



DESCRIPTION OF HEALTH-RELATED REHABILITATION SERVICE PROVISION AND DELIVERY IN RANDOMIZED CONTROLLED TRIALS: A TOPIC REVIEW

Nada ANDELIC, MD, PhD^{1,2*}, Juan LU, MD, PhD^{3*}, Christoph GUTENBRUNNER, MD, PhD, FRCP⁴, Boya NUGRAHA, MS, PhD⁴, Mirinda GORMLEY, PhD³, Helene L. SØBERG, PT, PHD², Unni SVEEN, OT, PHD², Audny ANKE, MD, PhD^{1,5,6}, Marit KIRKEVOLD, RN, EdD^{1,8} and Cecilie RØE, MD, PhD^{1,2,7}

From the ¹Research Centre for Habilitation and Rehabilitation Models and Services (CHARM), Institute of Health and Society, Faculty of Medicine, University of Oslo, ²Department of Physical Medicine and Rehabilitation, Oslo University Hospital, Oslo, Norway, ³Department of Family Medicine and Population Health, Division of Epidemiology, Virginia Commonwealth University, Richmond, VA, USA, ⁴Department of Rehabilitation Medicine, Hannover Medical School, Hannover, Germany, ⁵Department of Rehabilitation, University Hospital of North Norway, ⁶Department of Clinical Medicine, Faculty of Health Sciences, UiT, The Arctic University of Norway, Tromsø, ⁷Institute of Clinical Medicine, Faculty of Medicine, University of Oslo and ⁸Institute of Nursing and Health Promotion, Oslo Metropolitan University, Oslo, Norway. *These authors contributed equally.

Objective: To determine how health-related rehabilitation services have been described in recently published randomized clinical trials, using the International Classification System for Service Organization in Health-Related Rehabilitation (ICSO-R 2.0) as a framework.

Methods: Medline was searched for English-language randomized clinical trials (RCTs) published between 1 January 2018 and 31 December 2018. RCTs were eligible if the primary goal was to provide rehabilitation services to targeted patient populations. Two authors independently screened and extracted data, and assessed the methodological quality of eligible trials. Descriptive analysis was used to compare service descriptions between eligible trials and the ICSO-R 2.0 framework (23 categories, 9 categories for provider, 14 categories for delivery).

Results: Twenty-nine RCTs, with a wide range of organizational units and target groups, were included. The median number of categories reported in the provider dimension was 4 (range 3–5). The median number of categories reported in the service delivery dimension was 8 (range 6–12). None of the RCTs described all ICSO-R recommended categories.

Conclusion: Descriptions of service organization in rehabilitation varied widely among recently published randomized clinical trials. Use of the framework for the classification of service organization and standardization of description of services is recommended in future RCTs, to facilitate better comparisons in service research across studies.

Key words: rehabilitation; health service; clinical trial; international classification; International Classification System for Service Organization in Health-Related Rehabilitation.

Accepted Aug 3, 2020; Epub ahead of print Aug 18, 2020

J Rehabil Med 2020; 52: 000093

Correspondence address: Nada Andelic, Research Centre for Habilitation and Rehabilitation Models and Services (CHARM), Institute of Health and Society, Faculty of Medicine, University of Oslo, Oslo, Norway. E-mail: nada.andelic@medisin.uio.no

Health-related rehabilitation aims to enable people with health conditions experiencing and likely to

LAY ABSTRACT

The aim of this review was to determine how health-related rehabilitation services have been described in randomized controlled trials published in 2018, using the International Classification System for Service Organization in Health-Related Rehabilitation (ICSO-R 2.0) as a framework. A total of 29 randomized controlled trials that met the inclusion criteria were identified. The description of service organization in rehabilitation varied widely among recently published randomized controlled trials. None of the randomized controlled trials reviewed described all ICSO-R 2.0 categories of provider and service delivery. In general, this review found that only half of the recommended categories of provider and service delivery dimensions were reported frequently in the reviewed literature. Future randomized controlled trials should use the framework for classification of service organization and for standardization of descriptions of services, in order to facilitate better comparisons in service research across studies.

