
REVIEW ARTICLE (META-ANALYSIS)

Key Characteristics of Rehabilitation Quality Improvement Publications: Scoping Review From 2010 to 2016



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Abstract

Objective: To characterize the peer-reviewed quality improvement (QI) literature in rehabilitation.

Data Sources: Five electronic databases were searched for English-language articles from 2010 to 2016. Keywords for QI and safety management were searched for in combination with keywords for rehabilitation content and journals. Secondary searches (eg, references-list scanning) were also performed.

Study Selection: Two reviewers independently selected articles using working definitions of rehabilitation and QI study types; of 1016 references, 112 full texts were assessed for eligibility.

Data Extraction: Reported study characteristics including study focus, study setting, use of inferential statistics, stated limitations, and use of improvement cycles and theoretical models were extracted by 1 reviewer, with a second reviewer consulted whenever inferences or interpretation were involved.

Data Synthesis: Fifty-nine empirical rehabilitation QI studies were found: 43 reporting on local QI activities, 7 reporting on QI effectiveness research, 8 reporting on QI facilitators or barriers, and 1 systematic review of a specific topic. The number of publications had significant yearly growth between 2010 and 2016 ($P = .03$). Among the 43 reports on local QI activities, 23.3% did not explicitly report any study limitations; 39.5% did not use inferential statistics to measure the QI impact; 95.3% did not cite/mention the appropriate reporting guidelines; only 18.6% reported multiple QI cycles; just over 50% reported using a model to guide the QI activity; and only 7% reported the use of a particular theoretical model. Study sites and focuses were diverse; however, nearly a third (30.2%) examined early mobilization in intensive care units.

Conclusions: The number of empirical, peer-reviewed rehabilitation QI publications is growing but remains a tiny fraction of rehabilitation research publications. Rehabilitation QI studies could be strengthened by greater use of extant models and theory to guide the QI work, consistent reporting of study limitations, and use of inferential statistics.

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Providers can no longer simply focus on the delivery of care they may believe is of quality. Increasingly, providers are being held accountable for their quality of care, and importantly for the conducting and reporting of processes leading to its evaluation and improvement.¹⁻³

In contrast with the remarkable advances in clinical science, numerous reports⁴⁻⁷ have shown suboptimal health care delivery around the globe, resulting in adverse health outcomes and wasted resources. In rehabilitation, unwarranted variations occur too often in the access to, and in the utilization, processes, and outcomes of, rehabilitation across regions, subpopulations treated, and even within the same type of setting.⁸⁻¹²

One way to close this quality gap is by embracing effective quality improvement (QI) processes.¹³ Continuously measuring

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quality of care is increasingly advocated, and relevant data increasingly are available to feed QI activities.^{3,14,15} However, evidence shows that both the quantity and quality of those QI endeavors remain suboptimal in health care.¹⁶⁻¹⁸

Historically, health providers received limited or no training in QI processes, methods, and philosophy.¹⁹⁻²¹ Therefore, many providers now are being tasked to do what they are fundamentally not prepared for—that is, to conduct and report QI activities and research. QI research is further limited by lack of awareness in the scientific community about its importance.²² In rehabilitation, there is limited information on the quantity, scope, and key characteristics of the empirical, peer-reviewed QI literature.

To address this gap, this article aimed to quantify and describe the scope of the empirical, peer-reviewed literature on rehabilitation QI from 2010 to 2016. Specifically, we aimed to carry out the following on the existing rehabilitation QI studies: (1) quantify the volume of publications, their growth over the years, and how they are distributed according to study type,²² country, and journals; (2) identify the underlying QI models and theories (eg, of uptake/dissemination, behavioral change) used in the studies; (3) identify the main topics, settings, and care levels addressed in the studies; (4) describe key methodological characteristics of the studies including (a) study designs and the nature of data collection (ie, prospective vs retrospective); (b) use of inferential statistics on the main variable of interest; and (c) description of study limitations; and (5) quantify the explicit mention/citation of the relevant reporting guidelines (ie, Standards for QQuality Improvement Reporting Excellence [SQUIRE]^{23,24}) as well as the report of the institutional review board (IRB) review and status.

Methods

A scoping review was conducted. This is a rigorous knowledge synthesis method most commonly used to address an exploratory research question, to map the existing literature on a field, or to preliminarily identify gaps in the literature. As a first review approach on a broad, complex, or fragmented topic, scoping reviews typically depict what has been done and not done, and by how much. As such, its outputs often inform further research questions and agendas.^{25,26}

In this scoping review, we used the Arksey and O'Malley's 5 mandatory methodological steps,²⁷ as updated and refined by others.^{25,28} While there is no previously published or registered protocol, they were applied as described below. Preferred Reporting Items for Systematic Reviews and Meta-Analyses²⁹ recommendations for systematic review conduct and reporting also informed the methodology, where appropriate.

Identifying the research question

After preliminary review of the related literature, we came to the following research question: Between January 2010 and December 2016, what is the scope (eg, the quantity, distribution by QI study types, problems addressed, improvement models and theory

followed, and key methodological characteristics) of the empirical and peer-reviewed literature on QI (or safety hazards prevention) that actively involves rehabilitation services or stakeholders?

The period of 2010 to 2016 was selected to reflect the more recent trends and allow for the mention/citation of the SQUIRE guidelines (first version published in the 2008²⁴).

