Review

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# Evidence-based rehabilitation medicine: definition, foundation, practice and development

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**Abstract:** To determine the definition, foundation, practice, and development of evidence-based rehabilitation medicine (EBRM) and point out the development direction for EBRM. Retrieve the database of PubMed, Cochrane Library, Embase, China national knowledge infrastructure (CNKI), Wanfang, and China science and technology journal database (CSTJ). The search was conducted from the establishment of the database to June 2023. The key words are "rehabilitation medicine and evidence based" in Chinese and English. After reading the abstract or full text of the literature, a summary analysis is conducted to determine the definition, foundation, practice, and development of EBRM. A total of 127 articles were included. The development of 14 sub majors in EBRM are not balanced, evidence-based musculoskeletal rehabilitation medicine (EBMRM) (31 articles, mainly focuses on osteoarthritis, osteoporosis and musculoskeletal pain), evidence-based neurorehabilitation medicine (EBNM) (34 articles, mainly concentrated in stroke, traumatic brain injury and spinal cord injury) and evidence-based education rehabilitation medicine (EBEDRM) (17 articles, mainly focuses on educational methodology), evidence-based nursing rehabilitation medicine (EBNRM) (2 articles), evidence-based engineering rehabilitation medicine (EBENRM) (7 articles), evidence-based traditional Chinese rehabilitation medicine (EBTCRM) (3 articles), evidence-based internal rehabilitation medicine (EBIRM) (11 articles), evidence-based intensive care rehabilitation medicine (EBICRM) (4 articles), evidence-based oncology rehabilitation medicine (EBORM) (6 articles), evidence-based physical therapy medicine (EBPTM) (3 articles), evidence-based cardiopulmonary rehabilitation medicine (EBCRM) (6 articles), evidence-based speech therapy medicine (EBSTM)/evidence-based occupation therapy medicine (EBOTM)/evidence-based geriatric rehabilitation medicine (EBGRM) (1 article). The EBMRM, EBNM and EBEDRM are relatively well developed. The development of EBNRM, EBENRM, EBTCRM, EBIRM, EBICRM, EBGRM, EBORM, EBCRM, EBPTM, EBSTM and EBOTM is relatively slow, indicating these eleven fields should be pay more attention in future.

**Keywords:** evidence-based medicine; rehabilitation medicine; evidence-based rehabilitation medicine; system evaluation

## Introduction

Evidence-based rehabilitation medicine (EBRM) has emerged alongside the development of evidence-based medicine (EBM). As a branch of rehabilitation medicine (RM), EBRM integrates the latest research evidence, clinical experience, and patient values to provide robust support for rehabilitation treatment decisions [1]. However, up to this point, there is no explicit definition of EBRM, and the foundation of the development remains unclear. The practical implementation is also lacking a systematic approach, and the future and development of the discipline are yet to be determined. Therefore, this article intends to explore these issues.

## Definition of evidence-based and EBM, RM and EBRM

### Definition of evidence-based and EBM

The term "evidence-based" is derived from the Latin word "experiri," meaning to strive, attempt, find out, prove, experience, test, or accept testing [2]. It implies making decisions or taking actions based on evidence and experience. In the field of medicine, the concept of evidence-based gradually evolved into EBM. EBM originated in the early

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1990s, initially focusing on educating clinical physicians to understand and utilize published literature for optimizing clinical care, including the scientific methodology of systematic reviews. Over time, there was an increasing recognition of the limitations of evidence itself, and a growing emphasis on integrating the assessment of evidence with patient values and preferences through shared decision-making [3]. As described by Dr. Sackett, EBM is defined as the conscientious, explicit, and judicious use of the current best evidence in making decisionss about the care of individual patients, while also taking into account the clinician's expertise, patient preferences, and values [4].

## Definition of RM and EBRM

RM is a unique medical discipline that focuses on restoring and enhancing functional ability and quality of life for individuals with disabilities or impairments caused by various conditions. It encompasses a wide range of interventions, including physical therapy, occupational therapy, speech therapy, and psychological support.

However, currently, there is no specific and explicit definition of EBRM. Building on the principles of EBM, we propose that EBRM, could be defined as a branch of RM, applies the principles of EBM to the field of rehabilitation. It involves the integration of the latest research evidence, clinical expertise, and patient values to inform and guide rehabilitation treatment decisions. EBRM emphasizes the use of high-quality evidence to optimize the effectiveness and efficiency of rehabilitation interventions, while considering individual patient values and preferences. The differences between RM/EBRM and EBM/EBRM are detailed in Table 1.

