential for secure identification online. Exclusion criteria were fracture(s), cognitive impairment, or severe psychiatric disorders. Health professionals at eight rehabilitation centres in different regions of Norway performed the eligibility screening and inclusion procedures.

All included patients received verbal and written information about the study and provided written informed consent. The study was approved by the Norwegian Regional Committee for Medical Research Ethics (REK South-East, 2017/665). Two patient research partners were members of the trial steering committee and involved in all stages of the trial.

Measurements

Time points for data collection

Patients were included from August 2017 to August 2018 and followed for 1 year. They used an online solution for self-reported health care assessments at admission (T_1) and discharge (T_2) from the rehabilitation stay, and at home 2, 7, and 12 months after admission (T_3, T_4, and T_5, respectively). The patients answered the QI questionnaire only at T_3. This time point was chosen to capture the patient perspective of the rehabilitation process in fair proximity to the rehabilitation stay, as well as in proximity to the first month of the follow-up period.

The patients reported goal attainment, physical function, and HRQoL at all five time points. In the present study, we only used the reports of these outcomes on T_4 to allow for sufficient time after discharge for patients to implement goal-directed self-management strategies and lifestyle changes in their daily lives.

Background variables

We collected patients' background characteristics at T_1, when the following variables were used as covariates: age, sex, body mass index (BMI = weight [kg]/height^2 [m^2]), civil status (living with partner [yes/no]), education level (yes ≥ tertiary education), paid employment (yes = part- or full-time), comorbidities (yes ≥1 additional diagnosis), weekly physical training (yes = physical activities leading to increased heart rate and breathing for ≥30 min, minimum once a week), and smoking (yes = now and then, or more often).

Quality indicators

Supported by the Norwegian Health Directorate, a QI set for use in rehabilitation for RMDs has been developed by an expert panel comprising clinicians, researchers, and patient research partners [11]. This expert panel used a RAND/UCLA Appropriateness Method to reach consensus regarding evidence-based quality statements for quality in rehabilitation. Three dimensions of quality (structure, process, and outcome) were operationalized into 19 structure, 11 process, and 3 outcome QIs [11]. The set consists of two separate questionnaires; leaders at each centre respond to the first questionnaire, comprising the structure indicators, and patients respond to the other questionnaire, comprising the process and outcome indicators. As the content of several structure indicators matches the content of the process and/or outcome indicators, the set allows for measuring quality from the perspective of both the provider and the patient [11]. The QI set has been proven feasible, with satisfactory face and content validity, and adequate responsiveness in primary and secondary health care [11, 30].

In Table 1, we describe the 11 process indicators examined in this study. Patients answered yes or no to whether they had received the content addressed by each indicator. The indicators target a continuum of delivered care from several rehabilitation settings, most typically initiated in secondary care and followed up in primary care. Notably, the indicators target the overarching, interprofessional processes that aim to support the patient's own rehabilitation process and increase the likelihood of desired outcomes. Consequently, the delivery of diagnosis- or profession-specific interventions is not directly measured by the process indicators. However, the indicators are expected to reflect the end product of general clinical reasoning and evidence-based interventions integrated throughout the rehabilitation process by health professionals, as experienced by the individual patient.

We calculated the results as pass rates (PRs). The PR for a single indicator was "the total number of patients who answered yes for this particular indicator" divided by "the total number of patients who answered yes or no for the same indicator". In addition, we calculated a summary PR score for each patient as the total of "yes" answers from the patient divided by the eligible QI items for the same patient. The minimum number of eligible items was 8 due to mandatory responses to P01 and P03–09 (Table 1). If the response was "yes" to P01, item P02 was also eligible. If the response was "yes" to P09, items P10–11 were also eligible. In conclusion, the number of eligible items was 11 if the patient answered "yes" to both P01 and P09, 10 if the response was "no" to P01, 9 if the response was "no" to P09, and 8 if the response was "no" to both P01 and P09 (Table 1). For

Table 1 Process indicators measuring quality in the rehabilitation process from the patient's perspective [11]

Main theme		Process indicator number	Question (yes/no)
A	Initial assessments	P01	Were your health condition and life situation assessed during the first days of your rehabilitation period? *If "yes", P02 is eligible:*
		P02	Did the assessments include both a physical examination and questions about mental and social conditions, network and home situation, and - if relevant – your work situation?
B	Patient participation and individual goal-setting through the rehabilitation process	P03	Was a written plan for the rehabilitation period developed that comprised your rehabilitation goals, what you should practice, etc.?
			Were you actively involved…
		P04	… in setting specific goals for the rehabilitation period?
		P05	… in preparing the specific written plan for the rehabilitation period?
		P06	Did you participate in at least two meetings with the team (or a health professional representing the team) during which your goal(s) and goal attainment thus far were discussed?
C	Patient participation, individual follow-up, and coordination across levels of health care		Were you asked if you wanted attendance in any of the meetings for…
		P07	… your next of kin?
		P08	… professionals you will relate to after the rehabilitation period?
		P09	Was a written follow-up plan developed for the period after rehabilitation, including what you were expected to work on yourself? *If "yes", P10–11, are eligible:*
		P10	Did you participate in developing the follow-up plan?
		P11	As part of this plan, were you consulted about whether you needed follow-up from external professionals after the rehabilitation period?

both single indicator PRs and summary PRs, we normalized the scores to 100 to report the values as a percentage (0–100%, with 100% = best score).

For statistical analyses, we aimed to record the overall influence of the perceived quality of the rehabilitation process as reflected by the summary PR score. In addition, to distinguish between essential components of the rehabilitation process, we grouped the single indicators into three categories reflecting the main themes of the rehabilitation stay and follow-up-period as presented in Table 1: Group A, *Initial assessments* (P01 + P02); Group B, *Patient participation and individual goal-setting through the rehabilitation process* (P03-P06); and Group C, *Patient participation, individual follow-up, and coordination across levels of health care* (P07-P11). For each patient, we calculated a summary PR score for each group of indicators. The PR score for Group A was the total "yes" answers to P01 and P02 divided by the eligible QI items in Group A for that patient. The PR score for Group B was the total "yes" answers to P03 - P06 divided by 4, because eligible QI items in Group B is always 4. Finally, the PR score for Group C was the total "yes" answers to P07 – P11 divided by the eligible QI items in Group C for that patient. In the statistical analyses, we used the term "PR variables" for the summary PR scores and PRs for Group A, B, and C.

Clinical outcomes

The primary outcome in the BRIDGE trial was goal attainment after 7 months, as measured by the Patient-Specific Functional Scale (PSFS) [31, 32]. The PSFS has open-ended categories in which the patients report up to five important activites that they currently find difficult to perform due to their health condition. The experienced performance for each activity is scored on an 11-point scale (0–10), with 0 indicating "unable to perform" and 10 indicating "no problem at all "[32, 33].

The secondary outcomes were physical function and HRQoL. We used the 30-s sit-to-stand test (30secSTS) [33–35] to assess physical function. According to specific instructions, the patient, who is seated in a chair, rises to a full standing position and then sits down again. The patient completes as many full stands as possible within 30 s [33, 35]. HRQoL was measured by the EuroQoL 5D-5L (EQ5D-index and EQ5D-vas) [33, 36]. For the EQ5D-index, patients respond to five dimensions of health (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) from 1 (no problems) to 5 (extreme problems). In the EQ5D-vas, the patients rate their current health state on a 100-mm visual analogue scale, with 0 indicating "*The worst health you can imagine*" and 100 indicating "*The best health you can imagine*" [33, 36]. All of these instruments have been tested for psychometric properties

with satisfactory results in Norwegian RMD populations [33].

We investigated the mean performance score for all reported goals for each patient, termed PSFS. In addition, we examined the first reported goal separately, termed PSFSA1, because the first goal set by the patient is reported to be the most reliable in terms of test-retest stability [32].

Furthermore, based on clinical experience and research [37], we knew that agreed rehabilitation goals for the follow-up period at home may differ from rehabilitation goals chosen for the rehabiliation stay. Therefore, patients and professionals in the BRIDGE trial were allowed to either agree on new PSFS goals at discharge or pursue the PSFS goals defined at admission. Consequently, though T_1 was the time point for baseline values for the 30secSTS, EQ5D-index, and EQ5D-vas, T_2 was the baseline time point for PSFS.

Rationale for the expected process-outcome relation

According to Donabedian's model for evaluating the quality of care, a good structure should increase the likelihood of a good process, and a good process, in turn, should increase the likelihood of good outcomes [17]. High-quality rehabiliation, as operationalized in the process indicators, aims to address patient-specific goals, physical function, and HRQoL either directly or indirectly through provided interventions, guidance, communication, and coordination. The rationale for these process-outcome assumptions was an inherent part of the RAND/UCLA process used to develop the QI set for rehabilitation [11]. To build consensus, the members of the panel rated proposed quality indicators according to the Organisation for Economic Co-operation and Development criteria in the Heath Care Quality Project [11, 38]. These criteria included considerations of the importance of what is being measured and how the health care system can take specific actions to improve their performance and ultimately, improve, maintain, or restore the patients' health status and desired outcomes [11, 38]. To be approved, each indicator needed a sufficient foundation in terms of available, scientific evidence or evidence from the opinions of the broad expert panel [11, 38]. Thus, development of the QI set for rehabilitation was based on *quality of care*, which was defined by the Institute of Medicine [39] as "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge," and *rehabilitation* is understood as a planned and coordinated process that reaches across levels of care, is tailored to the patient's experiences and goals, and assists the individuals in their own efforts to achieve their best possible functioning and coping [11, 40].

Statistical analysis

In the statistical analyses, we included all participants from the BRIDGE trial who completed the QIs at T_3. We analysed data in STATA IC, version 16, and set the statistical significance level to 0.05.

We performed descriptive analyses to report demographic data, quantify the quality of the received rehabilitation process, and describe the observed changes for each clinical outcome, calculated as the outcome score at T_4 minus the score for the same outcome at baseline. For the actual process indicators, there was no former established PR cut-off for high-quality care. Therefore, we used quartiles (0–25% = Q1, 25.1–50% = Q2, 50.1–75% = Q3, 75.1–100% = Q4) for the quality variable when we examined changes in outcomes by summary PR score for the process indicators.

As a preparatory analysis, we performed two regressions treating the summary PR for the quality variable as the response variable. In the first analysis, we regressed R on study centre alone. In the second regression, PR was regressed on the baseline predictors (age, sex, BMI, weekly training, comorbidity, paid employment, education level, civil status, and smoking), in addition to study centre.

Main analysis

We used a linear mixed model approach to assess the association between the process dimension of the quality of rehabilitation (the PR variable) and the study outcomes (goal attainment, physical function, and HRQoL, respectively). First, our primary independent variable was the summary PR for the process variables. For each outcome, its value at T_4 was treated as the response, and the fixed effects were its baseline value, the PR variable, and a variable capturing elapsed time since study start. To account for centre level clustering, we included centre as a random effect in the basic model. In the fully adjusted model, we included a wider range of baseline predictors: age, sex, BMI, weekly training, comorbidity, paid employment, education level, civil status, and smoking. In a separate analysis, the primary independent variable was replaced by the three summary PR values for the single indicators grouped into categories (Group A-C). We used the same basic and fully adjusted models as described above.

For each outcome, three models were fit: one without PR variable(s) (*null model)*, one with the summary PR (to examine the quality variable as a sum score; *alternative model I)*, and one with PRs for Groups A to C (to examine the quality variable as composed of the three

PR variables; *alternative model II*). Subsequently, the association between the quality PR and the outcome was assessed by the likelihood ratio test, comparing each of the latter two models to the first. In other words, we used the likelihood ratio test to examine whether the *alternative model (I or II, respectively)* provided significant improvement (better fit) over the *null model*.

For the main outcome, we also performed mixed-logistic regression analyses in order to differentiate between those attaining minimal clinically important difference (MCID) for PSFS, and not. MCID for PSFS is 2 or more points [32] and therefore, we evaluated PSFS as a dichotomized outcome (change >=2 yes/no). This was done first for PSFS, and next for PSFS-A1.