Identifying relevant studies

In February 2017, we searched MEDLINE (through PubMed), Scopus, CINAHL Plus with full texts (through EBSCO), the PEDro and the OTseeker databases. [Supplemental appendix S1](http://www.archives-pmr.org/) (available online only at <http://www.archives-pmr.org/>) presents the final PubMed search strategy, whose main terms informed the searches in the other databases. In brief, we used the Medical Subject Headings “quality improvement” and “safety management,” defined as a major topic, along with those same keywords present in the articles' title, abstract, or keywords. These terms then were combined (ie, using the Boolean operator “AND”) with a previously published filter for finding rehabilitation-related content on PubMed,³⁰ along with additional rehabilitation-related keywords (eg, physical therapy, occupational therapy) searched for in the articles' title, abstract, or keywords, and finally along with all the journals indexed in PubMed as pertaining to the field of physical medicine and rehabilitation.³¹ Searches were limited to English-language publications to facilitate the analysis and to capture research understood by an international audience.

The grey literature was not searched, as the focus was on the peer-reviewed scientific literature. Secondary searches included consulting the publication list of the Institute for Healthcare Improvement's repository,³² consultation of authors' personal libraries, and in a later stage, hand-searching the reference lists of the articles finally included.³³ References coming either from databases or secondary searches were subject to the same eligibility criteria.

Study selection

Studies were included if they pertained to (1) physical rehabilitation services or were implemented by rehabilitation stakeholders ([supplemental appendix S1](http://www.archives-pmr.org/) provides the full working definition); and (2) explicitly reported a data-driven QI study, including safety hazards prevention. Adapted from the classification of Portela et al,²² that second criterion consisted of 4 alternative inclusion categories: (1) empirical accounts of local QI programs or projects, with assessment of impact and the main goal being local change; (2) studies of QI effectiveness, typically conducted across sites and organizations, whose main goal was to produce generalizable knowledge on the effectiveness or effective implementation of QI interventions; (3) studies on the QI determinants, facilitators, or barriers; and (4) systematic reviews on any of the above.

[Supplemental appendix S1](http://www.archives-pmr.org/) provides a detailed description of each category, including more specific inclusion criteria, clarification notes, and specific criteria for exclusion.

Two reviewers independently applied the eligibility criteria both in screening the titles and abstracts and in the full-text review (T.S.J. and C.S.P. for the first screening, T.J. and C.P. for the full-text review). That process occurred after a first calibration exercise (pilot testing of 5% of references necessarily yielding interrater reliability $\geq 80\%$). In the first screening, and for a higher breadth of coverage, references were kept whenever the article was selected by at least 1

List of abbreviations:

ICU	intensive care unit
IRB	institutional review board
PT	physical therapy
QI	quality improvement
SQUIRE	Standards for QQuality Improvement Reporting Excellence

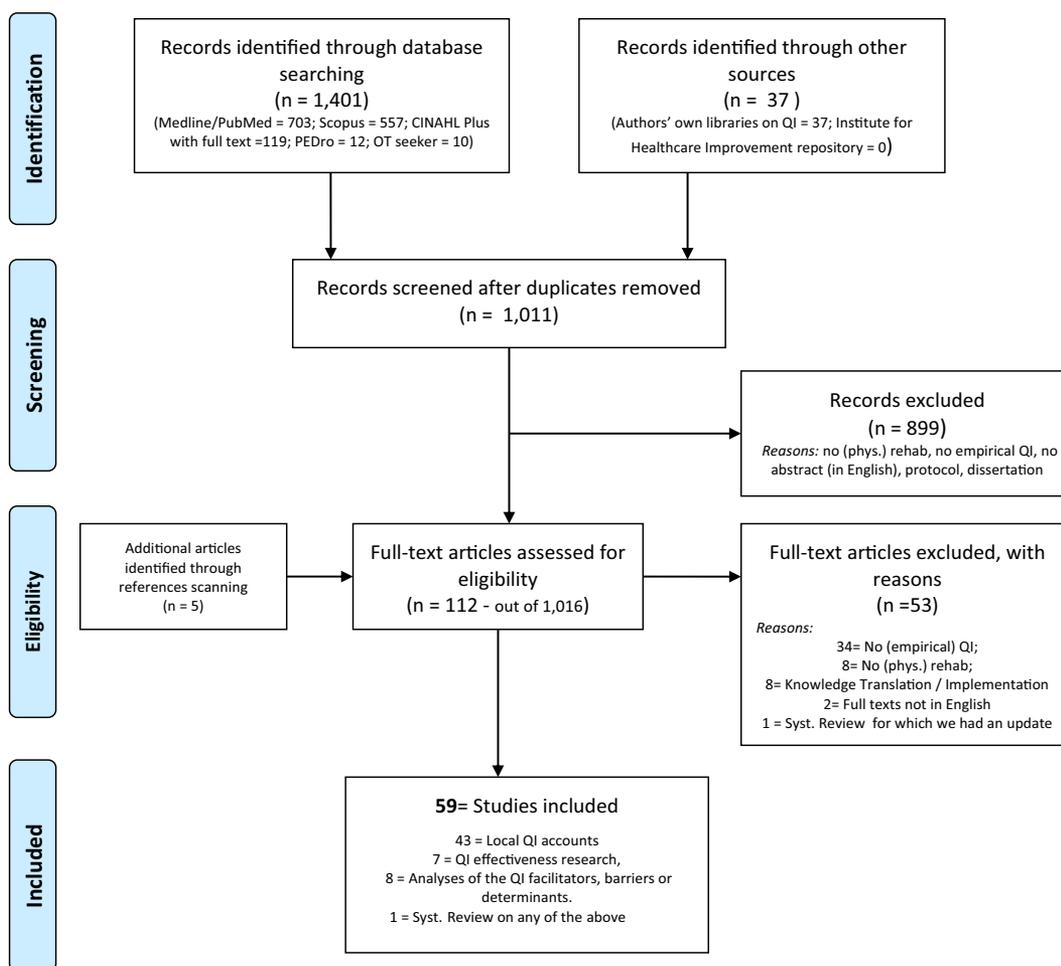


Fig 1 Flow diagram of the scoping review. Abbreviations: phys., physical; Syst., systematic.

reviewer. In the full-text review, both reviewers needed to agree on the decision (and reasons) to exclude a article.