**Table 1:** Differences between rehabilitation medicine (RM)/Evidence-based rehabilitation medicine (EBRM) and Evidence-based medicine (EBM)/EBRM.

| Focus | RM vs. EBRM | EBM vs. EBRM |
|---|---|---|
| Evidence source | Laboratory/human trials | Human tirals |
| Evidence collection | Not systematic/systematic | Systematic |
| Evidence evaluation | Neglect/mandatory steps | Mandatory steps |
| Evidence updated | Little or no/usually 1–2 times per year | Usually 1–2 times per year |
| Evidence recommendation | Little or no/mandatory steps | Mandatory steps |
| Evidence effectiveness | Function at a certain time node/ function at a certain endpoint | Disease/Function |
| Evidence basis | Basic research/clinical research | Clinical research |
| Evidence mode | Researcher-led/patient-led | Patient-led |

## Quality and recommended strength of evidence of EBRM

EBRM relies on the quality and recommended strength of evidence as important considerations for guiding rehabilitation practices. The quality of evidence refers to the reliability and credibility of the evidence. Commonly used tools for assessing evidence quality including GRADE (Grading of Recommendations Assessment, Development, and Evaluation) [5, 6] (see Supplementary Table 1) and OCEBM2011 (Oxford Centre for Evidence-Based Medicine 2011 Levels of Evidence) [7] (see Supplementary Table 2).

The recommended strength takes into account factors such as evidence quality, treatment effects, side effects, and patient values. Commonly used tools for determining recommended strength including GRADE [6] (see Supplementary Table 1), SORT (Strength of Recommendation Taxonomy Grade) [8] (see Supplementary Table 3), and OCEBM 2009 [9] (see Supplementary Table 4). Since EBRM is derived from EBM, it is not necessary to develop separate tools for evidence grading and recommended strength specific to EBRM.

# Fundamentals, principles and practice of EBRM

## Fundamentals of EBRM

High-value, standardized, and well-designed clinical research serves as the foundation for practicing of EBM [10]. High-quality systematic reviews empower the development of EBRM [11–13]. Clinical practice guidelines contribute to optimizing rehabilitation treatments for patients [14, 15]. The basis of evidence-based practice lies in the integration of values and preferences of patients [16, 17], expertise of healthcare professional [18] and the best available evidences [19], collectively providing information for clinical decision-making [20]. Randomized controlled trials (RCTs) and real-world evidence expand the evidence and knowledge of treatments [21]. Updating knowledge enhances clinical skills and enables better provision of evidence-based strategies for patients. Therefore, we propose that EBRM should encompass at least five fundamentals, referred to as the "SCVPU" elements: Systematic review, Clinical practice guidelines, Values of patients, Preferences of patients, and Updated knowledge.

## Principles and practice of EBRM

EBM is typically regarded as following the "5A" approach: Ask, Acquire, Appraise, Apply, and Assess [22]. The first

**Table 2:** Six steps and principles of Evidence-based rehabilitation medicine (EBRM).

| Steps | Principles | Description |
|---|---|---|
| 1 | Ask | Formulate clinical questions based on patient needs |
| 2 | Acquire | Retrieve relevant and up-to-date evidence |
| 3 | Appraise | Critically evaluate the quality and relevance of evidence |
| 4 | Apply | Apply the evidence to clinical decision-making |
| 5 | Assess | Evaluate the outcomes of rehabilitation interventions |
| 6 | Advance | Engage in continuous learning and improvement |

"Appraise" pertains to evaluating the evidence, while the second "Assess" pertains to evaluating outcomes. Since functional assessment is integral to rehabilitation, so the "Assess" of outcomes in EBRM is actually the evaluation of effects of rehabilitation. Due to the continuous updating of knowledge is one of an important element, EBRM should have 6 basic principles, also known as the "6A" principle, namely Ask, Acquire, Appraise, Apply, Assess, and Advance (As seen in Table 2).

# The development, practical process, and future of EBRM

## The development of EBRM from micro and macro perspectives

Micro rehabilitation medicine (Micro RM), also known as traditional RM, refers to non-systematic RM that primarily focuses on theoretical research in the field of rehabilitation. The discipline includes sixteen subfields: rehabilitation assessment, occupational therapy, physical therapy, speech therapy, rehabilitation engineering, psychological rehabilitation, musculoskeletal rehabilitation, neurological rehabilitation, orthopedic rehabilitation, internal medicine rehabilitation, geriatric rehabilitation, community rehabilitation, traditional Chinese medicine rehabilitation, educational rehabilitation, pediatric rehabilitation and rehabilitation nursing.