experience disability to achieve optimal functioning in interaction with the environment (1, 2). Thus, rehabilitation aims to maximize an individual's ability to live, work, and learn in one's living environment (3). Rehabilitation services must meet needs at different stages of disease and injury and deliver appropriate rehabilitation and interventions that ensure functional recovery and promote well-being (4, 5). Rehabilitation services are complex and differ in approach and set-up. Variations in service provision also exist due to context (i.e. geographical region, culture and available resources) (6–9). Successful rehabilitation should be person-centred and involve service users, their peers and families at all stages of the process (10). However, services are often developed in an *ad hoc* way in response to immediate rehabilitation needs within a budget, leading to inequality or lack of consistency in service provision (4). A possible reason for this has been a lack of conceptual models that can be used to guide and classify health-related rehabilitation service provisions in terms of organizational setting, technical and human resources, and goals (11).

The recently developed International Classification System for Service Organization in Health-Related Rehabilitation (ICSO-R) and its revised version (ICSO-R 2.0) aim to provide uniform criteria to describe and classify rehabilitation services at the meso-level of health-care (i.e. the organization and availability of services) (12–14). The ICSO-R 2.0 consists of 2 dimensions, “provider delivery” and “service delivery”, each with a more extensive list of categories and subcategories that characterize rehabilitation service organization (15). The provider dimension describes the framework of the organizational units, with the primary goal of providing rehabilitation services, and could be applied to describe where, by whom, and in which context the service is delivered (13, 15). The service delivery dimension contains interventions, procedures and devices provided to the service users within the context of the provider, and can be used to describe what and how services are delivered and for what reason (13, 15).

Clinical trials in the field of rehabilitation have been used as evidence-based medical decision-making tools to evaluate treatment effectiveness. In 2020, Gutenbrunner & Nugraha proposed including health system and organization as a fourth factor in the evidence-based medical decision-making process (16). This process considers the health system and organizational factors when evaluating the outcomes of a clinical trial. In clinical trials evaluating rehabilitation service provision, many factors, such as health professionals, facilities, service availability, diagnostic and treatment devices, and other aspects are covered by the ICSO-R 2.0. Therefore, by comparing service descriptions between clinical trials and the framework of ICSO-R 2.0, it is possible not only to provide insight into service provision research, but it is also feasible to appraise service descriptions systematically in the field of health-related rehabilitation. Hence, the aim of this study was to determine how these factors were described in recently published randomized clinical trials (RCTs) in the field of rehabilitation, using the framework of the ICSO-R 2.0.

METHODS

Literature search and study selection

A Medline search was performed for articles published between 1 January and 31 December 2018, among indexed English-language studies, to identify eligible RCTs in the field of health-related rehabilitation. The search strategy included the following terms:

- “rehabilitation” [Subheading] OR “rehabilitation” [All Fields] OR “rehabilitation” [MeSH Terms] AND
- “health services” [MeSH Terms] OR (“health” [All Fields] AND “services” [All Fields]) OR “health services” [All Fields] AND
- “rehabilitation centre” [All Fields] OR “rehabilitation cen-

- ters” [MeSH Terms] OR (“rehabilitation” [All Fields] AND “centers” [All Fields]) OR “rehabilitation centers” [All Fields] OR (“rehabilitation” [All Fields] AND “center” [All Fields]) OR “rehabilitation center” [All Fields] AND
- “hospitals, rehabilitation” [MeSH Terms] OR (“hospitals” [All Fields] AND “rehabilitation” [All Fields]) OR “rehabilitation hospitals” [All Fields] OR (“rehabilitation” [All Fields] AND “hospital” [All Fields]) OR “rehabilitation hospital” [All Fields] AND
- “randomized controlled trial” [Publication Type] OR “randomized controlled trials as topic” [MeSH Terms] OR “randomized clinical trials” [All Fields] OR “randomized clinical trials” [All Fields] AND
- 2018 [All Fields] AND
- Clinical Trial [ptyp].

All RCT reports published during the study period were eligible if the primary goal was to report the effectiveness of the rehabilitation interventions, and if the trials comprised rehabilitation programmes or services used in the targeted patient population. The RCTs were excluded if the primary objective was not to provide rehabilitation services. Based on the defined eligibility, 2 authors (NA and JL) independently screened the studies and finalized the study selection. Discrepancies between the 2 authors were evaluated, and a consensus was reached for the results. Fig. 1 presents the study selection process via the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommended flowchart (17).