Charting the data (data extraction)

For each article included, data were extracted on each element needed to answer our study’s specific objectives. Data extraction tables, one for each QI study type, were purposively built, after being pilot tested and readjusted by 2 review authors (T.S.J., C.S.P.) in a random sample of 3 articles for each table, when more than 3 articles existed per study type. Consistent with the scoping review methodology, the data extraction did not involve quality appraisal and grading.

Since data were limited to self-reported characteristics, the full data extraction was conducted by a single author (T.S.J.). Whenever data could not be completely and objectively retrieved from the article’s content, the senior author (H.H.) was called on to either infer that data from the whole reported content or to declare that the reported information was insufficient for the extraction purposes. A double check by another review author (C.P.) was performed for the determination of study limitations reported by the articles, as some interpretation could have been involved (eg, a report of how a QI intervention could have worked better was not considered a study limitation).

Collating, summarizing, and reporting the results

Descriptive statistics (eg, frequencies, percentages, population-adjusted number of publications per country) were calculated using Excel.³ The same software was also used to build charts (eg, depicting the distribution of the included literature over the years) and perform simple linear regression analyses to analyze publication growth over the study period. *P* values <.05 were considered statistically significant. Finally, a summative form of a qualitative content analysis was used to analyze data retrieved from the self-reported study limitations.³⁴

Results

Figure 1 presents the flowchart for this scoping review. From the initial 1011 unique records, 899 were excluded after reviewing their titles and abstracts. An additional 5 articles were identified through scanning references, resulting in a total of 112 full texts assessed for eligibility. Of these, a total of 59 articles met the inclusion criteria for empirical rehabilitation QI publications: 43 for local QI accounts; 7 for the QI effectiveness research; 8 on the determinants, facilitators, or barriers to the QI process; and 1 systematic review for any of the above.

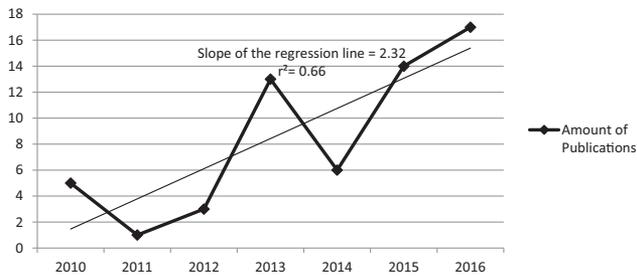


Fig 2 Publications of rehabilitation QI research per year and their growth (2010–2016).

Supplemental appendix S2 (available online only at <http://www.archives-pmr.org/>) provides spreadsheets for the (1) list of included articles organized by QI study type; (2) respective data extraction tables; and (3) list of articles excluded with the respective reasons.

As follows, we report the broad publication trends for all included articles first, and then the key characteristics of the included studies by QI study type.

Publication trends across all included studies

Figure 2 shows that the volume of rehabilitation QI articles published per year more than tripled from 2010 ($n=5$) to 2016 ($n=17$). During that period, the yearly growth was statistically significant (slope value of the linear regression model, 2.32; 95% confidence interval, .42–4.23; $P=.03$), but we note substantive yearly variation ($r^2=.66$) within the small yearly sample size and short time span under analysis.

Rehabilitation QI studies, reported in English, were carried out in 8 different countries. Countries with more than 1 such study were the United States ($n=33$), Australia ($n=8$), the Netherlands ($n=5$), United Kingdom ($n=5$), and Canada ($n=4$). Adjusted for the population size (values per 10 million inhabitants: population data for 2015, source World Bank), Australia (3.34), the Netherlands (2.95), and Canada (1.12) outpaced the United States (1.03) and the United Kingdom (.77).

Figure 3 shows the journals that have published more than 1 rehabilitation QI study; most of the studies (50.9%) were published by journals that have published a single rehabilitation QI study during the 7-year period under study.

Scoping the rehabilitation QI literature by study type

We detail below the key characteristics of the included studies by QI study type.

Local QI activities: aimed at effecting local change ($n=43$)

- **QI issues addressed:** Of the included studies, 30.2% focused on improving/introducing mobilization practices in intensive care units (ICUs), 11.6% on reducing pressure ulcer rates, 9.3% on reducing fall rates, 9.3% on implementing evidence-based practices, 9.3% on improving documentation practices, and 7.0% on enhancing discharge/transition processes. Ten other issues (eg, family experience with care, communication with patients about sex, infection rates) were addressed by a single article each (ie, 2.3% each).