Macro rehabilitation medicine (Macro RM), also known as EBRM, on the other hand, represents systematic RM that emphasizes the evidence-based practice of RM. The discipline includes fourteen sub-fields: evidence-based education rehabilitation medicine (EBEDRM), evidence-based nursing rehabilitation medicine (EBNRM), evidence-based engineering rehabilitation medicine (EBENRM), evidence-based musculoskeletal rehabilitation medicine (EBMRM), evidence-based neurorehabilitation medicine (EBNM), evidence-based traditional Chinese rehabilitation medicine (EBTCRM), evidence-based internal rehabilitation medicine (EBIRM), evidence-based intensive care rehabilitation medicine (EBICRM), evidence-based geriatric rehabilitation medicine (EBGRM), evidence-based oncology rehabilitation medicine (EBORM), evidence-based cardiopulmonary rehabilitation medicine (EBCRM), evidence-based physical therapy medicine (EBPTM), evidence-based speech therapy medicine (EBSTM) and evidence-based occupation therapy medicine (EBOTM).

Based on the above perspectives, we propose a conceptual framework for the development of the EBRM discipline, as shown in Figure 1.

## The development of EBRM from the perspective of ICF

The International Classification of Functioning, Disability, and Health (ICF) is a framework that views health as a comprehensive concept beyond the mere focus on disease or bodily impairment. From the perspective of the ICF, the development of EBRM and its future direction can be seen through the following four trends: personalized rehabilitation [23], multidisciplinary cooperation and comprehensive rehabilitation [24, 25], community rehabilitation and environmental optimization [26, 27]. These trends align with the principles and framework of the ICF, which emphasizes a holistic perspective on health and functioning.

## The development of EBRM from the perspective of rehabilitation education

From the perspective of rehabilitation education, the development of EBRM plays a crucial role in driving advancements in this field. Internationally, evidence-based practice is recognized as a fundamental element of healthcare professional education [28]. However, existing research in rehabilitation education has predominantly focused on patient care and medical knowledge competencies and in the musculoskeletal and pain medicine content category [29]. There is limited exploration of how existing rehabilitation education can be reformed and developed to cultivate rehabilitation professionals with EBRM thinking and research capabilities.

We believe that the development of EBRM will have the following five impacts in the field of rehabilitation education: update of teaching content, improvement of teaching methods, cultivation of research skills, awareness of interdisciplinary collaboration, emphasis on lifelong learning. By