Results

A total of 293 (78%) of the 374 BRIDGE trial participants completed the QI questionnaire at T_3 and were included in the current analysis. The participants were mostly female (76%), with a mean age of 52 (±12.3) years. They were referred to multidisciplinary rehabilitation most frequently due to inflammatory rheumatic disease (64%) or fibromyalgia syndrome (18%). Fifty percent of the study cohort had other chronic diseases (≥ 1 comorbidity) in addition to their primary diagnosis. Median disease duration for the primary diagnosis was 17 years. All of the baseline characteristics are presented in Table 2.

Table 2 Baseline characteristics of patients in this cohort study

	Total (n = 293)
Age, years, mean (min, max)	52 (18, 81)
Gender, female, n (%)	224 (76)
Diagnosis, n (%)	
Inflammatory rheumatic disease (SpA, PsA, RA, JRA)	188 (64)
Osteoarthritis	12 (4)
Connective tissue disease (SLE, SS, PMR, MCTD)	17 (6)
Fibromyalgia syndrome, CWP	54 (18)
Unspecific neck-, shoulder- and low back pain (> 3 months)	22 (8)
Osteoporosis	0
Disease duration, years, median (min, max)	17 (0, 68)
Comorbidities, n (%)	145 (50)
Medication usage	
NSAIDs, n (%)	134 (46)
Disease modifying anti-rheumatic drugs (DMARDs), n (%)	55 (19)
TNF-inhibitors, Biosimilars, JAK-inhibitors n (%)	102 (35)
Analgesics, n (%)	194 (66)
Other drugs, n (%)	201 (69)
BMI, kg/m^2, median (min, max)	28 (17, 66)
Smokers, n (%)	69 (24)
Snuff users, n (%)	21 (7)
Education > 12 years, n (%)	117 (40)
Paid work, n (%)	126 (43)
Recipients of social security benefits, n (%)	213 (73)
Living with partner, n (%)	201 (69)
Physical exercise ≥1 per week, n (%)	164 (56)
General activity ≥1 per week, n (%)	207 (71)

SpA spondyloarthritis, *PsA* psoriatic arthritis, *RA* rheumatoid arthritis, *JRA* juvenile rheumatoid arthritis, *SLE* systemic lupus erythematosus, *SS* Sjögren syndrome, *PMR* polymyalgia rheumatica, *MCTD* mixed connective tissue disease, *CWP* chronic widespread pain, Disease duration (symptom debut) and comorbidities are self-reported. *NSAIDs* nonsteroidal anti-inflammatory drugs, DMARDS include corticosteroids, *TNF* tumor necrosis factor, *JAK* Janus kinase, *BMI* body mass index (body weight/height^2). Physical exercise: increased heart rate and breathing for 30 min or longer. General activity: social or cultural activities, hobbies, work

Quality of the rehabilitation process

The response rate for the patient-reported QI questionnaire was 100% (no missing items). The median summary PR score of the 11 process indicators was 73% (range 11–100%). For single indicators, the PRs ranged from 9 to 99%. We found the highest PR score for the indicator reflecting patient participation in tailored goal-setting (indicator P04), whereas the lowest PR scores were found for indicators regarding attendance in rehabilitation meetings for family or next of kin (indicator P07, PR score 12%), or important others/external professionals (indicator P08, PR score 9%; Fig. 1). When considering the single indicators grouped into the main themes, we found that the PR score was lowest (median 40%) for Group C, regarding individual follow-up and coordination across levels of care (Fig. 1).

Patient-reported clinical outcomes

Available data and mean or median scores for the clinical outcomes at baseline and T_4 (group level) are presented in Table 3. At the individual level, we found variation in the change scores for the period between baseline and T_4 (Fig. 2). Though some individuals reported improvements, others experienced worsening or no change during the same period. This pattern was present for all clinical outcomes (Fig. 2).

The preparatory analysis showed that around 90% of the variation in care quality was unexplained by centre (adjusted R-squared was 0.08) and case-mix (adjusted R-squared for the baseline predictors were 0.10).

The process-outcome relation

As shown in Fig. 3, we found that changes in outcomes between T_4 and baseline did not differ much when we examined these changes visually as PR scores for each quartile. Thus, from these initial descriptive analyses, we assumed that patients who reported higher fulfilment of

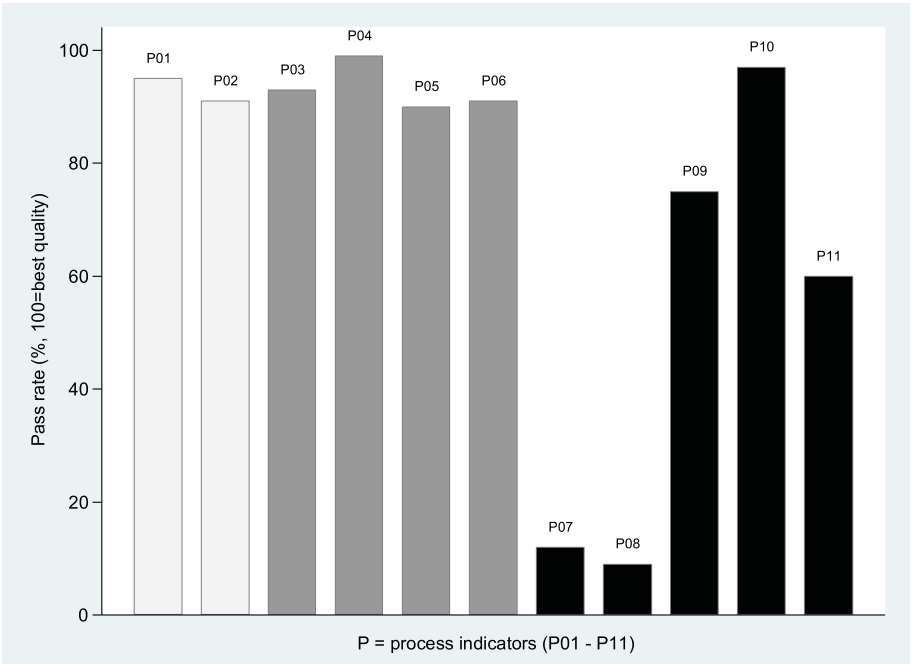

Fig. 1 Patient-reported quality of rehabilitation. Pass rates for single process indicators (P01-P11), reported by 293 participants in the BRIDGE trial. *P01-P02 (light grey): initial assessments (group A). P03-P06 (grey): individual goal-setting through the rehabilitation process (group B). P07-P11 (dark grey): individual follow-up and coordination across levels of care (group C)*

Table 3 Patient-reported ($n = 293$) clinical rehabilitation outcomes at baseline and after 7 months (T_4)

	Baseline		T_4	
Outcome variable *(instrument, scale)*	**No. of patients (%)**	**Value**	**No. of patients (%)**	**Value**
Goal attainment, all reported goals *(PSFS, 0–10, 10 = best)*	291 (99%)	5.7 (SD 2.1)	228 (78%)	5.4 (SD 2.1)
Goal attainment, first reported goal *(PSFSA1, 0–10, 10 = best)*	288 (98%)	5.7 (SD 2.6)	226 (77%)	5.4 (SD 2.8)
Physical function *(30secSTS, higher number = better)*	285 (97%)	14.5 (SD 5.4)	235 (80%)	17.6 (SD 7.4)
Health-related quality of life *(EQ5D-index, [− 1,1], 1 = best)*	279 (95%)	0.66 (min 0.28, max 0.94)	231 (79%)	0.73 (min 0.11, max 1.00)
Health-related quality of life *(EQ5D-vas, 0–100, 100 = best)*	288 (98%)	47.2 (SD 17.7)	239 (82%)	54.6 (SD 19.4)

Values are presented as mean and standard deviation (SD) for normally distributed data, or median with the minimum and maximum. *PSFS* Patient-Specific Functional Scale, mean ability score for all reported goals, *PSFSA1* Patient-Specific Functional Scale, mean ability score for the first goal set by the patient, *30secSTS* 30-s sit-to-stand test, *EQ5D-index* EuroQoL 5D-5L index value, *EQ5D-vas* EuroQoL 5D-visual analogue scale

the specified processes of rehabilitation (higher PRs) had only slightly or no better outcomes than patients who received less of the content addressed by the QIs (Fig. 3). The apparent lack of relationship between the quality of the rehabilitation process and the subsequent clinical outcome was confirmed in the mixed model analyses.

Results from the mixed model analyses showed that higher summary PRs for the process indicators were not associated with improved goal attainment, physical function, or HRQoL. As shown in Table 4, part 1 (quality variable as a sum score), the beta-coefficients ranged from 0.001 to 0.106 in the basic model and − 0.010 to 0.099 in the fully adjusted model. We found similar results when we examined the quality variable composed of the three PR variables for Group A, Group B, and Group C. None of the PR variables for the main themes in the rehabilitation process could explain the variance in any of the clinical outcomes (Table 4).

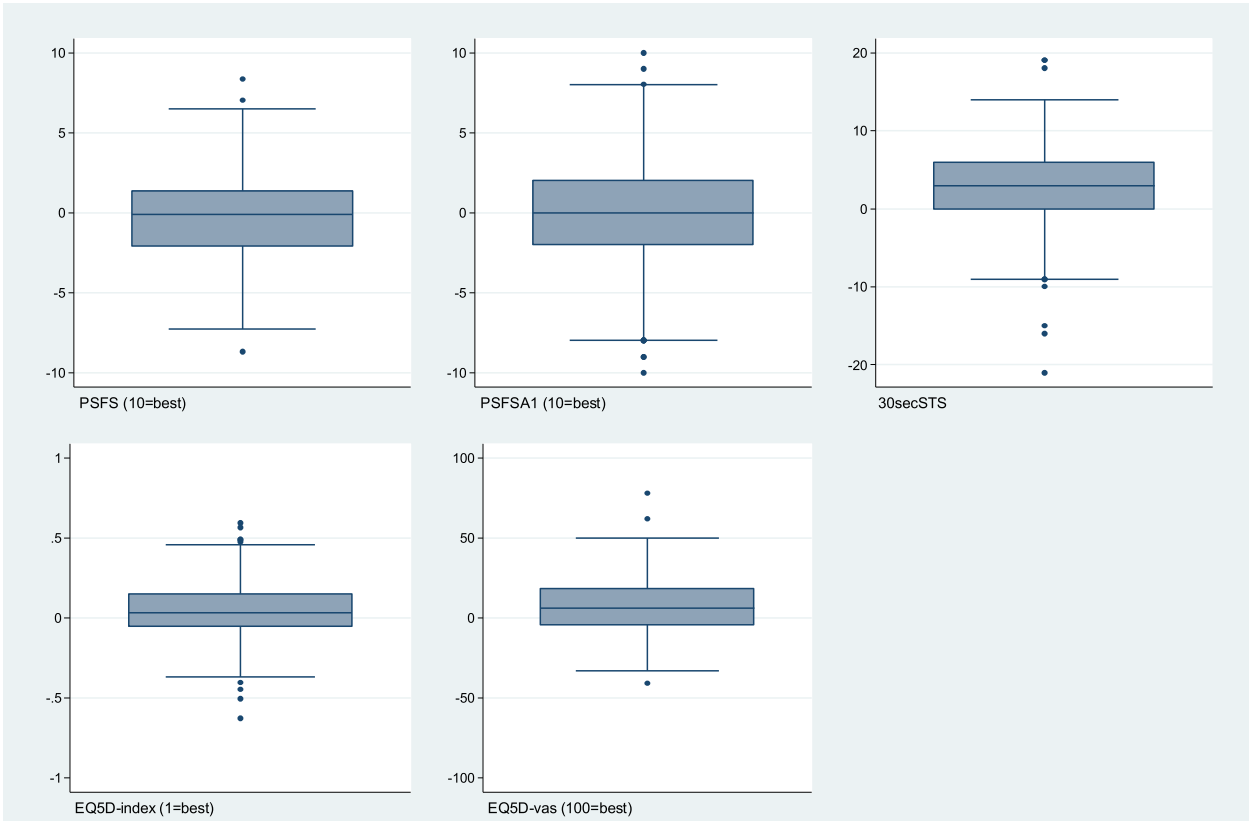

Fig. 2 Distribution of change scores between 7 months and baseline for each clinical outcome in the BRIDGE trial. Positive values indicate improvements during the time period. *PSFS: Patient-Specific Functional Scale, mean performance score for all reported goals; PSFSA1: Patient-Specific Functional Scale, the performance score for the first reported goal only; 30secSTS: 30-s sit-to-stand test; EQ5D-index: EuroQoL 5D-5L index value; EQ5D-vas: EuroQoL 5D-5L visual analogue scale*

The likelihood ratio tests resulted in p-values >0.05 at different levels of adjustments, indicating that a model including the quality variable did not provide a better fit for the data than the simpler model without the quality variable. Thus, no significant associations were found between the process PRs and any of the outcome variables. Analyses with the main outcome as a dichotomized variable gave the same results.