Data extraction

A standardized protocol and a data extraction sheet were developed to extract the relevant information from each original report and compare the data with the provider and service delivery dimensions and corresponding categories, as proposed by ICSO-R 2.0 (15). Prior to the formal data extraction process, the authors (NA and JL) extracted data and studied the concepts of the recommended service description items. All discrepancies were resolved through consensus or through consulting other co-authors.

According to the ICSO-R 2.0, the provider dimension is defined as “organizational units with the primary goal of providing rehabilitation services”, consisting of 9 categories: context, ownership, location, governance/leadership, quality assurance and

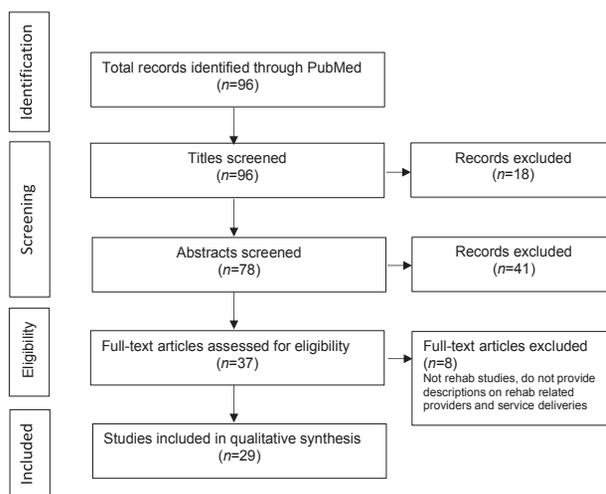


Fig. 1. Study selection process.

management, human resources, technical resources, funding of provider, and other categories of provider. The service delivery dimension is defined as the provision of “A set of products (interventions, procedures, devices, and pharmaceuticals, etc.) to a specified group of individuals (patients, informal caregivers, and/or other users and clients), aiming at achieving or maintaining optimal functioning (rehabilitation) within an organizational context (provider)”. This dimension describes the characteristics of service delivery, including 14 categories: health strategies, service goals, target groups, modes of referral, location of services delivery, facility, setting, integration of care, patient-centredness, aspects of time and intensity, rehabilitation team, reporting and documentation, funding of service delivery, and other categories of service delivery. A set of pre-defined inclusion and exclusion criteria is included in 2 ICSO-R 2.0 dimensions for corresponding categories and subcategories (15). The outcome measurements from the selected studies were reported along with the dimensions of the International Classification of Functioning, Disability and Health (ICF) (Body Function, Activity and Participation, and Environmental Factors) (18).

Methodological quality assessment

The methodological quality of all 29 eligible RCTs was assessed independently by 2 authors (NA and JL), with the assessment items set out by Cicerone et al. (19). The original 16 items were developed to assess the quality of RCTs on cognitive rehabilitation in patients with a traumatic brain injury. This study selected 10 items that were relevant to the current study objective:

- specified eligibility criteria;
- described method of randomization;
- concealed treatment allocation;
- described interventions;
- blinded outcome measurements;
- described withdrawal or dropout;
- sample size description;
- intention-to-treat analysis;
- point estimate and variability;
- statistical comparison treatment effects.

Based on a total score of 10, the methodological quality was classified as “high”, “moderate” or “low” for RCTs receiving a score of 9–10, 6–8 or 5 or less, respectively.

Data analyses and synthesis

Data on the characteristics and methodological quality of the eligible RCTs are summarized descriptively, e.g. the continuous variables were summarized as means and standard deviations or medians and ranges, as appropriate, and discrete variables were presented as frequencies and percentages. The information regarding the recommended ICSO-R 2.0 service descriptions is presented in tables/figures based on the provider and service delivery dimensions by category and subcategory under each dimension and methodological quality of RCTs. All data analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC, USA).