- **Settings and care levels addressed:** 39.5% of the studies were implemented in inpatient, postacute rehabilitation facilities, 32.6% in acute care sites (mostly ICUs), 14.0% addressed specific outpatient rehabilitation facilities, and 7.0% addressed transitions between 2 settings or care levels. A multicenter physical therapy (PT) organization, a geriatric rehabilitation hospital, and a chronic care service introducing a PT outreach support program were setting types addressed by 1 QI study each.
- **Study designs:** 81.4% of the studies used a pre-post design, and data from multiple time points were used to assess the intervention impact in 37.1% of these cases. That times series approach was common when the variable of interest was on incidence rates (eg, of falls, infections, or pressure ulcers) or on adherence rates (eg, providers' compliance with a new tool, accuracy on documentation practices). Only 18.6% of the studies used stepwise, cyclical QI processes (eg, with interim findings from first improvement cycle driving further QI cycles). Finally, 1 study reported to quasi-experimental, cluster randomized experiment with the intervention implemented first in some clusters of providers and then in the remaining clusters within the same employer/organization.
- **Nature of data collection:** 48.8% of the studies used some form of retrospective data collection (66.7% of which used retrospective data collection in both the pre- and postintervention), 41.8% of the studies collected data prospectively for both pre- and postintervention(s) periods (half of which using data routinely collected and therefore readily available), and 9.3% of the studies used baseline values equal to zero (eg, new tool implementation). One stepwise case study had both retrospective and prospective data collection for differing improvement stages and variables of interest.
- **Reported use of QI processes/models:** Nearly half of the studies examining local QI activities (46.5%) did not report using any particular improvement process or model. The most commonly reported such model/process ($n=9$) was the Plan-Do-Study-Act. The "four Es" approach (engage, educate, execute, and evaluate) was reported for 2 studies. There were 10 models/processes that were reported by a single study each (eg, Logic model, the 5 stage "clinical application design," Lean Six Sigma, Failure Mode and Effect Analysis).

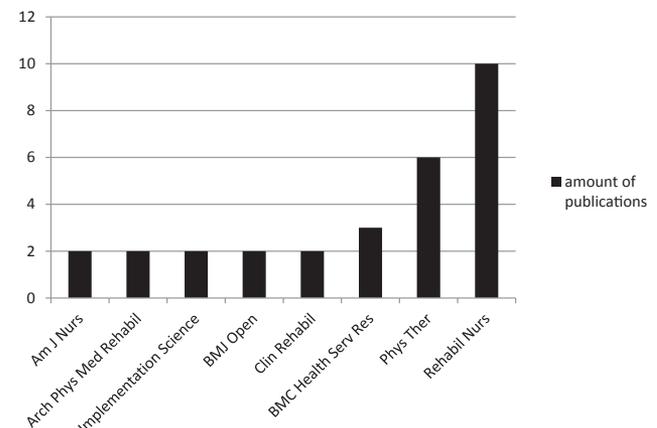


Fig 3 Number of rehabilitation QI research publications per journal (only journals with >1).

- *Reported use of theoretical models:* Only 7.0% of the articles (n=3) explicitly reported consideration or the use of behavior (change) or diffusion/uptake theory. One study reported to the Bandura's self-efficacy concept, another to the Roger's diffusion theory, and finally another one for the adult learning and change management theory.
- *Report of the IRB review/status:* 44.2% of the studies did not mention IRB review/approval, 37.2% reported IRB approval (43.8% of which with explicit designation as QI), 11.6% reported that a formal exemption was provided by designated IRB bodies, in 11.6% authors report themselves that the study was of QI nature or met QI or service evaluation definitions. Finally, 1 study reported that IRB approval was not sought.
- *Mention/citation of relevant reporting guidelines:* 95.3% of the studies did not mention or cite the *SQUIRE* guidelines (the standard for the reporting of QI studies).
- *Report of inferential statistics on the main outcome variable(s):* 39.5% of the articles did not present any form of inferential statistics for their primary results, including nonparametric tests and inferential methods typically used in QI studies (eg, statistical process control³⁵).
- *Report of study limitations:* 23.3% did not explicitly report any study limitations (ie, regarding any methodological gaps and/or any caution for the readers in the interpretation of the results). In particular, 80% of those that did not report study limitations also did not use inferential statistics to empirically examine the results of the QI activity. Among the studies that reported at least 1 study limitation (n=33), 48.5% reported limitations with the internal validity of the study because of study design (eg, pre-post designs); 45.5% reported limitations for generalizing results from the studied context to other contexts; 24.2% reported the use of small samples affected statistical power; 24.2% reported specific events or procedures that may have directly interfered with the results; 18.2% reported limitations with the accuracy, validity, and/or completeness of the data or its collection; and 18.2% of the studies reported that data on likely confounders were not collected. In addition, 12.2% of the studies reported not being able to determine which aspect(s) of a multicomponent intervention accounted for the results, 9.1% of the studies reported that follow-up data were lacking, 9.1% that preintervention data were insufficient, and 6.1% mentioned no standardized outcome measure. Also, 6.1% mentioned possible bias because of the Hawthorne effect (ie, increased attention paid to the QI subject accounting for the change), and 6.1% reported that the outcomes measured were not the most relevant or ideal for the variable of interest (eg, evaluation of the number of items documented by providers but without evaluation of documentation accuracy). Five other types of study limitations (eg, the impact of the QI Project on Resources/Workload not measured) were identified by a single study each (3.0% of the cases).

QI effectiveness research: aimed at generalizing results (n=7)

Of the 7 such studies identified, most (n=4) focused on falls reduction (2 in Australia, 1 in Poland, 1 in Canada). Two focused on improving evidence-based care through adherence to recommended practices (1 in the United Kingdom, the other in the Netherlands), and 1 study evaluated the impact of "audit & feedback" QI strategy in cardiac rehabilitation programs across the Netherlands.

The study designs were varied, including 2 multicenter cluster randomized controlled trials; 1 stepped-wedged randomized

controlled trial; 1 quasi-experimental study with intervention arms comparing 2 alternative approaches; 1 cost-effectiveness analysis of the QI intervention; and 2 pre-post studies, 1 of which simultaneously conducted mixed-methods process evaluation.