Additional analyses

During the observation period of this study, the support from health professionals was intended to decrease as the degree of patients' self-management increased. The choice of T_4 was to allow sufficient time for patients to establish self-management strategies and new, goal-directed habits in daily life, but the long interval (7 months after admission) may have challenged the recommended proximity of the outcomes to the received process of care [18]. Especially in cases with only brief, if any, contact with health professionals during the follow-up period, it may be questionable to attribute differences in outcomes to the rehabilitation received months ago. Therefore, to attain better proximity to the provided rehabilitation care, we performed additional analyses by replacing outcome data at T_4 with data collected at T_3 (2 months after admission). However, we did not find any associations between the process PRs and any of the outcome variables.

Discussion

In this study, we did not find any associations between the quality of provided rehabilitation processes and subsequent clinical outcomes of multidisciplinary rehabilitation for adults with RMDs. The PR values for the process indicators were not associated with improvements in either patient-specific goal attainment, physical function, or HRQoL measured 7 months after the initiated rehabilitation process in the BRIDGE trial.

Regarding PRs, we found lower values for QIs within the domain of follow-up and coordination compared to PR values for indicators regarding initial assessments and tailored goal-setting. These findings may indicate a

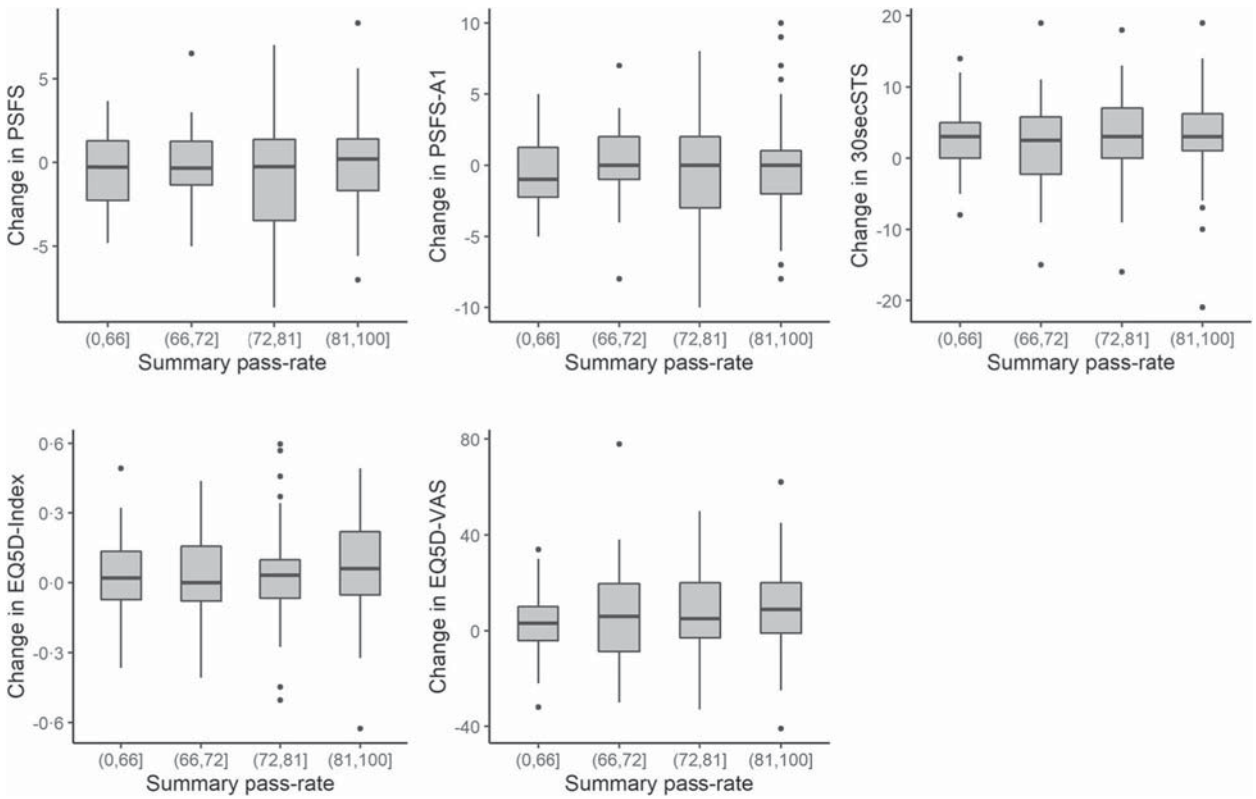

Fig. 3 Change in outcome by summary pass rate quartile for the process indicators. A positive change score indicates improvements between baseline and 7 months. Pass rates in the highest quartile indicate highest fulfilment of the process indicators (best quality). *PSFSA1: Patient-Specific Functional Scale, the performance score for the first reported goal only; 30secSTS: 30-s sit-to-stand test; EQ5D-index: EuroQoL 5D-5L index value; EQ5D-vas: EuroQoL 5D-5L visual analogue scale*

suboptimal transition between the rehabilitation process introduced in secondary care and the expected continuation in a community-based setting. As highlighted by others [41], improved rehabilitation outcomes for people with RMDs are more likely to be realized if support is established over a longer period of time. It can be argued that some indicators, such as involvement of next of kin or important others in the community, may not be applicable to all individuals [18]. However, results from the BRIDGE pilot study highlight that 98% of the patients report a need for follow-up from primary health care or other services, most frequently from a general practitioner, a physiotherapist, or the Norwegian Labour and Welfare Service [42]. In the same pilot study, an association was found between planned and received follow-up care and adherence to self-management activities [42]. As shown in other studies and stated by different health authorities, coordination across services is important in a high-quality rehabilitation process but often among the weakest elements in the rehabilitation trajectory [8, 9, 11, 43–46]. Therefore, further efforts are needed to attain an extended rehabilitation process after discharge [8, 9, 11, 43–46]. Such efforts should target the process dimension of quality in terms of tasks performed in the patient-professional cooperation. Equally important are efforts towards the structure dimension of quality, such as referral routines and information flow between providers and affiliated services, and sufficient competence and human resources at all levels of care being allocated and used in the best possible manner to facilitate a seamless transition of care and desired health outcomes for the patients [8, 9, 11, 43–46].

In contrast to what we hypothesized, patients who reported receiving higher quality rehabilitation did not report better outcomes at T_4 compared to patients who reported a lesser quality process. One reason may be found in the relationship between patients' outcome expectations and their agreements with clinicians regarding appropriate goal-setting. As the mean RMD duration in our sample was more than 15 years, some participants may have been striving towards maintenance of function as opposed to expectations of clinical improvement. Therefore, future quality initiatives and research should address both maintenance and improvement as desired

Table 4 Associations between quality indicators and clinical outcomes in mixed model analyses

1. To examine the quality variable as a sum score*(clinical outcome (one by one) as the dependent variable)*

		Basic adjustments		Large adjustments	
Clinical outcome (instrument)	**Quality variable**	**β (95% CI)**	***p*-value**	**β (95% CI)**	***p*-value**
Goal attainment, all reported goals (PSFS)	QI Summary PR score	0.010 (−0.009–0.030)	0.29	0.008 (− 0.013–0.028)	0.46
Goal attainment, first goal only (PSFSA1)	QI Summary PR score	0.015 (− 0.011–0.040)	0.26	0.017 (− 0.011–0.044)	0.23
Physical function (30secSTS)	QI Summary PR score	0.012 (− 0.039–0.063)	0.65	−0.010 (− 0.063–0.043)	0.71
Health-related quality of life (EQ5D-index)	QI Summary PR score	0.001 (− 0.001–0.002)	0.36	0.001 (− 0.001–0.002)	0.50
Health-related quality of life (EQ5D-vas)	QI Summary PR score	0.106 (− 0.044–0.255)	0.17	0.099 (− 0.060–0.258)	0.22

2. To examine the quality variable as composed of three scores*(clinical outcome (one by one) as the dependent variable)*

			Basic adjustments		Large adjustments	
Clinical outcome (instrument)	**Quality variables**		**β (95% CI)**	***p*-value**	**β (95% CI)**	***p*-value**
Goal attainment, all reported goals (PSFS)	QIs grouped into three main themes	PR score Group A	0.006 (−0.005–0.017)	0.26	0.003 (− 0.008–0.014)	0.62
		PR score Group B	− 0.001 (− 0.020–0.017)	0.90	−0.001 (− 0.021–0.018)	0.90
		PR score Group C	0.002 (− 0.008–0.012)	0.71	0.002 (− 0.009–0.013)	0.71
Goal attainment, first goal only (PSFSA1)	QIs grouped into three main themes	PR score Group A	0.004 (− 0.010–0.019)	0.56	0.001 (− 0.014–0.015)	0.94
		PR score Group B	0.009 (− 0.016–0.033)	0.49	0.016 (− 0.010–0.042)	0.23
		PR score Group C	−0.001 (− 0.015–0.013)	0.85	− 0.002 (− 0.016–0.013)	0.81
Physical function (30secSTS)	QIs grouped into three main themes	PR score Group A	0.022 (− 0.007–0.050)	0.14	0.014 (− 0.014–0.043)	0.32
		PR score Group B	− 0.011 (− 0.059–0.037)	0.66	−0.029 (− 0.079–0.022)	0.27
		PR score Group C	0.007 (− 0.020–0.034)	0.60	0.008 (− 0.020–0.035)	0.57
Health-related quality of life (EQ5D-index)	QIs grouped into three main themes	PR score Group A	0.000 (− 0.001–0.001)	0.90	0.000 (− 0.001–0.001)	0.86
		PR score Group B	0.000 (− 0.001–0.002)	0.78	0.000 (− 0.002–0.002)	0.92
		PR score Group C	0.000 (− 0.000–0.001)	0.29	0.000 (−0.000–0.001)	0.24
Health-related quality of life (EQ5D-vas)	QIs grouped into three main themes	PR score Group A	0.049 (−0.037–0.134)	0.26	0.034 (− 0.052–0.121)	0.44
		PR score Group B	− 0.007 (− 0.151–0.137)	0.92	−0.032 (− 0.188–0.124)	0.69
		PR score Group C	0.047 (− 0.031–0.125)	0.23	0.056 (− 0.025–0.137)	0.17

β beta-koeffisient. *CI* confidence interval, *QI* quality indicator, *PR* pass rate. "Basic adjustments" included fixed effects of the quality variable, the outcome's baseline value, time (elapsed time since study start), and random effects of centre (clustering). "Large adjustments" added age, sex, BMI, weekly training, smoking, comorbidity, paid employment, education level, and civil status. *Group A* Initial assessments, *Group B* Individual goal-setting through the rehabilitation process, *Group C* Individual follow-up and coordination across care levels, *PSFS* Patient-Specific Functional Scale, mean performance score for all reported goals, *PSFSA1* Patient-Specific Functional Scale, mean performance score for the first activity set by the patient, *30secSTS* 30-second sit-to-stand test, *EQ5D-index* EuroQoL 5D-5L index value, *EQ5D-vas* EuroQoL 5D-visual analogue scale

outcomes [38]. In addition, rehabilitation outcomes are likely to be affected by factors beyond the issues covered by the selected quality indicators. Thus, the benefits of good quality may be lost or reduced during the follow-up period [18, 47]. Such concurrent factors may be fluctuating symptoms related to the RMD or additional health problems related to comorbid conditions [48, 49]. Clinicians' interpersonal skills during the rehabilitation process may also vary and reduce the potential benefit, such as lower degree of careful listening or communication that is not adapted to the patient's culture, level of health literacy, or other background characteristics [15]. Furthermore, at the patient level, other non-medical determinants of health are important for outcomes, such as aspects of the patients' personal health behaviour after discharge, degree of life stress, lack of social support, or social events or duties inducing altered priority-setting, less available time, and less attention towards the ongoing rehabilitation process [38]. In our study, patients' additional health challenges or non-medical determinants

arising after discharge may not have been addressed sufficiently due to suboptimal coordination across care levels and less support from health professionals in the follow-up period. However, some variance in outcomes is probably influenced by factors beyond the variance in process quality. Thus, outcomes for patients with RMDs can be difficult to relate directly to the delivered process of rehabilitation [18, 48, 49]. Nevertheless, efforts should be made to improve the quality of rehabilitation processes as an independent contribution to the desired clinical outcomes [38].