RESULTS

Characteristics of included randomized controlled trials

A total of 29 eligible RCTs were included in the current review (20–48). Most of the studies (79%) were con-

ducted in hospital settings or independent rehabilitation units. Table I illustrates the descriptive summary of the characteristics of all RCTs. Overall, 21% were pilot RCTs, and 79% were RCTs. A majority of the RCTs (86%) used a parallel design, and the rest were crossover (10%) or clustered designs (4%). Approximately one-third of the RCTs (31%) were multi-centred studies, and the remainder (69%) were single-centred studies. The target patient groups from these studies were patients with neurological disorders, such as stroke or chronic stroke (62%), musculoskeletal conditions (14%), heart diseases (14%), lung diseases (7%) and elderly patients (3%). The size of the RCTs ranged widely from 15 to 914 subjects. Most of the studies (76%) had fewer than 100 participants. Half of the studies were conducted in Europe (52%). The remaining studies were conducted in Asia (34%) and the USA or Canada (14%). Using the Methodological Quality Assessment criteria (19), 55% of the RCTs were rated as of high methodological quality, 38% were rated as of moderate quality, and 7% of low quality. The details of the methodological quality evaluations are shown in Table SI¹.

¹<https://doi.org/10.2340/16501977-2726>

Table I. Study characteristics (*n* = 29)

Characteristics	
Trial phase, %	
Pilot randomized controlled trial	21
Randomized controlled trial	79
Trial design, %	
Parallel	86
Cross-over	10
Cluster	4
Study participation centre, %	
Single	69
Multiple	31
Total sample size, range	15–914
Targeted population, %	
Neurological disorder	62
Muscular conditions	14
Heart disease	14
Lung disease	7
Elderly	3
Study location, %	
Europe	52
North America	14
Asia	34
Methodological quality*, %	
High	55
Moderate	38
Low	7
Report on 9 categories of ICSO-R provider dimension	
Median number	4
Minimum–Maximum	3–5
Report on 14 categories of ICSO-R service delivery dimension	
Median number	8
Minimum–Maximum	6–12

*Modified risk of bias assessment, based on Cicerone KD et al. 2009, 10 items were assessed. Each item represents 1 point; studies were scored 9–10 points, 6–8 points, or 5 points or below, and were considered as high, moderate or low quality, respectively.

The median number of corresponding provider categories reported by all 29 RCTs was 4 (range 3–5) out of 9 possible categories. The median number of the corresponding service delivery categories was 8 (range 6–12), out of 14 possible categories. A similar pattern was found in median numbers of reported provider and service delivery categories in high-quality studies (4 and 8), and these were somewhat higher than the median numbers reported in moderate-quality studies (3.5 and 7). None of the RCT reports described all ICSO-R recommended categories for either the provider or service delivery dimension.

Report on the provider dimension

Fig. 2 and Table II show provider dimension descriptions from all RCTs compared with the ICSO-R 2.0. Of the 9 possible categories, 1.1 Context and 1.3 Location were described by all trials (100%). The categories 1.6 Human Resources (86%) and 1.7 Technical Resources (79%) were also reported frequently. For the category 1.1 Context, most trials were performed in rehabilitation hospitals, clinics, or centres (55%); multiple settings (17%); or the community (7%). Category 1.6 Human Resources primarily reports different types of healthcare providers, such as physicians, nurses, physical therapists and occupational therapists, among others. Finally, the category 1.7 Technical Resources predominantly includes equipment and infrastructure, such as therapeutic and assistive devices and technical infrastructure.

Only one study reported public ownership for Item 1.2 Ownership. The assessed trials did not report the following categories:

- 1.4 Governance/Leadership and its subcategories 1.4.1 Mission, 1.4.2 Vision and 1.5 Quality Assurance and Management;
- 1.5 Quality assurance and management;
- 1.8 Funding of Provider and its subcategories 1.8.1 Source of Money and 1.8.2 Criteria of Spending; and
- 1.9 Other Categories of Provider.