Studies on QI process and its determinants, facilitators, or barriers (n=8)

Of the 8 studies falling into this category, 3 pairs (n=6) had common authors, and those pairs pertained to the same sequence of studies: a falls prevention program in Australia, an audit and feedback strategy for cardiac rehabilitation in the Netherlands, and an audit and feedback strategy for the delivery of evidence-based stroke rehabilitation in Australia. Of the 2 studies remaining, 1 was focused on the variables affecting PT providers' use of feedback reports for quality improvement; the other described the experience of prosthetic clinic providers when implementing externally facilitated QI activities as part of routine patient care.

Methodologically, qualitative exploratory research was used in 4 studies. Among these, a focus group alone was used in 1 study, and in 2 other studies focus groups were used in combination with other sources (individual interviews, field notes). In the remaining study, an ethnographic approach was used. Quantitative survey research, with regression analyses, was used in the 2 other studies, coming from the same authors and within the same broad investigation. Finally, 1 study used a mixed-methods approach that combined statistical analysis of survey results with a qualitative analysis of semistructured interviews.

Systematic reviews on any of the topics above

Only 1 systematic review was found to meet the inclusion criteria. It addressed interventions designed to prevent health care bed-related injuries in patients treated in rehabilitation units. The review was only able to identify 2 studies meeting the inclusion criteria, and none of the studies showed the underlying intervention was effective.

Discussion

This systematic scoping review identified the quantity and explored the scope and key characteristics of the peer-reviewed, empirical QI literature in rehabilitation published between 2010 and 2016. While a total of 59 rehabilitation QI studies were identified, that amount is but a tiny fraction of the research publications in the rehabilitation field. For example, for a similar period (2007–2013), there were over 16,000 rehabilitation clinical trials.³¹ Clinical research and other forms of rehabilitation health services research are highly important, but to have an impact on clinical care, that research needs to be linked to practice through dissemination, knowledge translation, and finally QI activities.^{36,37}

In the broader health care literature we find a variety of examples of structured, organizational-wide QI programs, with a special focus on systematically translating a broad range of research results into routine clinical practice.³⁸⁻⁴⁰ In rehabilitation, however, while a few important QI activities were found at the organizational level,⁴¹⁻⁴³ even these were mostly topic-focused, time-limited, or both. While discrete QI activities are surely needed, it would appear that the rehabilitation field could benefit from organization-wide QI programs focused on developing QI processes and programs that cut across QI topics.¹⁵

Like QI activities in other fields,^{18,44} the quality of rehabilitation QI would appear to warrant further attention. Most

strikingly, we found that nearly a quarter of the local QI empirical accounts did not explicitly report any study limitations, which has been identified as an important aspect of QI publications.⁴⁵ In addition, more than three quarters of the studies that did not report study limitations also did not use inferential statistics to empirically examine the results of the QI activity. While all studies, no matter how sophisticated and be they research or QI, have their own limitations and should be interpreted within specified cautions, that applies even more so to studies of QI activities. That occurs in part because of their intrinsic characteristics (ie, given their aim to produce local change rather than produce generalizable knowledge²²), compounded by methodological challenges common to the QI research and indeed any research carried out in real-world circumstances. For example, QI studies require consideration of local contextual variables and how they could have influenced the process and the outcomes of the QI activity.^{23,46,47} Insufficient consideration of these QI main tenets, at least included in the description of the studies' limitations, is an important deficit in the rehabilitation QI studies that requires attention.

A number of factors may contribute to suboptimal conduct and/or reporting of QI endeavors. Providers may be asked to lead the design and implementation of QI activities and then scientifically report on those activities; however, they may not have been provided appropriate training in QI methodology,²⁰ may not have access to needed scientific tools (eg, statistical software), and may not have protected time, financial or human resources (eg, statistical advisors), or scientific writing experience at their disposal.

First, rehabilitation journals can consider how their publication policies and guidelines support or impede publication of high-quality rehabilitation QI investigations. Second, the rehabilitation community needs to pay greater attention to opportunities for carrying out QI studies and sharing results of their work with the broader rehabilitation community. Finally, clinician-researcher partnerships for QI can also be established. Clinicians interested in carrying out QI projects will benefit from guidance by experienced rehabilitation researchers. Researchers will enhance both the quality of the work and potential funding for doing more rehabilitation QI research. Improved care as well as more and improved QI research may all come as a result.

Several other findings warrant comment. Methodologically, just over half of the local QI projects mentioned a QI model or process guiding the QI activity, and less than one fifth specifically reported multiple improvement cycles (ie, the initial QI actions being measured and whose results feeding further action and measurement),^{48,49} which is one of the predominant features of QI models in the health field.¹⁶

Nearly half of the studies of local QI activities used some form of retrospective data collection, sometimes for the post-intervention period too. While retrospective data collection has a number of methodological pitfalls, that may have been the only or best option because of (1) lack of quality and outcomes data routinely collected for the main variable of interest, and/or (2) QI implementation ahead of an initial, structured plan to measure the QI impact. Unfortunately, there is no way to know whether providers tried, a posteriori, to find data support and publish an improvement process when it was perceived as effective. This may lead to a reporting bias for positive QI results, when the reporting of unsuccessful QI is at least as valuable. While this phenomenon is well known and increasingly tackled in clinical research (ie, through the mandatory clinical trial registration⁵⁰), publication bias for positive results remains a substantive risk for QI studies.