Taken together, weak associations between the process quality and outcomes do not necessarily devalue the importance of a high-quality rehabilitation process. Methodological challenges in identifying associations between the process and patient outcomes have been reported by others [15, 18, 47–50]. In particular, as recognized in the BRIDGE trial, such challenges tend to occur when the delivered processes are complex and include several steps, longer periods of time are necessary to establish the desired outcomes, or the performance assessed by the outcomes is influenced more by the degree of patient adherence and selected self-management strategies than the provided care [18, 48]. Despite these challenges, the value of process indicators has been proposed to be important drivers of quality improvement because the use of these indicators may lead to improved awareness about the recommendations for optimal rehabilitation management and guide the clinical performance on a day-to-day basis [47, 50–52]. Though outcome measures are less informative about a problem related to delivery of care, the process indicators convey information about which parts of the rehabilitation practice have potential for improvement [15, 47, 48, 51, 52]. Such information may stimulate a dialogue between leaders and clinicians about appropriate actions to improve practices and step up the local quality initiatives and adoption of best practice recommendations [48]. Finally, process indicators may increase transparency regarding clinical processes and reduce unwanted differences in providers' performance [52]. More research on associations between providers' performance and the outcomes of rehabilitation is warranted. Strengths and limitations.

The strengths of this study include a large study cohort, a statistical methodology accounting for the hierarchical data structure, and a > 76% response rate 7 months after baseline. Furthermore, we evaluated QIs and outcomes from the same perspective (the patient perspective). This study also has some limitations. First, a small difference in quality when looking at PRs for Group A and Group B may reduce the potential to explain variations in outcome(s) at 7 months. Second, confounders, such as *self-efficacy, readiness for change,* and *health literacy,* could have been added in the analysis to better address potential self-management-related factors influencing the outcome [15]. Third, though the recruitment of patients from rural and urban regions and different rehabilitation settings may strengthen the generalizability of the findings in a Norwegian context, our results may not be applicable for settings and rehabilitation trajectories that differ significantly from the Norwegian health care system. Another limitation is the limited scientific evidence regarding why increased delivery of high-quality rehabilitation will lead to improvements in goal attainment, physical functioning, and HRQoL. However, expert opinions were used to supplement the available scientific evidence regarding each QI in the systematic development process [11]. There may also be a potential recall bias caused by the time point for measuring the QIs. Two months after the start of rehabilitation (i.e., T_3), patients may not accurately remember the process they underwent before discharge. Nevertheless, at this first time point at home, their memory was probably helped by re-scoring the clinical outcomes, by a mandatory follow-up phone call from the rehabilitation centre between discharge and T_3, and, optimally, the beginning of the extended care from the community. Lastly, limitations due to the yes/no format of the QI questionnaire yield information restricted to confirmed/unconfirmed for the content addressed by each indicator. Consequently, we did not know patients' opinions on whether the goals were appropriately ambitious, whether plans for self-management and follow-up were feasible in their context at home, or whether potential barriers were identified and planned for. In future research, we will address these questions.

Implications

This study is a first step to exploring associations between rehabilitation processes and the subsequent clinical outcomes using the process indicators from a QI set for rehabilitation in patients with RMDs. Our results support the need to promote the process indicators as a useful tool to be aware of, recognize, and deliver all aspects of best rehabilitation practice. Using the process indicators, we revealed that the quality of rehabilitation is still suboptimal regarding coordination between care levels and sufficient support for the patients' self-management strategies after discharge. However, in rehabilitation, it can be difficult to relate the outcomes directly to the quality of the delivered rehabilitation process due to the additional influences of environmental factors and non-medical events arising along the highly personalized rehabilitation process. However, we consider information about clinical outcomes to be valuable and meaningful in evaluating

and monitoring rehabilitation quality, but preferably in combination with information about the process dimension of quality.

For clinicians, improving the quality of rehabilitation processes may be difficult if the present structural conditions are disadvantageous. Therefore, quality initiatives from policymakers and leaders need to address structural factors aimed at increasing the likelihood of good processes, such as sufficient competence and resources in all care levels, written procedures, and establishment of good structures for mutual information flow and efficient referral routines. This broader perspective, including all dimensions of quality, applies well in complex rehabilitation, in which the health system, providers, and patients are mutually accountable for the clinical outcomes.

Results from this work may inform decisions on expected standards of rehabilitation services, such as stakeholders' efforts to identify and reduce unwarranted variance in quality. Moreover, providers' and receivers' input on how quality initiatives apply and work in different contexts, will be essential in future work for further developing of national plans and indicators for quality improvement in rehabilitation.

Conclusions

To the best of our knowledge, this study is the first examination of associations between the quality of rehabilitation processes and clinical outcomes based on the process indicators from a QI set for use in rehabilitation for adults with RMDs. We conclude that the quality of rehabilitation processes is not associated with subsequent clinical outcomes. An implication of this is that measuring only one dimension of quality may result in incomplete evaluation and monitoring of the quality of care, and we suggest using information from both the structure, process, and outcome dimensions to draw inferences about the quality and plan future quality initiatives in the field of complex rehabilitation.

Abbreviations

QI: Quality indicator; RMD: Rheumatic and musculoskeletal disease; PR: Pass rate; PSFS: Patient-specific Functional Scale; 30secSTS: 30 s sit-to-stand test; EQ5D-5 L: EuroQoL 5D-5L health-related quality of life; HRQoL: Health-related quality of life; BMI: Body mass index\.

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Authors' contributions

All authors were involved in drafting the article or revising it critically for important intellectual content. All authors approved the final version to be submitted for publication. Study conception or design: ALSS, GB, IK, HD, MA, IB, TD, SGE, GOF, ASH, ÅK, ADL, KT, HLV, and AMA. Acquisition of data: IB, SGE, GOF, ASH, ÅK, ADL, KT, HLV, and AMA. Analysis and interpretation of data: ALSS, JS, GB, HD, and IK. ALSS had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The study was approved by the Norwegian Regional Committee for Medical Research Ethics (REK South-East, 2017/665). All participants provided written informed consent. Our study was performed in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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ORIGINAL ARTICLE

Delivery of a quality improvement program in team-based rehabilitation for patients with rheumatic and musculoskeletal diseases: a mixed methods study

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ABSTRACT

Purpose: To investigate how a quality improvement program (BRIDGE), designed to promote coordination and continuity in rehabilitation services, was delivered and perceived by providers in routine practice for patients with rheumatic and musculoskeletal diseases.

Methods: A convergent mixed methods approach was nested within a stepped-wedge, randomized controlled trial. The intervention program was developed to bridge gaps between secondary and primary healthcare, comprising the following elements: motivational interviewing; patient-specific goal setting; written rehabilitation-plans; personalized feedback on progress; and tailored follow-up. Data from health professionals who delivered the program were collected and analyzed separately, using two questionnaires and three focus groups. Results were integrated during the overall interpretation and discussion.

Results: The program delivery depended on the providers' skills and competence, as well as on contextual factors in their teams and institutions. Suggested possibilities for improvements included follow-up with sufficient support from next of kin and external services, and the practicing of action and coping plans, standardized outcome measures, and feedback on progress.

Conclusions: Leaders and clinicians should discuss efforts to ensure confident and qualified rehabilitation delivery at the levels of individual providers, teams, and institutions, and pay equal attention to each component in the process from admission to follow-up.

➤ IMPLICATIONS FOR REHABILITATION

- Quality in rehabilitation should be characterized by a continuous and coordinated process from goal setting to follow-up.
- To improve the quality, sufficient involvement of next of kin and external services is needed.
- Clinicians may need training to build confidence in motivational interviewing, action- and coping planning, feedback on progress, and follow-up.
- Leaders should organize education sessions, optimize schedules, insert standardized outcome measures, and facilitate collaboration across levels of care and services.

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Background

Patients with long-term rheumatic and musculoskeletal diseases (RMDs) constitute a large proportion of the population needing rehabilitation services [1]. Rehabilitation has the potential to yield profound benefits for individuals and society by optimizing everyday functioning for people who experience functional limitations in the course of their disease [2–3]. Despite the impression that an increasing number of patients benefit from rehabilitation, such services are not sufficiently prioritized in or integrated into current health systems [1,3].

Recommendations from the World Health Organization (WHO) for scaling up rehabilitation address not only improving availability but also efforts to improve the quality of delivered care [3]. Public evaluations from WHO and different countries, including Norway, document that rehabilitation quality varies among healthcare providers and sites. In addition, these evaluations show that coordination is limited across services involved in rehabilitation, such as between levels of healthcare, between health services and a patient's place of employment or education, and between health services and the labor and welfare administration [3–6]. In addition, global and national health authorities have called for more patient involvement and co-determination regarding rehabilitation plans and needed follow-up and for better systems of standardization and documentation of quality [3–6].

The use of quality indicators (QIs) may help to define and monitor the recommended quality of care because such indicators comprise

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defined and measurable elements of practice performance that are relevant for drawing inferences about the quality of provided care [7–9]. A QI set has been developed for the RMD context to identify measurable elements of a team-based rehabilitation process that facilitate recommended continuity in a patient-centered rehabilitation process and efficient coordination across involved professions and services [10]. In this set, the indicators explicitly reflect the providers' responsibility to facilitate a high degree of patient participation in all phases of a rehabilitation process, such as individual goal setting, development of written rehabilitation plans, tailored follow-up, and use of standardized instruments for baseline assessments and outcome monitoring [10]. Hence, several interacting elements are needed to ensure a high-quality rehabilitation process, and a number of behaviors are required by those delivering the rehabilitation. Efforts to fulfill the QIs for rehabilitation thus may be considered complex interventions in which the providers are expected to strike a balance between fidelity to key elements of a high-quality rehabilitation process and tailoring that process to the local setting and individual patient [10].

With a growing interest in quality improvement in health services for RMDs [11–17], more knowledge is needed about using complex interventions to improve quality in rehabilitation processes and how providers deliver and perceive such quality improvement programs [18]. The BRIDGE program is a quality improvement program, comprising five interacting elements needed to provide a high degree of patient involvement in a continuous and coordinated rehabilitation process from goal setting to follow-up. Included elements in the BRIDGE program are motivational interviewing (MI), patient-specific goal setting, written plans for rehabilitation, personalized feedback on progress, and tailored follow-up. Knowledge is needed about what efforts are necessary to deliver such programs. In the current study, we used a mixed methods approach to evaluate the delivery of the BRIDGE program from the perspective of health professionals who delivered it as part of a multicenter study. The overall aim was to investigate how the providers delivered and perceived the BRIDGE program.

Methods

Design

We used a mixed methods approach for two reasons. First, quality of healthcare was understood as a multidimensional concept, requiring many different measures [7]. Our intention was to relate and combine measurable and not directly measurable aspects of how the BRIDGE program was delivered.

Second, the BRIDGE program was expected to have the potential to improve both structural and process dimensions of the quality of the provided rehabilitation processes, and a convergent mixed approach [19] enabled us to generate a comprehensive account on how the program influenced both dimensions. The structural dimension was related to the setting within which the rehabilitation was delivered. In our study, this dimension was defined as written materials and written procedures available for daily use at rehabilitation centers, describing the rehabilitation process they intended to deliver [7, 10]. The process dimension was related to enacting the continuous and coordinated rehabilitation process itself in terms of the actual activities and collaboration between BRIDGE program providers and patients, from admission and throughout the follow-up period [7, 10].

Our guiding study objectives were as follows: (1) to evaluate whether written procedures regarding intended rehabilitation practice were supplemented or changed because of the BRIDGE program (quantitative data); (2) to evaluate the health professionals' assessments of whether the elements of the BRIDGE program were delivered (quantitative data); (3) to explore the health professionals' perspective on changes in their practice or behaviors when delivering the BRIDGE program (qualitative data); and (4) to compare and combine the results from objectives 1–3 (a mixed approach).