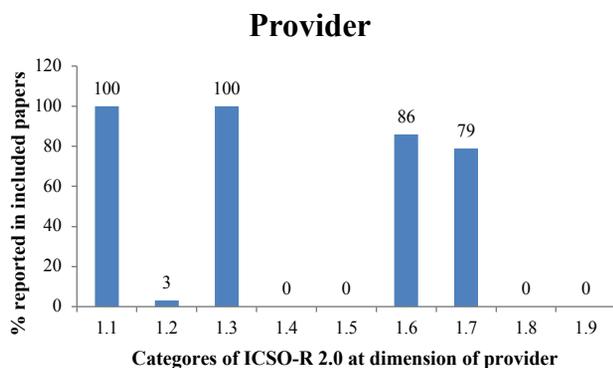


Fig. 2. Categories of ICSO-R 2.0 at dimension of provider.

Report on the service delivery dimension

Fig. 3 and Tables III and IV present information from all trials that address the proposed service delivery categories. Out of all 14 categories, the categories 2.2 Service Goals, 2.3 Target Groups, 2.10 Aspect of Time and Intensity, and 2.12 Reporting and Documentation were reported by all RCTs. The categories 2.7 Setting (93%), 2.11 Rehabilitation Team (90%), and 2.13 Funding of Service Delivery (69%) were also reported frequently. The categories 2.4 Modes of Referrals (55%), 2.5 Location of Service Delivery (21%), 2.6 Facility (17%), 2.8 Integration of Care (28%) and 2.9 Patient-Centeredness (52%) were reported less often. Only one of the selected RCTs reported 2.1 Health Strategies (other than rehabilitation), whereas none of the studies reported 2.14 Other Categories of Service Delivery.

The results show that all studies reported recovery and improvement in functioning or health status as the goals of the services (2.2 Service Goals). Item 2.3.1 Target Group-Health Conditions includes patients primarily exhibiting neurological conditions (62%), including stroke (55%), with an age range of 20–87 years. Only 3 studies directly reported the level of care (2.7.1), either tertiary or secondary. In 2.7.2 Mode of Service Delivery, most services were delivered through inpatient (28%), outpatient (34%), multiple settings (17%) and at home (3%). The most frequent types of care (2.7.3 Phase of Health Care) were post-acute and chronic rehabilitation (58%), followed by acute rehabilitation (14%) and subacute rehabilitation (14%).

The subcategories of rehabilitation teams (2.11.1 Professions) includes physicians and physiotherapists. In addition, 2.11.2 Interaction Approach was described in only 38% of the studies (e.g. multi-professional team (17%) and counselling (14%)). Regarding 2.12 Reporting and Documentation, most primary and secondary outcome measurements could be linked to the body function and body activities of the ICF. Furthermore, 24% of the studies reported measurements of

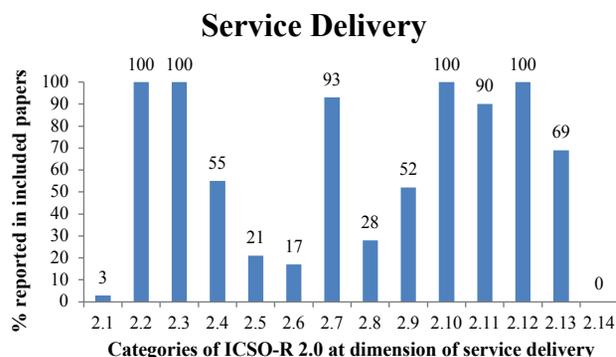


Fig. 3. Categories of ICSO-R 2.0 at dimension of service delivery.

Table II. Current rehabilitation-related randomized controlled trial reports vs International Classification of Service Organizations in Rehabilitation (Version 2)'s recommendations regarding descriptions of service providers*