Very little use of behavioral change, diffusion or learning theory was reported (7% of the local QI accounts), even though the use of these theories is highly recommended for QI endeavors.⁵¹⁻⁵³ The reporting of IRB review or approval, or both, also was highly variable. That can reflect prevalent uncertainties and still evolving definitions on which activities, with which attributes, should be classified as QI or as research (eg, pragmatic research on health care delivery organization), who is accountable for that classification (eg, local IRB committees, the investigators themselves, institutional policies), and what kinds of review or oversight should be applied to QI activities.⁵⁴

We note that rehabilitation QI publications were relatively spread across journals, with most published in journals that did not publish more than 1 such article. This means readers/providers looking for rehabilitation QI publications must rely on database searches, and authors need to take actions to ensure their manuscripts are readily located with database searches (eg, writing "quality improvement" in titles, abstracts, and/or keywords).

Finally, we were impressed with the proportion of rehabilitation QI publications on mobilization in ICUs. Early endeavors to treat this newly identified problem were clinically driven and were studied using QI methodology,^{37,55} not in the least because of the challenges with carrying out research in the ICU setting. Indeed, the practitioners and investigators in the ICU showed that QI studies can serve as a pathway for simultaneously improving the rehabilitation knowledge and clinical care.

Study limitations

The search strategy sought empirical studies with an explicit framing and keywords for rehabilitation quality (or safety) improvement processes. Relevant studies with an implicit framing may not have been detected and therefore not considered. In addition, we did not include several forms of rehabilitation research (eg, practice-based research,⁵⁶ pragmatic trials⁵⁷) that sometimes resemble and partly overlap with QI processes, methods, strategies, and purposes.^{22,54,58} Such publications were not considered unless explicitly testing the effectiveness of QI activities. The focus on empirical studies of QI activities in clinical rehabilitation also means that we did not include conceptual articles, editorials, and other nonempirical publications (ie, without evaluation of impact), nor did we include QI in the curriculum/education of rehabilitation providers, although these are important and can be valuable.^{15,20,59,60}

Key characteristics of the studies were extracted and analyzed; however, that is a more limited review than a systematic appraisal of the methodological quality of the rehabilitation QI studies, and important methodological lessons may have been missed. Of note, lack of citations or explicit mention of SQUIRE guidelines does not necessarily equate to high or low reporting quality, or even that the guidelines have not been considered or used. Also, the option to review only the studies in English may have reduced the inclusion of studies from non-English-speaking countries.

Methodologically, we did not use 2 independent reviewers for the data extraction. Although a potential source of bias, this approach is supported by the pilot test of the data extraction table (conducted by 2 reviewers), the nature of the content extracted, the use of a second reviewer to confirm the absence of report on the studies' limitations, and the availability of assistance by a seasoned research author when needed (eg, when more subjective or interpretative extraction was required).

Finally, we do not describe specific contents or results for the QI interventions. Although arguably important, that information is

potentially misleading when presented and analyzed transversally across varying contexts and QI purposes, especially without in-depth, systematic appraisal of methodological quality.

Conclusions

The quantity of the rehabilitation QI studies is growing, but it remains a small portion of all rehabilitation research. The most common focus for rehabilitation QI studies was the mobilization in ICUs. Many areas were found warranting further methodological development, such as the use of existing models and theories for guiding QI work, the use of inferential statistics, and the report of study limitations.

Supplier

a. Excel; Microsoft Corp.