The clinical setting

Providers at eight Norwegian rehabilitation centers delivered the BRIDGE program as part of the intervention phase in a stepped-wedge cluster-randomized controlled trial (RCT), the BRIDGE trial [20], presented in Box 1. The main results of the trial are published elsewhere [21].

In the control phase (T1), providers delivered their traditional programs, which could include asking patients about their goals, but involved variability or even insufficient descriptions of intended phases in a rehabilitation process. When switching to the intervention phase (T2), providers started to deliver the more structured and defined rehabilitation process described by the BRIDGE program (Box 1), which was intended to be similar across all participating centers and facilitate a high degree of patient involvement in a continuous and coordinated rehabilitation process for each patient.

The BRIDGE research team selected the interacting elements comprising the program based on four preceding research projects in Norway, Norwegian public reports documenting a lack of coordination and continuity across levels of rehabilitation care, and theories on goal setting and behavioral change in rehabilitation, as described elsewhere [20–21]. In brief, the theories addressed a rehabilitation process based on the patient's autonomy, strengths and capabilities, valued and prioritized rehabilitation goals, and confidence in agreed-upon plans and actions. The theoretical grounding also addressed feedback on progress in order to affirm patient motivation, adjust goals or actions if necessary, facilitate problem-solving and adherence to self-management strategies over time, and establish and coordinate tailored support from others until the patient develops new habits, needed changes, and meaningful goal attainment in their daily life [20–21].

Data collection

During T2, quantitative and qualitative data were collected on how the BRIDGE program was delivered and how it influenced rehabilitation quality, as reported from the provider perspective. Data sources consisted of health professionals' responses to two questionnaires and results from focus groups (FGs) consisting of members from the multidisciplinary teams delivering the program at each center. The types of data collection were concurrent but separate and did not depend on each other [19]. We kept the data from questionnaires and FGs separate during the analyses, before mixing the results during the overall interpretation and discussion [19] (Figure 1).

Data source 1: quality indicators (quantitative data, a questionnaire)

A QI set developed for use in multidisciplinary RMD rehabilitation [10] reflected recommendations for three dimensions of quality (structure, process, and outcome). Used in primary and secondary care, the QI set has shown adequate feasibility, face and content validity, and responsiveness [10, 22]. The set consisted of two separate questionnaires and allowed for measuring quality from the perspectives of both providers and patients [10]. Evaluation of patient-reported quality has been reported elsewhere [23]. In this study, we examined the provider-reported quality of rehabilitation.

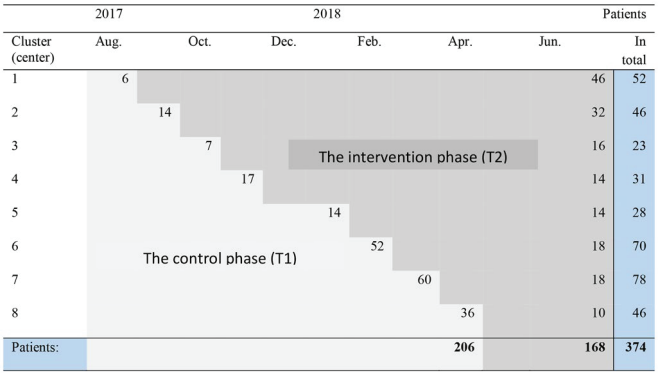
Box 1. The overarching BRIDGE trial and the BRIDGE program.

Objective: To evaluate the effectiveness of a structured goal setting and tailored follow-up rehabilitation program (the BRIDGE program) compared to existing rehabilitation programs for patients with RMDs.

Intervention: The BRIDGE program, developed by the research team, was designed to improve the quality in rehabilitation processes, with emphasize on high degree of patient involvement, continuity and coordination across levels of healthcare. The program included five interacting elements, presented in the table, meant to facilitate the health professionals' guidance and support to each patient's rehabilitation process over time.

Elements in the BRIDGE program:	Available tools to support each phase in the rehabilitation process: *Guidance booklets, developed for the intervention phase in this trial, were available for providers and patients, respectively.*
Motivational interviewing (MI)	The provider booklet included highlights from MI theory, an MI conversation guide related goal setting and follow-up, and a template for the provider's MI self-evaluation. MI rating scales were available for the providers, to guide the patients' reflections on their levels of willingness, confidence, and readiness for actions.
Patient-specific and structured goal setting	A brief introductory film about rehabilitation goals, developed for this trial, was available for patients, at YouTube. The booklets included written information about goals and goal setting, and a reflection task called "The shoe" (additional file 7) designed to stimulate the development of goals for each patient.
Written plans for rehabilitation	The booklets contained brief educational material, examples and templates for goal-directed action- and coping plans, including strategies for overcoming potential barriers. The plans addressed both strategies for self-management and support from others.
Personalized feedback on progress on goals/ outcomes	Digital graphs, based on electronic questionnaires, were meant to be used as feedback on progress on goal attainment and other outcomes throughout the follow-up period. The patients could choose to use the graphs in dialogues with important others and external services. They could also use pre-existing smartphone applications for self-management, feedback and maintenance of health-related behavior changes over time. Names of relevant applications were recorded on a list developed for this trial.
Tailored follow-up after discharge	One month after discharge, patients received an MI-based follow-up call designed to facilitate the further rehabilitation process. The booklets contained templates for written plans for patients' self-management and follow-up, including assessment of necessary support and available resources (e.g., next of kin or external services).

Design: The figure presents the stepped-wedge cluster-randomized design, with number of patients included from each center. A total of 8 Norwegian rehabilitation centers (clusters) in secondary care started in the control phase simultaneously (T1, delivering their traditional programs). They switched to the intervention phase (T2, adding the BRIDGE program) in a randomized order based on pre-defined time points. There was an educational outreach visit at each centre shortly before their timepoint for crossover, directed at the local coordinator, the multidisciplinary team, and their leader(s). At the end of the trial, all centers delivered the BRIDGE program. A total of 374 adults with RMDs were included: n = 206 in the control group (recruited in the T1 phase, light grey in the figure) and n = 168 in the intervention group (recruited in the T2 phase, dark grey in the figure).



Outcomes: Data on standardized, patient-reported outcomes were collected at admission and discharge, and at 2, 7, and 12 months after admission. Primary outcome was patients' goal achievement measured by the Patient Specific Functional Scale. Secondary outcomes were physical function (30-seconds Sit-To-Stand test) and health-related quality of life (EuroQoL 5D-5L). [20–21]

The provider-reported questionnaire included 19 structure indicators, as presented in additional file 1. The QIs were related to written documents (procedures or method descriptions) being present and easily accessible at the rehabilitation center as a structural foundation for daily clinical practice [10]. Ten QIs addressed the use and monitoring of standardized outcome measures, and six QIs addressed patient participation in goal setting, planning, and evaluating throughout the rehabilitation period and follow-up. Assessments of follow-up needs from next of kin or external services were covered in three items.

Between 6 and 8 weeks after adding the BRIDGE program, the leader of each center or another person familiar with the written procedures available for daily use, answered "yes" or "no" to each statement presented in additional file 1. The answers given at T2 were compared to the same measurement conducted at the beginning of T1. At both time points, data were collected in a telephone-based interview conducted by the central project coordinator (ALSS).

Data source 2: program-fidelity checklist (quantitative data, a questionnaire)

The fidelity checklist included measurable aspects of the elements intended to be delivered in the BRIDGE program. There were 18 items with response alternatives "yes" or "no" and a "not appropriate" alternative for two items (Table 1). During T2, the providers

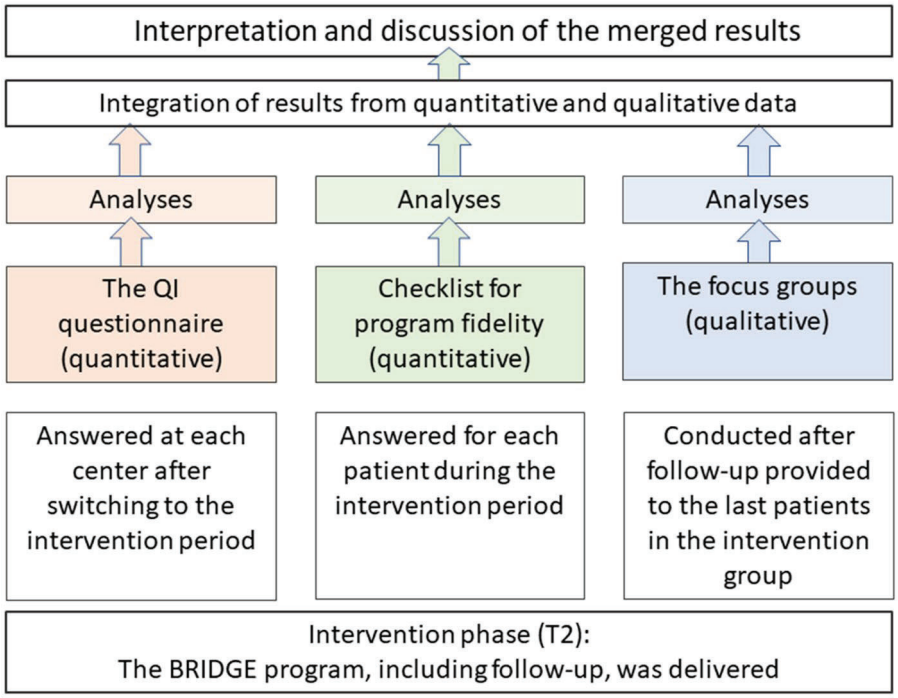


Figure 1. Procedural diagram for the convergent approach: the quantitative and qualitative data were collected separately in the intervention-phase of the trial, before they were analysed separately, and then integrated and discussed for the purpose of a mixed, complementary investigation of the delivery of the BRIDGE program. QI: quality indicators.

completed one checklist for each patient along with their ongoing rehabilitation process, starting with items for the establishment of the process at admission and ending with items for a mandatory follow-up conversation after discharge. Responders were members of the multidisciplinary teams, mainly local project coordinators, who were familiar with the content of the delivered rehabilitation process.

The MI approach was expected to influence items in the checklist regarding goal setting, development of rehabilitation plans, and follow-up. To highlight these expectations, guiding information was included in the provider booklet (Additional file 2).

Data source 3: FGs (qualitative data)

We arranged three FGs with representation from all centers and all professional groups. The FG interviews were performed after the providers had completed all potential follow-up interventions for all patients, i.e., about 6 months after the discharge of the last patients in the intervention group (Figure 1). The same interview guide (Additional file 3) was used in all groups and included questions about the providers' impression of the program and their experiences translating it into their local setting. We included two group tasks in each FG to stimulate group interactions and give providers the opportunity to reflect on shared experiences or different viewpoints and express their beliefs, attitudes, questions, and concerns about program delivery [24]. In the group tasks, the participants rated cards naming the elements and tools in the BRIDGE program from "less" to "more" important and useful in supporting the patients' rehabilitation process. The rating scale was 0–10, with 10 indicating most important or useful (see Additional file 4 for details regarding the group tasks).

The FG conversations were audiotaped and carried out on the same day in three different rooms at the same location. Each group was facilitated by one moderator (ALSS, IK, or ASH [one of the site coordinators]) and supported by an assistant moderator (IJ, TND, HLV). The assistant moderator took brief field notes during the discussions to capture impressions and nonverbal observations, managed the material needed in the group tasks, and photographed the rating of the cards on the table.

To establish a purposive sample, we aimed to include men and women and at least one representative from all of the different professions delivering the BRIDGE program, such as a nurse, social worker, physiotherapist, occupational therapist, and sports educator. In dialogue with the local project coordinators, we recruited 15 professionals and deliberately assigned them to the groups to ensure three groups with mixed locations and professions represented.

Ethics

All participants provided written informed consent to participate, after reading the invitation letter that explained the purpose of this study. The Norwegian Regional Committee for Medical Research Ethics (REK South-East, 2017/665) approved the study. Provider representatives and two patient research partners were involved in all stages of the study.

Analyses

We used STATA/IC 14.0 and Microsoft Office Excel 2019 to analyze numeric data, and Nvivo 12 Plus for text data. Nvivo was not used as a codebook but rather as a way to facilitate the processes of clustering and meaning-mapping of textual data.

Quality indicator data

We considered a structure indicator as achieved if the item was answered "yes" and calculated the degree of achievement as pass rates (PRs). For each center, we calculated summary PR as *PR total* equal to "*the total number of items achieved at this center*" divided by

Table 1. Fidelity checklist for optimal delivery of the BRIDGE program.