RCTs (n=29)**	Descriptions of service providers								
	1.1 Context	1.2 Ownership	1.3 Location of the provider	1.4 Governance/ leadership	1.5 Quality assurance & management	1.6 Human resources	1.7 Technical resources	1.8 Funding of provider	1.9 Other categories of provider
Fossat et al. (20), 2018 ^H	A regional hospital, multipurpose ICU	No	Orléans, France	No 1.4.1 No 1.4.2 No 1.4.3 No	No	No	Therapeutic devices (early in-bed cycling, electrical stimulation)	No 1.8.1 No 1.8.2 No	No
Peng et al. (21), 2018 ^H	Multiple (a teaching hospital and patients' home)	No	Chengdu, China	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (PTs, cardiac and psychiatric nurses)	Other – telehealth infrastructure	No 1.8.1 No 1.8.2 No	No
Schuster-Amft et al. (22), 2018 ^H	Multiple (3 university rehabilitation hospitals, outpatient departments)	No	Switzerland	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (Experienced PTs/OTs)	Technical infrastructure (virtual reality-based training system)	No 1.8.1 No 1.8.2 No	No
Tanaka et al. (23), 2018 ^M	A rehabilitation hospital	No	Hiroshima, Japan	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (attending physicians, PTs)	Assistive devices (external robot)	No 1.8.1 No 1.8.2 No	No
Fotakopoulos & Kotila (24), 2018 ^L	A university hospital, rehabilitation centre	No	Greece	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (physicians)	Diagnostic devices (CT – cerebral blood flow)	No 1.8.1 No 1.8.2 No	No
Kim et al. (25), 2018 ^H	A rehabilitation center	Public (National rehabilitation center)	Seoul, South Korea	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (PT/OT)	Assistive devices - exoskeleton system	No 1.8.1 No 1.8.2 No	No
Charususin et al. (26), 2018 ^H	Multiple hospitals	No	Belgium Canada Netherlands Germany	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (health professionals)	Diagnostic and therapeutic devices (breath device, cycling and treadmill)	No 1.8.1 No 1.8.2 No	No
Erbil et al. (27), 2018 ^M	Physical medicine and rehabilitation of medical school, outpatient clinic	No	Kocaeli, Turkey	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (health professionals)	Therapeutic and assistive devices (orthosis, weight support, treadmill, biofeedback)	No 1.8.1 No 1.8.2 No	No
Cha et al. (28), 2018 ^H	A rehabilitation hospital, inpatient unit	No	Daejeon, Korea	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (rehabilitation staff members)	Therapeutic and assistive devices (sensor pre-set, auditory feedback device)	No 1.8.1 No 1.8.2 No	No
Klomjai et al. (29), 2018 ^M	A university	No	Thailand	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (researcher, PT)	Therapeutic and assistive devices (transcranial direct current stimulation)	No 1.8.1 No 1.8.2 No	No
Martens et al. (30), 2018 ^M	Home, nursing homes and rehabilitation facilities	No	Belgium, France Luxembourg	No 1.4.1 No 1.4.2 No 1.4.3 No	No	No	Therapeutic and assistive devices (transcranial direct current stimulation)	No 1.8.1 No 1.8.2 No	No
Zintchouk et al. (31), 2018 ^H	Two community rehabilitation units	No	Aarhus, Denmark	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (geriatrician, community nurses, assistant nurses, PTs, OTs, and nutritionists)	No	No 1.8.1 No 1.8.2 No	No
Hsieh et al. (32), 2018 ^M	Six hospitals	No	Taiwan	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (therapists)	Therapeutic and assistive devices (robotic devices)	No 1.8.1 No 1.8.2 No	No
Chen et al. (33), 2018 ^M	A hospital (general wards, ICU, out-patient department)	No	Taipei, Taiwan	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (cardiologist, PTs, nurses)	No	No 1.8.1 No 1.8.2 No	No
Manji et al. (34), 2018 ^M	A rehabilitation Hospital	No	Japan	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (physicians)	Technical devices (transcranial direct current stimulation Treadmill)	No 1.8.1 No 1.8.2 No	No