Keywords

Quality improvement; Rehabilitation; Review; Safety management

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Supplemental Appendix S1

PubMed Search Strategy

("Quality Improvement"[Majr] OR "Quality Improvement"[Tiab] OR "Safety Management"[Majr] OR "Safety Management"[Tiab]) AND (("Musculoskeletal Manipulations"[Mesh] OR "Physical Therapy Modalities"[Mesh] OR "Physical Therapy Specialty"[Mesh] OR "Physical Therapist Assistants"[Mesh] OR "Physical Therapists"[Mesh] OR "rehabilitation"[Subheading] OR "rehabilitation"[MeSH] OR "Physical and Rehabilitation Medicine"[Mesh] OR "Rehabilitation of Speech and Language Disorders"[Mesh] OR "rehabilitation centers"[MeSH] OR "Rehabilitation Nursing"[Mesh] OR "Rehabilitation, Vocational"[Mesh] OR "Activities of Daily Living"[Mesh] OR "physical therapy"[Tiab] OR "occupational therapy" OR "speech and language therapy"[Tiab] OR "recreation therapy"[Tiab] OR "rehabilitation"[All Fields] NOT "Correction of Hearing Impairment"[Mesh] NOT "Substance Abuse Treatment Centers"[Mesh] NOT "Mouth Rehabilitation"[Mesh]) OR ("Acta Belg Med Phys"[Journal] OR "Adv Clin Rehabil"[Journal] OR "Am Correct Ther J"[Journal] OR "Am J Occup Ther"[Journal] OR "Am J Phys Med"[Journal] OR "Am J Phys Med Rehabil"[Journal] OR "Am Rehabil"[Journal] OR "Ann Readapt Med Phys"[Journal] OR "Ann Phys Rehabil Med"[Journal] OR "Ann Phys Med"[Journal] OR "Annu Rev Rehabil"[Journal] OR "Arch Phys Ther (Leipz)"[Journal] OR "Arch Phys Med Rehabil"[Journal] OR "ARN J"[Journal] OR "Artif Limbs"[Journal] OR "Assist Technol"[Journal] OR "Aust J Physiother"[Journal] OR "Aust Occup Ther J"[Journal] OR "Braz J Phys Ther"[Journal] OR "Bull Prosthet Res"[Journal] OR "Can J Occup Ther"[Journal] OR "Clin Rehabil"[Journal] OR "Dev Neurorehabil"[Journal] OR "Disabil Health J"[Journal] OR "Disabil Rehabil"[Journal] OR "Disabil Rehabil Assist Technol"[Journal] OR "Eura Medico-physics"[Journal] OR "Eur J Phys Rehabil Med"[Journal] OR "Fysiater Revmatol Vestn"[Journal] OR "IEEE Int Conf Rehabil Robot"[Journal] OR "IEEE Trans Neural Syst Rehabil Eng"[Journal] OR "IEEE Trans Rehabil Eng"[Journal] OR "Int Disabil Stud"[Journal] OR "Int J Rehabil Res"[Journal] OR "Int Rehabil Med"[Journal] OR "J Belge Med Phys"[Journal] OR "J Belge Med Phys Rehabil"[Journal] OR "J Belge Rhumatol Med Phys"[Journal] OR "J Back Musculoskelet Rehabil"[Journal] OR "J Bodyw Mov Ther"[Journal] OR "J Burn Care Rehabil"[Journal] OR "J Cardiopulm Rehabil"[Journal] OR "J Cardiopulm Rehabil Prev"[Journal] OR "J Dance Med Sci"[Journal] OR "J Geriatr Phys Ther"[Journal] OR "J Hand Ther"[Journal] OR "J Head Trauma Rehabil"[Journal] OR "J Neuroeng Rehabil"[Journal] OR "J Neurol Phys Ther"[Journal] OR "J Occup Rehabil"[Journal] OR "J Orthop Sports Phys Ther"[Journal] OR "J Outcome Meas"[Journal] OR "J Pediatr Rehabil Med"[Journal] OR "J Physiother"[Journal] OR "J Rehabil"[Journal] OR "J Rehabil Med"[Journal] OR "J Rehabil Med Suppl"[Journal] OR "J Rehabil R D"[Journal] OR "J Rehabil Res Dev"[Journal] OR "J Rehabil Res Dev Clin Suppl"[Journal] OR "J Soc Work Disabil Rehabil"[Journal] OR "J Spinal Cord Med"[Journal] OR "J Sport Rehabil"[Journal] OR "J Am Paraplegia Soc"[Journal] OR "J Assoc Phys Ment Rehabil"[Journal] OR "Man Ther"[Journal] OR "Neuropsychol Rehabil"[Journal] OR "Neuro-Rehabilitation"[Journal] OR "Neurorehabil Neural Repair"[Journal] OR "Occup Ther Health Care"[Journal] OR "Occup Ther Int"[Journal] OR "Orizz Ortop Odie Riabil"[Journal] OR "Ortop Traumatol Rehabil"[Journal] OR "OTJR (Thorofare N J)"[Journal] OR "Pediatr Phys Ther"[Journal] OR "Pediatr Rehabil"[Journal]

OR "Phys Med Rehabil Clin N Am"[Journal] OR "Phys Occup Ther Pediatr"[Journal] OR "Phys Ther"[Journal] OR "Phys Ther Sport"[Journal] OR "Physiotherapy"[Journal] OR "Physiother Res Int"[Journal] OR "Physiother Theory Pract"[Journal] OR "PM R"[Journal] OR "Presse Therm Clim"[Journal] OR "Prog Phys Ther"[Journal] OR "Qual Life Res"[Journal] OR "Radiobiol Radioter Fis Med"[Journal] OR "Record (Washington)"[Journal] OR "Rehab Manag"[Journal] OR "Rehabil Fyz Lek"[Journal] OR "Rehabilitation (Stuttg)"[Journal] OR "Rehabil Lit"[Journal] OR "Rehabil Nurs"[Journal] OR "Rehabil Psychol"[Journal] OR "Rehabil Rec"[Journal] OR "Rehabilitation (Bonn)"[Journal] OR "Rev Bras Fisioter"[Journal] OR "Rheumatol Phys Med"[Journal] OR "Rheumatol Rehabil"[Journal] OR "Scand J Occup Ther"[Journal] OR "Scand J Rehabil Med"[Journal] OR "Scand J Rehabil Med Suppl"[Journal] OR "Soc Rehabil Rec"[Journal] OR "Spec Educ"[Journal] OR "Spec Educ Forward Trends"[Journal] OR "Top Spinal Cord Inj Rehabil"[Journal] OR "Top Stroke Rehabil"[Journal] OR "Torture"[Journal] OR "Train Sch Bull (Vinel)"[Journal] OR "Trans Am Clin Climatol Assoc"[Journal] OR "Vopr Kurortol Fizioter Lech Fiz Kult"[Journal] OR "Z Physiother"[Journal]) AND "2010/01/01"[PDat] : "2016/12/31"[PDat] AND English[lang]

Note: As the PubMed indexation for Medical Subject Headings can take about 2 years to be completed, that continuous update can increase the number of entries retrieved with the search strategy, should the search strategy be replicated at a later date. References published in 2017 are excluded.

Working Definitions

A. Physical rehabilitation working definition (inclusion/exclusion criteria)

Inclusion criteria:

1. The QI intervention was implemented in a health care setting (inpatient or outpatient), residential or community site, which explicitly provides physical rehabilitation care—that is, health care activities delivered by health professionals directed to either achieve or maintain optimal functioning of persons experiencing or likely to experience disability. We define disability for this purpose as permanent or temporary physical impairments either from a specified health condition or from the aging process. Neuro-behavioral, cognitive, and communication sequelae of any physical injury or disease are considered physical impairments.
2. The QI activity actively involved rehabilitation stakeholders either in its design or implementation. Rehabilitation stakeholders include rehabilitation health workers (eg, physicians with specialty in physical medicine and rehabilitation, physical therapists, occupational therapists, speech and language pathologists, prosthetists and orthotists, and nurses working in rehabilitation services, as well as rehabilitation service managers).
3. Care delivered by rehabilitation health workers in settings other than those explicitly providing physical rehabilitation care (eg, intensive care units, acute care wards), as long as those rehabilitation health workers had an active involvement in the design or implementation of the QI activities.