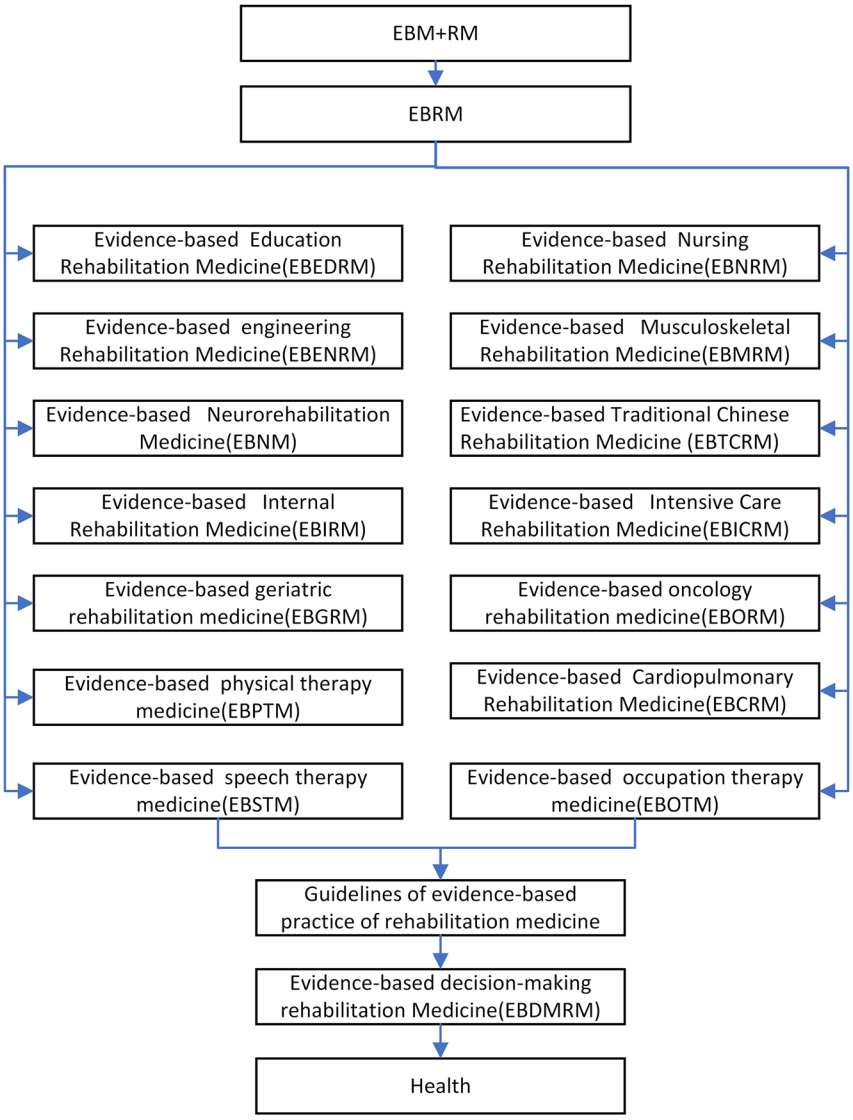


**Figure 1:** Conceptual framework for the development of evidence-based rehabilitation medicine (EBRM) discipline. EBM, evidence-based medicine; RM, rehabilitation medicine.

incorporating these impacts into rehabilitation education, professionals will be equipped with the necessary knowledge, skills, and attitudes to practice EBRM effectively.

## The development of EBRM from the perspective of scientific research dynamics

We retrieve electronic databases of PubMed, Cochrane Library, Embase, China national knowledge infrastructure (CNKI), and China science and technology journal (CSTJ). The keywords are: rehabilitation medicine and evidence based. The search was conducted from the establishment of the database to June 2023. The search results are shown in Figure 2, and the search strategy is shown in Supplementary Figure 1 (using PubMed as an example). To gather a broader range of literature, we simultaneously conducted searches in the physical collection of books and journals at the West China Clinical Medical Library of Sichuan University, spanning from the establishment of the library to June 2023. The summarized feature and quality assessment (the OCEBM method was used as an evaluation tool) of references cited in this paper as seen in Supplementary Table 5.

### Analyze the results of search and explore the development of EBRM

Through the database search, literature screening, and final selection, a total of 127 articles were included. After reviewing the abstracts or full texts of the articles, the research directions were classified and summarized. It was found that there were relatively more publications in the fields of EBMRM, EBNM, and EBEDRM. This indicates that