Element in the BRIDGE program	Single items in the providers' checklist for program fidelity (no. 1–18)	Yes	No	n.a
Structured goal setting	*During the first days of the rehabilitation stay:*			
	1 Deliver the P booklet, and invite P to prepare to goal setting using the booklet, the video and the reflection task.			
	2 Together with P, develop 3–5 written rehabilitation goals, and ask P to write the goals in his/her booklet.			
Written rehabilitation plan	3 Together with P, develop a written rehabilitation plan related to the stay, including strategies for potential barriers.			
Monitoring the goal progress/individual feedback along the rehabilitation process	*At admission:*			
	4 Introduce the digital solution for data collection, and guide P to secure identification online.			
	5 Guide P to record the agreed goals digitally (in the PSFS), and to complete the other outcome measures in the online solution.			
	During the stay:			
	6 Provide positive feedback to P on goal-directed actions and tasks performed in the process			
	7 Together with P, adjust goals and actions when necessary, to gain sufficient self-efficacy (related to goals and goal-directed activities), and sufficient outcome expectations.			
	At discharge:			
	13 Ensure that P know when and how to use the online solution for further evaluation at home.			
	14 Inform P how to use the graphs for clinical outcomes for feedback on their own progress; alone or in dialogue with next of kin or important caregivers across levels of care.			
Tailored follow-up, across levels of care.	*Before discharge:*			
	8[a] Together with P, identify 3-5 goals for the time after discharge (written both in the P's booklet and in the online solution for data collection).			
	9[a] Together with P, develop a written plan for follow-up, including strategies to overcome potential barriers.			
	10 Ensure that P's plan for self-management (support from others not required) is completed and documented in the online solution for data collection			
	11 Together with P, discuss and plan follow-up from externals (documented in the online solution for data collection)			
	12 Make an appointment regarding appropriate time for the mandatory phone call about 4 weeks out in the follow-up period			
	After discharge:			
	15 Conduct the agreed follow-up conversation (phone call) with P			
	16 If appropriate for the rehabilitation process: conduct further phone calls (up to four during the follow-up period)			
	During the follow-up phone conversations:			
	17 Together with P, evaluate goals and interventions, consider the need for adjusted or new interventions, or additional support from externals in primary care or local community.			
	18 If appropriate for the rehabilitation process: support P in getting in contact with services relevant for the P's further rehabilitation process in the follow-up period.			

n.a: not appropriate (a third response alternative applicable for only item 16 and 18); P: the patient; PSFS: Patient-specific functional scale.
[a]Patient-specific goals and rehabilitation plans for the follow-up period may be identical to initial goals and plans, if appropriate for the context at home.

"*total number of items (=19)*." In addition, we calculated PRs for single indicators across the centers as "*the total number of centers that checked 'yes' for this item*" divided by "*total number of eligible centers (=number of centers that checked 'yes' or 'no' for this particular item)*." The PR values were presented as percentages ranging from 0% to 100%, with 100% representing the best quality. We used descriptive statistics to compare changes in PR data between T1 and T2.

Program fidelity data

The fidelity checklist contained 18 eligible items. If the response option "*not appropriate*" was used once or twice, the number of eligible items was 17 or 16, respectively. We calculated a summary fidelity score for care provided to each patient, as "*the number of items adhered to for this patient*" divided by "*the number of eligible items for this particular patient's rehabilitation process*." At the group level, we calculated the fidelity score for single items in the checklist, equal to "*the total number of 'yes' for this item*" divided by "*the total number of eligible cases for this particular item*." We presented the results in percentages ranging from 0% to 100%, with 100% representing the highest fidelity, and used descriptive statistics to calculate the median, maximum, and minimum values.

FG data

The audio recordings were transcribed by the researcher mainly responsible for the FG analyses (ALSS). Data relevant to our research questions were extracted from the FG transcripts and field notes and analyzed using a reflexive thematic analysis [25]. The researcher (ALSS) did not differentiate among the three FGs but rather analyzed for recurring patterns across the entire transcript material. Categories and themes developed early in the

process were refined, replaced, or expanded as other passages from the transcripts were analyzed or when transcripts or passages were revisited several times.

Initial categories and preliminary themes (generated by ALSS) were presented and discussed at an overarching level with the local site coordinators and the wider research group (GJA, MA, GB, AMB, TD, CE, IJ, HLV, IK) early in the process and later discussed in more detail with a second researcher (HLV). The further process was driven by one researcher (ALSS) as an interpretative reflexive process [25–26]. First, patterns of shared meaning were developed inductively based on the content of the data. Then, existing concepts and ideas from relevant literature [27–28] were added to the interpretation process to expand understanding of the providers' reflections and behaviors when delivering the BRIDGE program in their routine clinical settings. Titles of the final themes were formulated as first-person wordings, as spoken by the providers, reflecting patterns identified during the iterative process back and forth between raw data, categories, theories, and themes. Illustrative quotations (Q) have been edited for readability.

Integration

We compared the results from the different data sets to determine how they converged, diverged, or expanded each other [19]. To illustrate how the data related, we used a joint display figure for the overall results and a joint display table for details.

Results

Changes measured by the structure indicators

There were no missing data for the QI questionnaire. The median *PR total* increased from 53% at T1 to 90% at T2, calculated for all of the centers as a whole sample. At T2, the PRs for single indicators were 100% for all of the indicators, except for the two indicators related to written documents addressing possible attendance in meetings for next of kin or external services (PR ≤ 25%; see additional file 5 for details about changes measured by the indicators).

Fidelity of program delivery

The checklist was answered by the providers regarding the rehabilitation processes for 156/168 patients (93%) receiving the BRIDGE program. The fidelity of program delivery was high, with a median summary score of 94% (range 6%–100%). The fidelity score for single items differed according to phases in the rehabilitation process from admission to the follow-up period. More specifically, initial goal setting was delivered with higher fidelity compared with tailored follow-up across levels of care. Intervention content addressing the time after discharge and involvement of next of kin or external services was delivered with less fidelity than the inpatient parts of the program (Figure 2; see Additional file 6 for details about the measured program fidelity).

Results from FGs

A total of 15 providers of the BRIDGE program participated in the FGs. In Table 2, we present details of participant characteristics and group composition. Approximately 2 hours of discussion in each group were audiotaped and transcribed verbatim. In the following quotations, the symbol * indicates work experience over the median experience among the FG participants.

The analysis of the providers' descriptions and reflections on practicing BRIDGE led to an understanding that optimal program delivery depended on four themes, as described from the provider perspective:

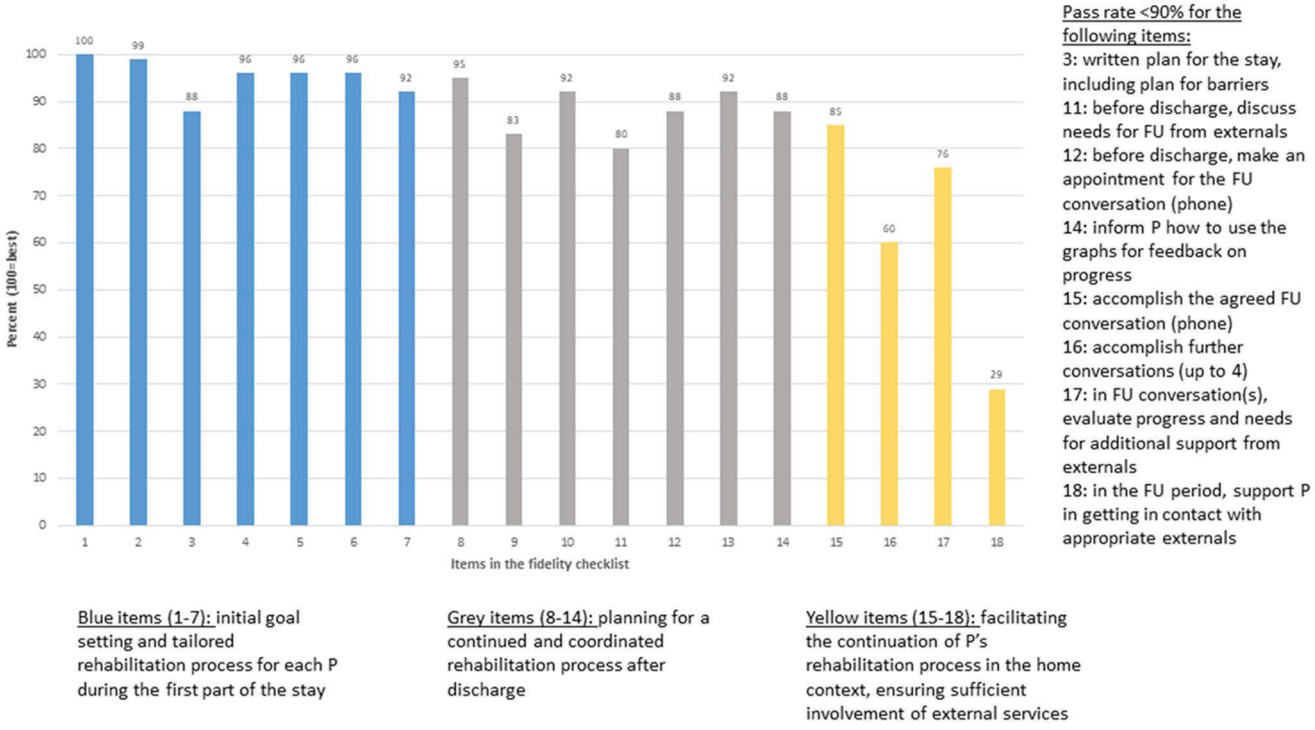


Figure 2. Fidelity scores for single items in the providers' checklist for fidelity in the BRIDGE trial. HP: health professionals; rehab: rehabilitation; P: patient; PR: pass rate; FU: follow-up.

Table 2. Characteristics of the participants and composition of the focus groups.

Group no.	Partici-pants	Age (years) (min–max)	Rehabilitation site	Profession	Postgraduated studies (completed or current) MI (courses or education)	Work experience in somatic rehabilitation (years)	Focus group duration (minutes)
1	5	31–51	1 hospital 4 rehabilitation institutions	2 OT 2 PhT 1 SE	1 master 1 master (c) 1 postgrad.st 1 postgrad.st MI 3 1-day seminars MI	6–26	118
2	5	36–60	2 hospitals 2 rehabilitation institutions	2 OT 2 PhT 1 SW	1 master 3 postgrad.st 1 postgrad.st(c) 1 postgrad.st MI 4 1-day seminars MI	7.5–34	132
3	5	28–61	1 hospital 3 rehabilitation institutions	1 N 3 PhT 1 SW	1 postgrad.st 1 basic course MI 4 1-day seminars MI	3–30	105[a]
In total	15	median 41 (28–61)	3 hospitals 5 rehabilitation institutions	1 N 4 OT 7 PhT 2 SW 1 SE	2 master 1 master (c) 5 postgrad.st 1 postgrad.st (c)	median 12 (3–34)	355

c: current; OT: occupational therapist; PhT: physiotherapist; SE: sport educator; N: nurse; SW: social worker; postgrad.st: postgratuate studies comprising participants with master's (completed) in public health science (1) and physiotherapy (1); a participant with a master's (current) in health science; participants with postgraduate studies (completed) in multidisciplinary rehabilitation (1), rehabilitation and integrated health (1), evidence-based practice in health (1), cognitive therapy (1), vitality training (1), and motivational interviewing (MI) (2); and 1 participant with postgraduate study (current) in cognitive therapy.
[a]Group 3: duration 105 min, +15 min not audiotaped, due to technical problems with one dictation machine.

Improving my professional skills

This theme reflected the providers' perceived competence when practicing elements in the program. Statements suggested that parts of the BRIDGE program implied improvements in the providers' behaviors and conversation skills, compared to the delivery of their traditional programs.

Paying attention to my professional toolbox

This theme comprised the providers' attention towards supporting material and practical objects available in the BRIDGE program, developed to guide or facilitate the interacting phases in each patient's rehabilitation process.

Expressing my professional mind

This theme addressed the providers' professional understanding of the program and their theory-based accounts for use of the elements comprising it. Several statements suggested that the BRIDGE program evoked the providers' consciousness about core values and important activities in rehabilitation, as one stated: "[BRIDGE was] like 'this is what we should be excellent in' [as rehabilitation experts]" (Q 56).