Exclusion criteria:

1. Psychosocial, substance abuse, or mental health rehabilitation, unless those conditions are secondary to physical impairments and addressed by physical rehabilitation services and workers.

2. Rehabilitation of visual and hearing impairments, intellectual disabilities, and oral/dental problems.
 3. Health care for chronic/noncommunicable conditions without explicit mention of associated physical impairments, disability, or their rehabilitation.
 4. Vocational rehabilitation, forensic rehabilitation, or community-based rehabilitation approaches without an explicit inclusion of health care activities, delivered by health care professionals.
 5. Public health action and societal barriers removal (eg, introducing ramps for public building access) were not considered physical rehabilitation services or care unless those activities were part of the care for a specific patient.
- B. Specifications for QI inclusion criteria

Inclusion Category	Description	Specific Criteria	Clarification Notes	Exclusions for the Category
1. Empirical report or account of local QI journeys, programs, or projects (with impact assessed).	Service delivery or organization initiatives primarily oriented to secure positive changes (ie, improvements) in a local setting, even though secondarily they may yield new knowledge that others can further use in practice (with consideration of the different contexts) or even test for higher generalization.	<p>The QI initiatives need to explicitly report all of the following elements:</p> <ul style="list-style-type: none"> • The improvement target(s)—ie, problem to be addressed. • Characteristics of the improvement initiative and of the implementation context. • The involvement of the rehabilitation providers/stakeholders in its design and/or implementation. • Reports values on measuring the QI impact, or lack thereof. This only needs to account for 1 of the forms below: <ul style="list-style-type: none"> a. Report quantitative values for at least 1 measured target of change, outcome, or quality indicator for 1 time before the improvement initiative and at least 1 time thereafter, for the same variable of interest. b. It has multiple or continuous measurements of the variable(s) of interest, which can assume a cyclical, iterative process. c. Qualitative data from the patient's experience or perspective are also considered as a measure of impact. 	Local, providers-led adoption or implementations of a new practice guideline, service model, etc, are also considered.	<ul style="list-style-type: none"> • Action driven by researchers or knowledge producers: ie, Dissemination, Knowledge Translation or Implementation activities. Note, however, that participation and use of health services research and researchers (sometimes internal staff), knowledge brokers, etc, is not a criterion for exclusion if those activities are framed as part of a local QI journey or project. • The QI only has qualitative measurement in the form of a process evaluation.
2. Studies of QI effectiveness.	Explicit, primary orientation toward evaluation (ie, producing new, more widely applicable scientific knowledge) on the effectiveness of a certain QI intervention or strategy—beyond securing local improvements. It aims to test an	<p>The QI evaluative studies can have the following designs:</p> <ol style="list-style-type: none"> Traditional RCTs, cluster RCTs, stepped-wedged RCTs, pragmatic controlled trials. Quasi-experimental designs, including uncontrolled and controlled before-and-after 	Studies are usually led by researchers and implemented across organizations, but can be led by providers (across organizations) as long as they fit the goals described.	<ul style="list-style-type: none"> • Any of the described designs when not explicitly addressing a QI program, issue, or intervention.

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Inclusion Category	Description	Specific Criteria	Clarification Notes	Exclusions for the Category
	a priori hypothesis, usually on the broader effectiveness of an intervention that often has proved preliminary face validity in a few specific contexts. It is implemented in more than 1 site or organization with relatively similar characteristics and with the same purpose of generalizing knowledge.	<p>studies, and time-series designs.</p> <p>c. Observational designs: ie, longitudinal designs relying on multiple successive measurements with statistical analysis separating the effect of the intervention from secular trends or normal (ie, nonspecial cause) variation.</p> <p>d. Studies on the economic evaluation of a QI initiative toward determining its cost-effectiveness or the most cost-effective solution.</p>		<ul style="list-style-type: none"> • Studies on the costs that disregard the effectiveness of the QI. • Studies focused on the formal education of rehabilitation providers for acquiring QI capacities are not included.
3. Studies of QI process determinants, facilitators, or barriers.	These studies aim to depict variables and processes that contributed to the success or lack thereof of a QI study or intervention.	<p>Studies that explore or determine which factors (eg, contextual, of the QI process) helped to determine the success, or lack thereof, of the QI initiative. Methodologically, they can refer to the following:</p> <p>a. Process evaluations of the improvement processes.</p> <p>b. Qualitative studies on the improvement process: ie, on how it functions, functions best, does not function, and why.</p> <p>c. Case studies on further understanding the improvement process and its results.</p> <p>d. Other observational studies on the factors affecting the improvement process, either cross-sectional or longitudinal.</p>	This type of study is reflected in the primary goals and results of the article (ie, not considered as secondary analyses within another article).	<ul style="list-style-type: none"> • Preliminary process evaluations on QI or implementation studies or whose improvement processes were not (fully) implemented yet, and for which there are no results of improvement or lack thereof.
4. Systematic reviews on any of the above.	Studies with a systematic search and analysis of the literature.	Studies included in that systematic review can be of any study design.	Scoping review or realist reviews are also included.	<ul style="list-style-type: none"> • Editorials, conceptual or perspectives articles without new empirical or systematically reviewed data.

Abbreviation: RCT, randomized controlled trial.