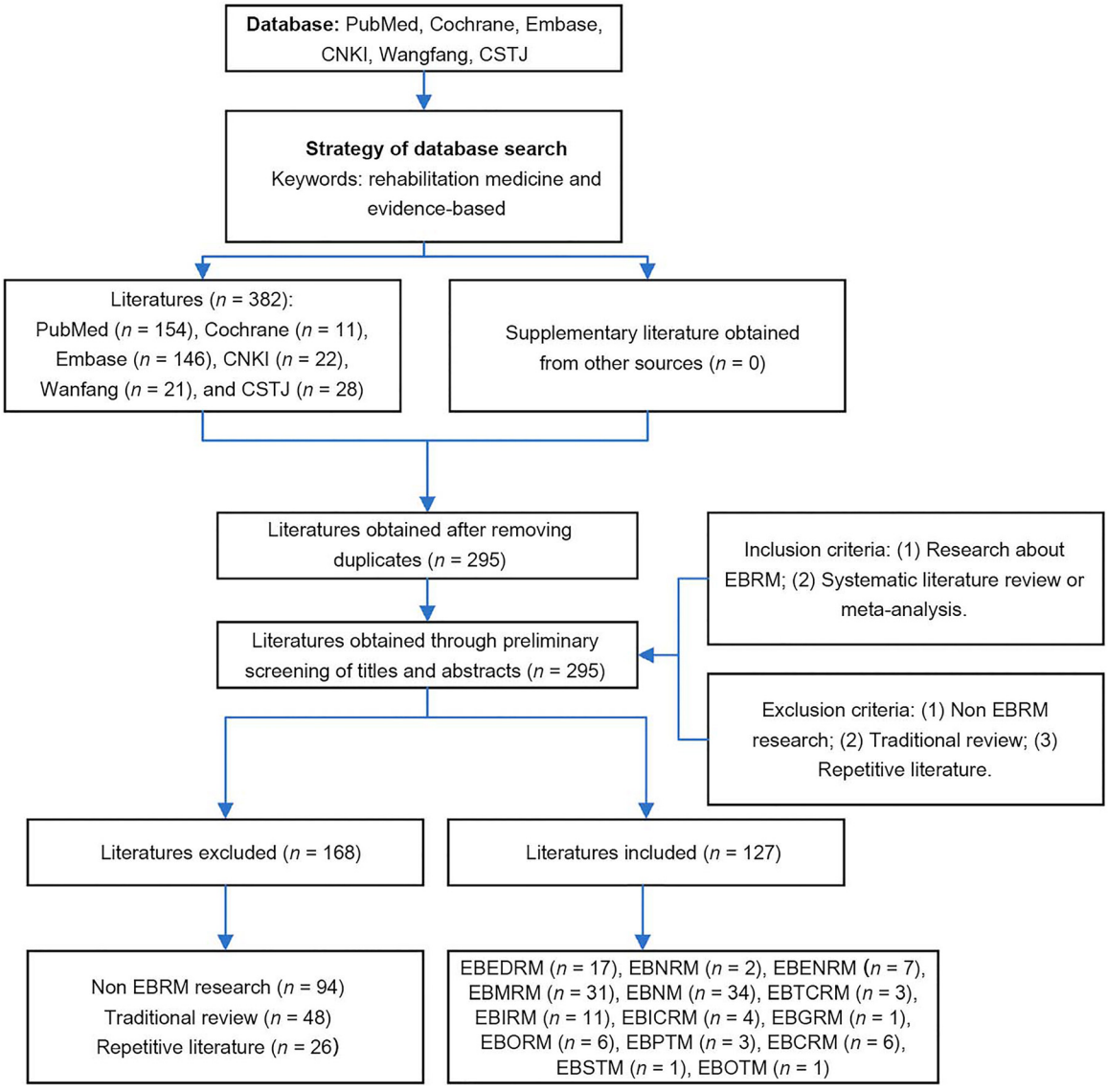


**Figure 2:** Results of database search. CNKI, China national knowledge infrastructure; CSTJ, China science and technology journal database; EBRM, evidence-based rehabilitation medicine; EBEDRM, evidence-based education rehabilitation medicine; EBNRM, evidence-based nursing rehabilitation medicine; EBENRM, evidence-based engineering rehabilitation medicine; EBMRM, evidence-based musculoskeletal rehabilitation medicine; EBNM, evidence-based neurorehabilitation medicine; EBTCRM, evidence-based traditional Chinese rehabilitation medicine; EBIRM, evidence-based internal rehabilitation medicine; EBICRM, evidence-based intensive care rehabilitation medicine; EBGRM, evidence-based geriatric rehabilitation medicine; EBORM, evidence-based oncology rehabilitation medicine; EBPTM, evidence-based physical therapy medicine; EBCRM, evidence-based cardiopulmonary rehabilitation medicine; EBSTM, evidence-based speech therapy medicine; EBOTM, evidence-based occupation therapy medicine.

EBRM in these three fields has shown good development, with a relatively high level of attention from scholars. On the other hand, the number of articles published in the fields of EBNRM, EBENRM, EBTCRM, EBIRM, EBICRM, EBGRM, EBORM, EBCRM, EBPTM, EBSTM and EBOTM were relatively small, indicating that the development of EBRM in these eleven fields is relatively slow. The following is a detailed introduction to the current development status of EBMRM, EBNM, and EBEDRM, and a summary development of EBNRM, EBENRM, EBTCRM, EBIRM, EBICRM, EBGRM, EBORM, EBCRM, EBPTM, EBSTM and EBOTM.

### The development of EBMRM

In the field of EBMRM, the main research focuses on osteoarthritis, osteoporosis and musculoskeletal pain, and also focuses on other conditions such as hip and knee replacements [30], hip fractures [31–33], pinal deformities [34–36], and muscular diseases [37, 38].