Table II *cont.*

RCTs (n=29)**	Descriptions of service providers								
	1.1 Context	1.2 Ownership	1.3 Location of the provider	1.4 Governance/ leadership	1.5 Quality assurance & management	1.6 Human resources	1.7 Technical resources	1.8 Funding of provider	1.9 Other categories of provider
Wu et al. (35), 2018 ^H	A tertiary hospital (Outpatient rehabilitation department)	No	Taiwan	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (physiatrist, investigator)	Technical devices (Extracorporeal shock waves)	No 1.8.1 No 1.8.2 No	No
Cho et al. (36), 2018 ^H	A hospital	No	Seoul, Republic of Korea	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (PTs, research staff)	Therapeutic equipment (breath device)	No 1.8.1 No 1.8.2 No	No
Sunamura et al. (37), 2018 ^H	A cardiac rehabilitation centre	No	Rotterdam, Netherlands	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (specialized nurses)	No	No 1.8.1 No 1.8.2 No	No
Munari et al. (43), 2018 ^H	A university hospital, Neurorehabilitation unit	No	Verona, Italy	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (physicians)	Technical infrastructure (Heart rate monitors, treadmill)	No 1.8.1 No 1.8.2 No	No
Maciaszek (44), 2018 ^M	A neurological rehabilitation unit	No	Poland	No 1.4.1 No 1.4.2 No 1.4.3 No	No	No	Therapeutic infrastructure (posturographic platform)	No 1.8.1 No 1.8.2 No	No
Lewthwaite et al. (45), 2018 ^M	Seven independent outpatient units	No	USA	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (clinicians, OTs)	No	No 1.8.1 No 1.8.2 No	No
Picelli et al. (46), 2018 ^H	A neuromotor and cognitive rehabilitation research centre	No	Verona, Italy	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (investigators)	Therapeutic infrastructure (cathodal cerebellar and spinal stimulation)	No 1.8.1 No 1.8.2 No	No
Bergmann et al. (47), 2018 ^H	A rehabilitation hospital	No	Bad Aibling, Germany	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (scientific staff members)	Technical infrastructure (virtual reality robot-assisted gait training)	No 1.8.1 No 1.8.2 No	No
Nazligul et al. (38), 2018 ^M	A university hospital, physical medicine and rehabilitation outpatient clinic	No	Istanbul, Turkey	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (PT, researcher)	Therapeutic infrastructural device (electrotherapeutic modality)	No 1.8.1 No 1.8.2 No	No
Farias-Godoy et al. (39), 2018 ^M	A cardiac rehabilitation clinic	No	Vancouver, British Columbia, Canada	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (cardiologist, nurse, dietitian, and exercise specialist and laboratory technician)	No	No 1.8.1 No 1.8.2 No	No
Jansen et al. (40), 2018 ^H	An independent level 1 trauma centre, inpatient and outpatient clinic	No	Wuerzburg, Germany	No 1.4.1 No 1.4.2 No 1.4.3 No	No	No	Technical infrastructure (active controlled motion device).	No 1.8.1 No 1.8.2 No	No
Horton et al. (41), 2018 ^H	Two hospitals	No	UK	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (healthcare professionals)	No	No 1.8.1 No 1.8.2 No	No
Cannell et al. (42), 2018 ^H	Two independent subacute rehabilitation units	No	Tasmania, Australia	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (senior PT)	Technical infrastructure (game-based software system)	No 1.8.1 No 1.8.2 No	No
Blitz et al. (48), 2018 ^L	A children's hospital, rheumatology clinic	No	Los Angeles, USA	No 1.4.1 No 1.4.2 No 1.4.3 No	No	Yes (rheumatologist, PT)	Supportive device (pedometer)	No 1.8.1 No 1.8.2 No	No
Porportion of any report, %	100	3	100	0	0	86	79	0	0

*RCT: randomized controlled trials; ICSSO-R: International Classification of Service Organizations in Rehabilitation; No: not described; Yes: described; PT: physiotherapist; OT: occupational therapist.

**Superscript letters denote the methodological quality of each study as presented in Appendix Table SI: H: high quality; M: medium quality; L: low quality; ICU: intensive care unit.

Table III. Current rehabilitation-related randomized controlled trial (RCT) reports vs International Classification of Service Organizations in Rehabilitation (ICSO-R) (version 2)'s recommendations on descriptions of service deliveries*