Optimizing the organization at my workplace

This theme comprised the contextual factors at each center, influencing the delivery of the BRIDGE program. As a pattern, the providers' statements pointed to a mutual influence between the elements of the program and the contextual settings at each center, such as the organization of meetings and time schedules, or human contextual factors related to the individual team members, the local research coordinator, or the leader of the center. The context modified the delivery of BRIDGE, and vice versa.

Content related to each theme are briefly labeled (i) skills, (ii) tools, (iii) mind, and (iv) organization. To enhance readability, the following presentation of details about the FG results are structured along the phases in the rehabilitation process from goal setting to follow-up.

Skills

Initial goal setting and tailored rehabilitation process during the first part of the stay

Several providers stated that guiding the patients in formulating written goals was more difficult than making oral agreements. To be more confident, some providers prepared for the goal setting by reading about goal-setting techniques in the provider booklet. For others, the booklet was perceived to include too much information covering all stages in the rehabilitation process. Therefore, they used the booklet infrequently as support for the development of goal-setting skills.

Planning for a continued and coordinated rehabilitation process

The use of written rehabilitation plans in the BRIDGE program implied the need to invite the patients to reflect not only on actions needed for goal achievement but also on potential barriers and strategies for overcoming them. The latter represented a more advanced aspect of planning compared with traditional practice, and one provider stated: "We developed tailored plans, but we did not talk about barriers…I do not think I have the talent needed to do that task" (Q 105). Others explained how they tailored phrases to their everyday vocabulary, resulting in improved confidence: "… for me, it became easier when I just invited [the patient] to develop *a good plan B* instead of using the barrier word or other complicated words" (Q 103*). Training of skills to identify strategies for barriers could be motivated by positive experiences in interaction with their patients, as stated by this provider: "…those dialogues [planning for barriers] were useful…most patients could imagine potential barriers, such as *how to manage if it is a rainy day* or *I am worn-out* or *I am too busy*" (Q 99*).

Some providers described the use of MI rating scales as more difficult and advanced than basic parts of MI, such as reflections, empathy, and positive affirmations. Their stated reasons for infrequent use or non-use of the MI rating scales were partly related to the providers' role-identities. For example, some providers associated "learning new provider skills" with "being less competent than I was when delivering the traditional program," as illustrated in this quotation: "I did not use the MI rating scales, but some of my colleagues who are more familiar with MI did, but for me…I was not comfortable. For me, it is important to be competent and good in interaction with my patients, and therefore I have to be comfortable with what I practice" (Q 89*).

Facilitate continuation in the home context and sufficient involvement of external services after discharge

Some providers highlighted the benefit of dedicated time to practice and develop conversation skills, in terms of team-based workshops, peer-to-peer learning, or guidance from the local site coordinator. However, the content in such initiatives mostly addressed goal setting and MI used in the initial parts of the rehabilitation process. Similar leader-led initiatives to empower clinicians' practicing of tailored feedback on progress or cooperation with next of kin or external services were not described.

Tools

Initial goal setting and tailored rehabilitation process during the first part of the stay

All providers rated the reflection task, "The shoe" (Additional file 7), as the most useful tool to support the patient's initial rehabilitation process. "The shoe" was a drawing designed to stimulate the development of goals for each patient. Different parts of the surface of a shoe represent potential headings for rehabilitation goals for people with RMDs. In line with the Norwegian saying "Where the shoe pinches", the patients considered their everyday situation according to the topics written on "the shoe". Providers stated that this task worked as a quick and "to-the-point" preparation for goal setting for patients. Additionally, the task seemed to widen the scope of topics for rehabilitation goals, reaching beyond or supplementing the more frequently occurring topic "physical training." The consequence was that different professions were invited to engage in goal setting, such as social worker or a nurse: "They [the patients] said they experienced a new way of thinking about factors influencing it [their health and pain], and difficult things became easier to talk about because 'the shoe' influenced the patients' mental process in a way (-)" (Q 69*).

Planning for a continued and coordinated rehabilitation process

Less attention to tools, such as MI rating scales or smartphone applications relevant to support health-related behavior changes, was explained by forgetfulness and delay in changing routines. Some providers used an available tool a few times and experienced benefit in interaction with their patients but did not automatically change their habitual practice.

Facilitate continuation in the home context and sufficient involvement of external services after discharge

A few statements outlined the importance of feedback on progress (the digital graphs as a tool): "I rated the graph [as] highly important [to support the process] because I saw how the patients responded to the document…the visual effect…so concrete…for some patients, the graph illustrated well the fluctuations [of their symptoms or activity problems], and they wanted to present it to the general practitioner" (Q 7). Hence, experienced effectiveness was a prominent reason for rating the graphs or other BRIDGE tools as highly useful.

Mind

In general, the providers' theoretical grounding of activities in the BRIDGE program could vary along a continuum from not verbally expressed to evoked and expressed. The degree of theoretical grounding could improve by peer-to-peer learning or individual self-reflections, as part of the dialogues within the FGs.

Initial goal setting and tailored rehabilitation process during the first part of the stay

Goal setting and MI were collectively rated as highly important to support the rehabilitation process. Provider explanations for why those elements were important typically addressed theoretical concepts, such as patient autonomy, motivation, and responsibility: "BRIDGE is about the patient being responsible for his own rehabilitation process, and I think that is great, because the likelihood of goal attainment increases when the patient talks and reflects, and we are more in the background…and we use the right tools, such as MI, to listen and reveal the patients' actual meanings and wishes" (Q 68).

Planning for a continued and coordinated rehabilitation process

Less priority was given to BRIDGE elements if the added tasks were perceived to be too time-consuming or less important: "We do plan for goal-attainment after discharge, but not necessarily as a written plan…writing requires additional time, and is not necessarily a must…for some patients, I think the good conversation is most helpful" (Q 108*). However, the group discussions about the BRIDGE elements could result in new understanding or evoke professional reasoning: "First I rated it [written rehabilitation plan] as less important, but now [after reflections in the FG], I will say it is very important. I need something written–reflecting the patients' own words and statements–to evaluate if we have a similar understanding of the situation and to have some written agreements to give feedback on–or adjust–during the process" (Q 149).

Some providers linked the use of written rehabilitation plans to theoretical concepts such as the patients' coping skills and sufficient self-efficacy towards goal-directed plans and actions. They described the MI rating scales as valued tools to support the patient's reflections on their confidence and readiness for change and to facilitate agreements on a written rehabilitation plan comprising tailored goal-directed actions. When listening to others' reflections during the FGs, some providers realized the potential in forgotten or unused tools, as illustrated in the following dialogue: *Informant 3*: "I am surprised, because I realize–while we are talking–that during the BRIDGE, I forgot the possibility of using available applications from the list (laughing)…." *Informant 4*: "Agree, I know the feeling… (more laughing)…I realize I could have been more conscious regarding the applications, and also the MI rating scales…we could have used these tools more often." *Informant 5**: "I think–after our discussions–that in my unit, we could have used the introduction video about rehabilitation goals…from now, I will consider to use the video-presentation at our unit" (Q 39).

Facilitate continuation in the home context and sufficient involvement of external services after discharge

Some providers linked the use of feedback and follow-up after discharge to theoretical concepts such as patients' self-management

over time and their ability to solve problems during their own rehabilitation process: "It [BRIDGE] was a reminder of the patients' further process after discharge, and [a reminder of] the contrast related to a few weeks in our unit and plenty of weeks in the home setting… therefore, the patients' ability to solve problems and manage is most important…and [involvement of] relevant collaborators after discharge" (Q 133*). Experienced benefit from the mandatory phone call after discharge could also lead to a high rating of follow-up as an important tool to support the patients' process: "The patients described that they were motivated to engage in the agreed actions due to a sense of responsibility…they knew that someone would keep in touch and call them…prior to that, they would try to comply with their [rehabilitation] plan" (Q 116).

The reasons for lower ratings were either diffuse or characterized by anticipated low effectiveness in spite of limited or no experience with the tool, as illustrated in the following: "I do not know (laughing), I am not sure what I was thinking" (Q 74), and "I do not know [but have not checked] if the patients read the written plan [or used the digital graphs] afterwards" (Q 125).

Organization

Initial goal setting and tailored rehabilitation process during the first part of the stay

The introduction video about goals was a frequently omitted tool. Existing organization at the centers was in some cases suitable for the presentation of the video: "We added the video about rehabilitation goals in the first group education [a routine meeting already established in the center]" (Q 44*), and in other cases, it was not: "Admission is one by one [at our center], not groups…I did not use the video about goals, individuals could have used the tablet to watch the video alone, but…no" (Q 52*). In general, the providers' ability to deliver the BRIDGE program was influenced by leader-led changes in schedules, for instance, to reorganize the sequence, duration, or content of goal-setting meetings during the patients' first days after admission, and to decide which parts of the interventions were suitable in group versus individual interaction with the patients.

At some centers, the program delivery was driven only by the local coordinator and a few team members. At other centers, in contrast, the topic for current institutional quality initiatives coincided with one or several elements in BRIDGE, such as goal setting (at one center) or MI (at two centers): "As decided by the leaders, all professionals providing rehabilitation services at our workplace attended MI seminars in this period…[] to strengthen MI knowledge in the team…and [the leaders organized] a better structure in our schedules to pay more attention to goal setting, the patients' motivation and so on" (Q 90*).

Planning for a continued and coordinated rehabilitation process

At some centers, the written rehabilitation plans improved the organization and cooperation within the team, as one provider observed: "A great benefit in our team was that the content in our meeting became more focused due to actions and goals written in the rehabilitation plan…we kind of…organized the meetings around each plan" (Q 152). Another provider noted: "… even the doctors ask for the patient's goals now…that really did not happen earlier [prior to BRIDGE]. In addition, the work done by the occupational therapist or the nutritionist …contributions from different disciplines became more visible and specific, when reported in the template [rehabilitation plan] and we use the template every Friday [at the team meetings]" (Q 153).

Facilitate continuation in the home context and sufficient involvement of external services after discharge

Although standardized instruments for baseline assessments and outcome monitoring were included in the program, participants in the FGs focused relatively less on this topic. Some providers stated that the digital solution of data collection in the RCT required additional time and efforts in comparison with T1. Two providers described how they included evaluation of the patient's progress on goal attainment in the mandatory follow-up conversation. Beyond that, little information was present in the transcripts regarding how or if providers used the results from the outcome measures in interactions with patients.

In a few examples, some providers outlined positive experiences when inviting persons from the patient's work or social services to meetings before discharge. Others stated that "what we can do while the patient is here [at the institution] is to guide the patient to… better ability to self-manage, but at home…what happens when they return home…we do not know" (Q 141*). In general, information about the organization of cooperation and dialogues with next of kin or external services was scarce in the transcripts.

Integration of results from questionnaires and FGs

Evidence in the quantitative findings indicated that the structure dimension of quality of a continued and coordinated rehabilitation process were improved as intended from T1 to T2, in terms of a higher degree of available written procedures, templates, and other supporting material relevant for the interacting phases in the rehabilitation process. Furthermore, evaluation of the measurable part of the process dimension of rehabilitation quality indicated that the providers delivered most of the elements of the BRIDGE program to most of their patients. Integrating the results from the FGs led to expanded insights into *how* the BRIDGE program was delivered, depending on the features of the institution, the team, and/or the individual providers. The integrated results are presented in Figure 3 (joint display, figure). In additional file 8 (joint display, table), we present more details about how the quantitative and qualitative findings for each element in the quality improvement program are related.

High program fidelity, as measured quantitatively, seemed to correspond with qualitative findings reflecting the providers' confidence that they were suitably skilled to deliver what was intended and their consciousness about the components' theoretical grounding or potential effectiveness. Other corresponding data addressed the presence of learning possibilities within the team or the institution, collective efforts to build confidence and seek experience with new tasks, and leaders who reorganized the routines and schedules to facilitate the delivery of the BRIDGE program. Conversely, lower program fidelity seemed to correspond with qualitative findings covering the same features, but then as being lacking or present to a lower degree within individuals, teams, or institutions.