Ilieva et al. [39] proposed that the optimal management of osteoarthritis (OA) involves a combination of non-pharmacological and pharmacological approaches, which is a common theme among most evidence-based management guidelines for OA. Dincer [40] suggested that for patients with hand osteoarthritis (HOA), a combination of pharmacological and non-pharmacological treatments is preferable to alleviate pain and improve function. After reviewing the literature, Larmer et al. [41] emphasized the critical role of exercise and education for patients with OA. It is recommended to educate all patients with HOA on joint protection (how to avoid detrimental mechanical factors), particularly before engaging in exercise and ultrasound therapy. Additionally, strengthening exercises within the range of joint motion and local heat application (such as paraffin treatment) are advised [42]. Valero-Alcaide et al. [43] found strong evidence supporting the use of exercise and physical therapy as conservative treatments for hip osteoarthritis. Additionally, PRP (platelet-rich plasma) injections are becoming increasingly common for treatment of OA. Loew et al. [44] conducted a study indicating that aerobic walking therapy could improve pain, quality of life, and functional status in patients with knee osteoarthritis (KOA). However, Wu et al. [45] found a lack of evidence in EBM regarding the use of backward walking, also known as retro-walking, despite its potential benefits in symptom improvement, rehabilitation, and adjunctive treatment for KOA.

Regarding osteoporosis (OP), Oral et al. [46] suggested that existing evidence indicates a wide range of interventions within the scope of RM that may be effective in preventing and/or managing OP and its sequelae. These interventions encompass strategies of prevention (including education and self-management, with exercise being of utmost importance), strategies of pain management, and the use of spinal orthoses or hip protectors. Marchenkova [47] analyzed the rehabilitation treatment of elderly patients with osteoporotic vertebral fractures and found that a comprehensive medical rehabilitation plan, including physical exercise, physiotherapy, and orthotics, could significantly improve patients' functionality.

Pain is a common complaint among patients undergoing rehabilitation, and existing evidence suggests that the role of physical therapists in pain management is justified [48]. Individuals with musculoskeletal pain issues are often overlooked, and their concerns are frequently misunderstood by healthcare providers, leading to a lack of timely or effective treatment. In response to this, Walsh et al. [49] had developed international standards for the care of acute and chronic musculoskeletal pain. Gebremariam et al. [50] argued that for patients with subacromial impingement syndrome, due to the potentially lower risks of complications, conservative treatment may be preferred and more beneficial. Low back pain (LBP) is a common condition in RM, and according to Golec et al. [51], there is moderate evidence supporting the implementation of clinical practice guideline principles to improve pain and disability ratings in nonspecific LBP patients. Hilde et al. [52] suggested that active engagement in daily activities within the limits allowed by LBP is important, while Le Blay [53] found strong evidence supporting the use of functional recovery programs for treating LBP. Malfliet et al. [54] recommended tailoring exercise modalities to the preferences and abilities of patients with LBP, highlighting that combining exercise interventions with a psychological component yields better results that are sustained over time. For patients with carpal tunnel syndrome, Huisstede et al. [55] found that surgical treatment appears to be more effective than splinting or nonsteroidal anti-inflammatory drugs with hand therapy in the medium to long term. However, there is no clear evidence favoring one surgical treatment over another, and further research is needed to investigate conservative surgical treatment options, taking into account the optimal timing of surgery. Regarding musculoskeletal disorders of the hand (trigger finger, Dupuytren's disease, and De Quervain's disease), Huisstede et al. [56] suggested that some interventions have shown efficacy for these conditions. However, due to the limited number of RCTs, it is difficult to draw definitive conclusions, highlighting the need for high-quality studies in this field. Generalized and regional soft tissue pain syndromes pose significant challenges in terms of functional loss and disability, leading to a substantial societal burden. Consensus on the optimal management of complex regional pain syndrome (CRPS) in adults has not yet been reached. Ferraro et al. [57] suggest that, based on current evidence, it is difficult to determine which therapies should be used for the exact and effective relief of pain, disability, or both. However, Oral et al. [58] argued that for CRPS, strong evidence supports the use of interventions such as repetitive transcranial magnetic stimulation (rTMS), spinal cord blockade, and stimulation to alleviate pain. They also emphasize the importance of functional-oriented assessment and management of the disease by rehabilitation physicians, using the ICF as a reference, to effectively meet the needs of patients with soft tissue pain syndromes. For patients with musculoskeletal disorders and injuries, Oral et al. [59] proposed that developing rehabilitation programs based on the ICF could ultimately improve the quality of life for this patient population.