Of note, the integrated view pointed to the highest quality during patient-centered goal setting and the initial phases of the rehabilitation process. It also indicated the highest potential for quality improvements regarding the use of written plans for rehabilitation, strategies for overcoming potential barriers, feedback on progress on standardized outcome measures, involvement of next of kin and external services, and tailored follow-up. Although the BRIDGE program was intended to bridge gaps between care levels, we found that this intention seemed not to be fulfilled: The quality indicators addressing next of kin and external services

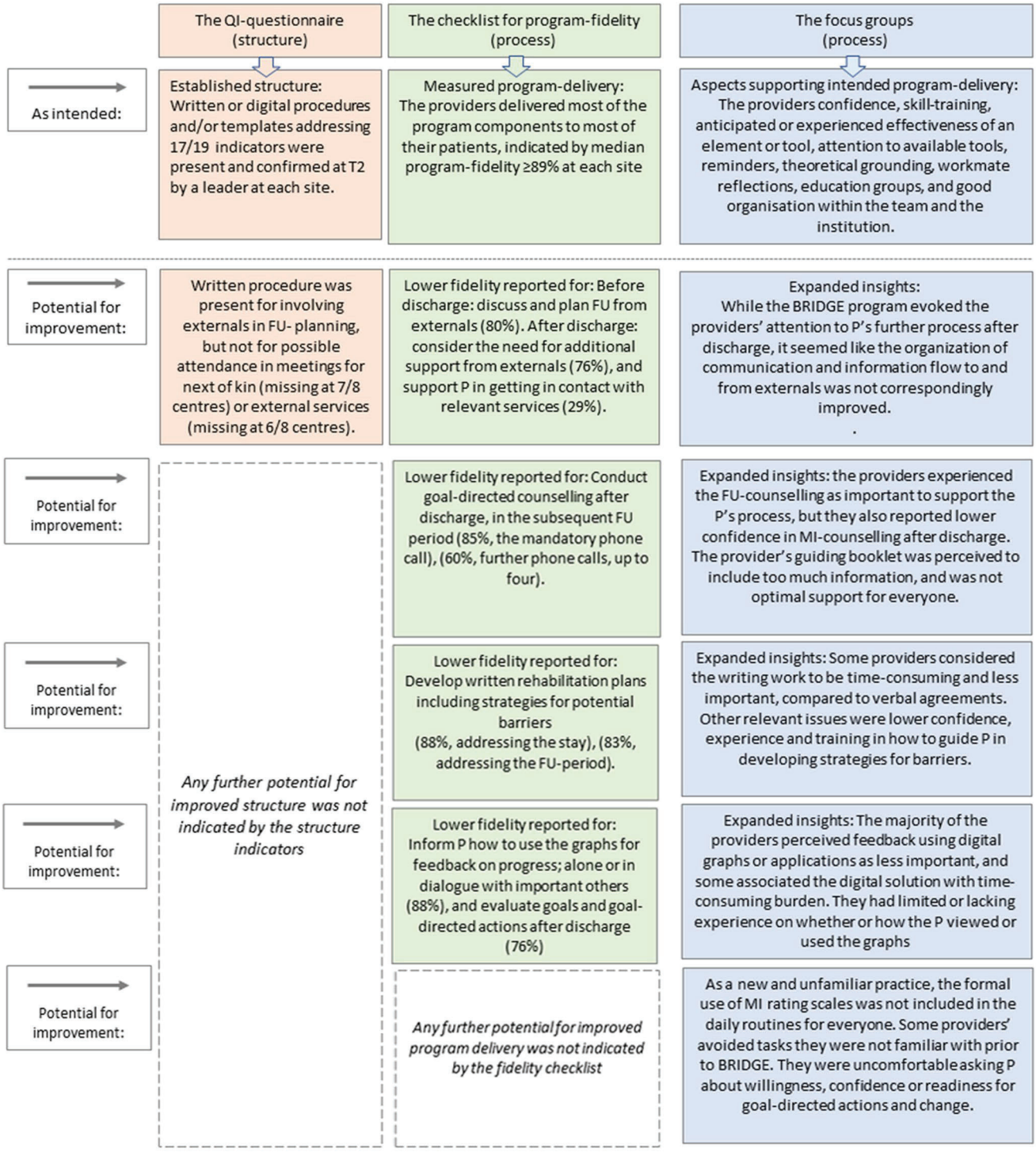


Figure 3. Joint display of intended program delivery confirmed by quantitative and qualitative results, and potentials for improvements suggested by the results from at least one database. FU: follow-up; P: patient; MI: motivational interviewing.

had the lowest pass rates, the check list items regarding involvement of next of kin and external services revealed less program fidelity, and reflections within the FGs were scarce regarding cooperation or dialogues with next of kin or external services.

Discussion

In this convergent mixed methods study, we investigated the provider perspective on how the BRIDGE program, designed to improve the quality of the rehabilitation process from admission to follow-up, was delivered and perceived by members of multidisciplinary teams from different sites. After the addition of the BRIDGE program, structural differences in quality (measured by the QIs) were improved to a high-quality level across all centers in terms of written documents for each phase in the rehabilitation process and electronic records for the standardized outcome measures being present and accessible at every site. Comparing these results with the overall high program fidelity (measured with the fidelity checklist) and statements (provided by the FGs) on improved practicing of tasks and dialogues with patients, we

suggest that the BRIDGE program had the intended positive influence on both the structure and process dimensions of quality of rehabilitation for patients with RMDs. However, the further integration of FG results indicated that delivery of the BRIDGE program could be considered as a continuum from lower to higher rehabilitation quality, depending on contextual factors, such as the influence of the individual providers, team leaders, and local institutional settings. These results underline the importance of paying attention to contextual features in future quality improvement research and practice, also in the field of rehabilitation [29].

Several contextual features seem to have influenced the program delivery, and some of them are worth special attention. First, some BRIDGE tasks entailed changes in the providers' behaviors and improved conversation skills, and results from the qualitative analyses indicated that delivery of these parts of the program depended on the extent of such preparation or training. Corresponding item scores in the fidelity checklist (quantitative findings), indicated that the program fidelity was lower for the use of rehabilitation plans including strategies for barriers, feedback on progress, and MI-guided counseling after discharge. Additionally, in the qualitative findings, the providers' statements indicated a lower perceived competence in measuring the patients' self-efficacy in completing goal-directed actions, either during the stay or after discharge. Our results confirm previous findings by Scobbie and colleagues in 2013 [30]. Although those authors included diseases other than RMDs, their evaluation pointed to the same provider challenges with the goal-setting process as we identified here, namely barriers and coping planning, appraisal and feedback, and measuring patient confidence in goal-directed actions [30]. Almost 10 years ago, these aspects were perceived as novel additions to rehabilitation practice for long-term conditions [30]. Our findings highlight that these aspects are still perceived as difficult to practice in daily routines. In the future, efforts are needed to improve provider competence along with suggested ways to address these difficulties.

Second, our qualitative findings indicated that high program fidelity was supported by the providers' understanding and beliefs about the components included in the BRIDGE program. The highest fidelity in the quantitative findings addressed goal setting and the early stages of the rehabilitation process. Based on results from the FGs, the same topics were perceived as most important to support the patients' rehabilitation process and were most frequently discussed within the team or the institution in education sessions during T2. However, as others have indicated, skilled behavior-change counseling includes, but is not restricted to, goal setting [30–33]. Therefore, institutional initiatives in training and education also should address providers' confidence and competency in action and coping planning, feedback on behavior and outcomes, and ways to build patient self-efficacy and ability to engage and sustain healthy behaviors over time, also in the face of barriers [30–33]. Taken together, a set of coordinated activities is needed for providers to guide the patients towards their goals. Suboptimal attention towards some steps or aspects may influence and weaken the whole intervention.

Third, when comparing quantitative and qualitative results for similarities, we also found an apparent need for professional initiatives to discuss and establish the sufficient degree of involvement of external services and/or next of kin. It has been suggested that patients with RMDs prefer to self-manage without support from others, but their needs for tailored, supported self-management are also well documented in the literature [34–38]. Therefore, providers should guide patients in problem-solving skills and strategies for coping with their challenges in daily life. Simultaneously, providers should help patients find and express their individual need for support in follow-up and maintain suitable and sufficient continuity after discharge. A variety of preferred supports are documented for people with RMDs, such as health professionals, fellow patients, employers, colleagues, stakeholders from labor and welfare services, the education system, neighbors, friends, and relatives [34–38]. Active involvement of next of kin is highlighted as relevant, not only for potential support but also because of necessary adjustments between the patient and near relatives in their daily life, both at emotional and practical levels [38–39].

Finally, it could be argued that the delivery of the BRIDGE program was challenged by the program itself, which comprised several interacting elements and required a number of tasks and behaviors from both providers and patients. This complexity was reflected in the relatively high number of structure indicators and items in the fidelity checklist. However, rehabilitation, by nature, is a complex and lengthy process, and the stages and components included in the program were intended to build on each other and were assumed to be equally important. In the current study, a higher program fidelity seemed to be facilitated not only by new knowledge but also by evoking knowledge established prior to BRIDGE. Some providers described this as evoking "sleeping" or "dimmed" knowledge. The providers' expressed theoretical grounding seemed to be positively influenced by self-reflection on recommended routine practice, workmate reflections, team-based or institutional education initiatives, and reminders. The BRIDGE program was perceived as a reminder of core values in rehabilitation and seemed to motivate providers to practice tasks that they associated with high-quality rehabilitation. Also, the checklist, some passages in the guidance booklets, and other preferred BRIDGE tools seemed to prompt the providers to prepare and perform central aspects of the complex intervention. As others have indicated, providing reminders to healthcare professionals may lead to improved processes of care [40–41]. The use of provider reminders seems to be of special importance for overcoming problems with information overload, time constraints, or unconscious omissions of one or several components when delivering complex interventions [40–41]. Such knowledge is highly relevant to improving the quality of the complex, interacting components included in the rehabilitation process.

Strengths and limitations

The mixed methods approach was considered a strength because it resulted in expanded insight into the delivery of the quality improvement program, allowing us to focus on *what* was delivered as well as *how* it was delivered in different settings. This dual focus was made possible because the quantitative and qualitative results both addressed the concept of quality of program delivery, and we could draw inferences from the integrated data.

This study also has some limitations. First, the PR changes measured by the structure indicators at T2 might have been a response to the T1 measures, i.e., changes because of leader-initiated improvements motivated by the T1 results at each site, rather than by improvements caused by the added quality improvement program. However, in the interview-based data collection, local leaders explained to the researcher (ALSS) that written and digital BRIDGE material supplemented some lacking documents in their exisiting procedures, leading to high fulfillment of QIs at T2. We do not know to what degree local institutions developed their own written or digital documents when the BRIDGE trial was completed.

Second, the fidelity checklist was developed for the BRIDGE project and has not been tested for psychometric properties, such as test-retest reliability and validity.

Third, the fact that study researchers mentored the FGs could have led to a response bias from participants, such as under-reporting of undesirable delivery or of critical opinions about the BRIDGE program. However, the qualitative data were rich and represented various attitudes, indicating the likelihood that statements were honest and dialogues were spontaneous among the FG participants.

This study was designed to investigate quality improvements in a national RMD rehabilitation context, but the generic nature of the multidisciplinary goal-setting and self-management processes indicates that the results, knowledge, and understanding may be transferable beyond this specific project. Future studies should include patient perspectives on receiving similar programs.

Conclusion

We found that the delivery of a quality improvement program designed to enhance continuity and coordination in rehabilitation processes depended on the providers' professional skills, their attention towards supporting tools developed to facilitate the rehabilitation process, and their professional mind in terms of theoretical grounding of activities in the rehabilitation program. Also important were organizational factors in their teams or institutions. Planning or evaluating the delivery of rehabilitation processes requires attention both to program components that can be measured quantitatively and to qualitative aspects of how to deliver them, at the levels of individual providers, teams, and institutions. Such approaches may promote equal attention to each phase from goal setting to tailored follow-up, decrease the risk of suboptimal support of patient self-management strategies over time, and reduce undesired variability in program delivery among providers and institutions.

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Authors contributions

ALSS drafted the article. All authors were involved in revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication. ALSS had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analyses. Study conception and design: ALSS, GB, GJA, MA, AMB, TND, CE, IJ, HLV, HD, IK. Acquisition of data: ALSS, TND, IJ, HLV, IK. Analysis and interpretation of data: ALSS, GB, GJA, MA, AMB, TND, CE, IJ, HLV, HD, IK

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