### The development of EBNM

In the field of EBNM, the main focus is stroke, traumatic brain injury (TBI), spinal cord injury (SCI), and other neurological disorders (including spinal malformations [60]), cognitive rehabilitation [61–63], hereditary ataxia syndromes [64], vestibular migraines [65], multiple sclerosis [66, 67], amyotrophic lateral sclerosis [68], neuropathic pain [69], Angelman syndrome [70], etc. The following provides a brief overview of the research progress in EBNM for stroke, TBI and SCI.

Elsner et al. [71] found that transcranial direct current stimulation (tDCS) could improve activities of daily living in post-stroke patients, but it does not improve the function of arm and leg, muscle strength, and cognitive abilities. Gambito et al. [72] updated the rehabilitation guidelines for stroke and suggested that they can be effectively utilized by guideline implementers in developing countries. Gonzalez-Suarez et al. [73] further discovered that non-adherence to stroke care of EBRM significantly increases the risk of medical complications such as cardiovascular events, pneumonia, pressure ulcers, and venous thrombosis. Gor-García-Fogeda et al. [74] identified the shortened version of the Fugl-Meyer assessment as the most suitable functional assessment tool for stroke patients. Early rehabilitation is crucial after stroke, but Langhorne et al. [75] found that initiating intensive activity within 24 h of stroke onset may pose some risks. In the realm of stroke-related sexual dysfunction rehabilitation, Stratton et al. [76] found that the effectiveness of three treatment methods (sildenafil, structured rehabilitation, and pelvic floor therapy) requires further validation. Based on their study, Küçükdeveci et al. [77] emphasized that rehabilitation physicians need to consider all impairments, comorbidities, and complications, as well as activity limitations, participation restrictions, and personal and environmental factors, in order to develop and manage comprehensive rehabilitation plans for stroke survivors. Hubbard et al. [78] conducted a study and found that rehabilitation facilities that offer evidence-based management are more likely to provide better rehabilitation outcomes for patients with stroke. Andan encouraging trends in the healthcare sector regarding improvements in service delivery for patients with stroke [79].

Brown et al. [80] identified that current systematic reviews for patients with traumatic brain injury (TBI) cover a wide range of topics but mainly focus on executive function, community integration, mental health, and pharmacological interventions. They highlighted the limitations of research designs in the field of RM, which restricts the utility of study findings in evidence-based practice. Kurnakova et al. [81] found that the use of various forms of physical exercise, neuromuscular stimulation, and robot-assisted training in rehabilitation is a prominent trend in evidence-based research for patients with TBI. Manaseer et al. [82] discovered that individuals with concussion may exhibit more frontal plane sway and slower walking compared to healthy controls. They also emphasized the need for high-quality prospective cohort studies to assess gait changes from concussion to recovery of activities, movement, recreation, and/or work. Following their study, Weddelll [83] suggested that reducing criticism from family members of patients with TBI may lead to improved rates of psychiatric recovery.

Spinal cord injury (SCI) is a devastating disease that presents a challenge to every healthcare system and society. Kurnakova et al. [84] conducted research that identified a set of effective techniques, including physical activity, pulse electrical therapy, and robot-assisted therapy, which could improve the functional abilities of patients with SCI. Rapidi et al. [85] found that rehabilitation physicians with expertise in interdisciplinary teams working in various environments could enhance the functional outcomes of patients with SCI through comprehensive rehabilitation programs. Sadeghi et al. [86] discovered that although whole-body vibration and focal vibration may reduce spasms in the short term, there is currently no evidence-based guidance in the literature to guide rehabilitation clinicians on the use of vibration applications for spasticity management for patients with SCI. Regan et al. [87] highlighted the lack of research on pressure ulcer preventive interventions specific to SCI, despite the cost-effectiveness of pressure ulcer prevention being well-established.

### The development of EBEDRM

In the field of EBEDRM, research is primarily focused on educational methodologies. Brown et al. [88] had developed methodological guidelines for rehabilitation researchers to conduct high-quality systematic literature reviews. Moore et al. [89] emphasized the importance of knowledge translation in the practice of EBRM. Negrini et al. [90] highlighted knowledge translation as a bridge in EBRM, facilitating the dissemination of evidence. Dijkers et al. [91] described the development of knowledge translation as a new art and science that facilitates the feasibility of services in EBRM. Sander et al. [92] emphasized that the translation of evidence helps in translating research findings into clinical practice.

It is crucial to educate rehabilitation professionals on how to utilize high-quality evidence and develop and evaluate contemporary best practices to improve rehabilitation practice [93]. Teaching the foundational knowledge of scientific research in physical medicine and rehabilitation education could assist physicians and therapists in selecting treatment methods based on (new) scientific

evidence [94]. Neumann et al. [95] found that rehabilitation physicians play a crucial role in interdisciplinary teams, and training in strategies of EBRM, knowledge, and critical analysis is essential for diagnosing and assessing health issues and ensuring safe interventions. Drefs et al. [96] emphasized the urgent need for interdisciplinary evidence-based continuing professional education, particularly in advanced stroke rehabilitation. And suggested that various online education approaches focused on evidence-based practices in each domain, providing high-quality credits, could meet the diverse needs of practicing rehabilitation professionals [97]. Hunter et al. [98] enabled rehabilitation professionals to use evidence-based methods to understand, assess, and treat pain conditions by offering an online graduate-level education program that grants a certificate in pain management.

**The development of EBNRM, EBENRM, EBTCRM, EBIRM, EBICRM, EBGRM, EBORM, EBCRM, EBPTM, EBSTM and EBOTM**

EBNRM primarily focuses on the rehabilitation of patients with TBI [99], while EBENRM centers on the application of footwear [100–102], prosthetic limbs [103], arch support [104], and power wheelchairs [105]. EBTCRM primarily emphasizes traditional Chinese exercise therapy [106] and acupuncture [107, 108]. The rehabilitation management covered in EBITRM includes blood lead toxicity in patients with retained missiles [109], obesity [110], chronic obstructive pulmonary disease [111], chronic respiratory conditions [112], low hematocrit in the acute rehabilitation setting [113], Behçet's disease [114], patients with methylmalonic acidemia [115], secondary Raynaud's phenomenon [116], COVID-19 [117] and frailty syndrome [118]. EBICRM focuses on improving post-intensive care outcomes [119], clinical practice of assessment scales for disorders of consciousness [120], early rehabilitation of adults with veno-venous extracorporeal membrane oxygenation [121], and bundled care for patients with dysphagia after severe TBI [122].

EBGRM primarily addresses the needs of aging people with disabilities [123]. EBORM focuses on disability in patients with advanced cancer [124], high-quality rehabilitation care, and rehabilitation for patients with cancer [125, 126]. EBCRM centers on specific exercise rehabilitation for atrial fibrillation [127], a modified Delphi process for phase II cardiac rehabilitation programs [128], internet-based interventions for the secondary prevention of coronary heart disease [129], digital platforms for supporting cardiovascular disease self-management [130], a consensus procedure using a Delphi process for cardiovascular conditions [131], and cardiac rehabilitation services for patients with colorectal cancer [132].

EBPTM primarily concentrates on functional electrical stimulation [133], evaluation of practice and innovation in rehabilitation using the ideal-physio framework [134], and extracorporeal shock wave therapy [135]. EBSTM mainly delves into important factors in health-related quality of life for people with aphasia [136]. EBOTM is primarily concerned with vocational rehabilitation intervention (the rejoin intervention) to support people with cancer in remaining employed [137].

## Conclusions

The development of the 14 sub specialties of EBRM is not balanced, among which EBMRM, EBNM, and EBEDRM have a relatively well developed. The research direction of EBMRM mainly focuses on osteoarthritis, osteoporosis, and musculoskeletal pain. EBNM is mainly concentrated in stroke, TBI, and SCI. The research direction of EBEDRM mainly focuses on educational methodology. The development of EBNRM, EBENRM, EBTCRM, EBIRM, EBICRM, EBGRM, EBORM, EBCRM, EBPTM, EBSTM and EBOTM are relatively slow, these eleven fields should be pay more attention in future.

## Limitations and advances

This study has some limitations and advances. Firstly, it is important to note that this research is merely a literature review and did not include a Meta-analysis. As a result, there was no assessment of the evidence levels for the retrieved literature. Secondly, our search was limited to the keywords "Rehabilitation medicine and evidence-based," which might have led to the omission of various rehabilitation treatment methods and a wide range of medical conditions. Consequently, some relevant literature might have been overlooked, although this does not undermine the central idea of the paper. Despite these limitations, the study was the initial time to systematic clarifies the definition, foundation and practice of EBRM. The study may provide valuable insights into the overall development of EBRM, offering useful guidance to future researchers.

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**Informed consent:** Not applicable.
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