RCTs (n=29)**	Part I service delivery descriptions						
	2.1 Health Strategies	2.2 Service goals	2.3 Target group(s) 2.3.1 Health Conditions 2.3.2 Functioning 2.3.3 Other Target Groups	2.4 Modes of Referrals	2.5 Location of Service Delivery 2.5.1 Location characteristic 2.5.2 Catchment Area	2.6 Facility	2.7 Setting 2.7.1 Levels of Care 2.7.2 Mode of Service Delivery 2.7.3 Phase of Care
Fossat et al. (20), 2018 ^H	No	Improvement of global muscle strength	2.3.1 Critically ill patients 2.3.2 Gait 2.3.3 Age 18 years or older	No	2.5.1 No 2.5.2 No	Yes (20 surgical ICU beds)	2.7.1 No 2.7.2 Inpatients 2.7.3 Acute rehabilitation
Peng et al. (21), 2018 ^H	No	Improvement in health	2.3.1 Patients with CHF 2.3.2 Other, heart function, QOL 2.3.3 Age 18 years or older	Referred by health professionals	2.5.1 No 2.5.2 No	No	2.7.1 No 2.7.2 Home-based telerehabilitation 2.7.3 Post-acute rehabilitation
Schuster Amft et al. (22), 2018 ^H	No	Improvement and recovery	2.3.1 Patients with stroke 2.3.2 Upper limb function 2.3.3 Age 20–81 years	No	2.5.1 No 2.5.2 No	Yes (PT or OT department)	2.7.1 No 2.7.2 Outpatient 2.7.3 Chronic rehabilitation
Tanaka et al. (23), 2018 ^M	No	Improvement In walking speed	2.3.1 Patients with first stroke 2.3.2 Motor deficit of arm and hand 2.3.3 Age 53–75 years	No	2.5.1 No 2.5.2 No	No	2.7.1 No 2.7.2 Outpatient 2.7.3 Sub-acute rehabilitation
Fotakopoulos & Kotila (24), 2018 ^L	No	Recovery after stroke	2.3.1 Patients with acute stroke 2.3.2 Gait and balance 2.3.3 Age 75 years or younger	No	2.5.1 No 2.5.2 No	No	2.7.1 No 2.7.2 No 2.7.3 Post-acute
Kim et al. (25), No 2018 ^H	No	Improvement of upper limb function	2.3.1 Patients with paraplegia 2.3.2 Arm function 2.3.3 Age 19 years or older	No	2.5.1 No 2.5.2 No	Yes (therapy rooms)	2.7.1 No 2.7.2 Inpatient 2.7.3 Post-acute rehabilitation
Charususin et al. (26), 2018 ^H	No	Improvement in respiratory muscle function	2.3.1 Patients with COPD 2.3.2 Respiratory function 2.3.3 Age 58–74 years	No	2.5.1 No 2.5.2 No	No	2.7.1 No 2.7.2 No 2.7.3 No
Erbil et al. (27), 2018 ^M	No	Improvement of balance	2.3.1 Patients with chronic stroke 2.3.2 Gait and balance 2.3.3 Age 18–70 years	No	2.5.1 No 2.5.2 No	No	2.7.1 No 2.7.2 Outpatient 2.7.3 Chronic rehabilitation
Cha et al. (28), No 2018 ^H	No	Improvement in walking and balancing abilities	2.3.1 Patients with hemiplegic stroke 2.3.2 Walking and balancing 2.3.3 Age 52–75 years	Referred by health professionals	2.5.1 No 2.5.2 No	No	2.7.1 No 2.7.2 Inpatient 2.7.3 Post-acute rehabilitation
Klomjai et al. (29), 2018 ^M	No	Improvement of lower-limb function and gait	2.3.1 Patient with sub-acute stroke 2.3.2 Sit-to-stand, walking 2.3.3 Age 59–77 years	No	2.5.1 Home-based/centre-based 2.5.2 No	No	2.7.1 No 2.7.2 No 2.7.3 No
Martens et al. (30), 2018 ^M	No	Improvement of behaviour	2.3.1 Patients in minimally conscious state 2.3.2. Behavioural effects 2.3.3 Age 16 years or older	No	2.5.1 Home, nursing home or 2.5.2 No	No	2.7.1 No 2.7.2 Inpatients, outpatients, or home and community 2.7.3 Chronic rehabilitation
Zintchouk et al. (31), 2018 ^H	No	Effect of comprehensive geriatric care	2.3.1 Older patients referred to rehab unit from home or hospital 2.3.2 Other healthcare utilization, daily activities and QOL 2.3.3 Age 65 years or older	Referred by health professionals	2.5.1 Community rehabilitation unit 2.5.2 Geographical area	No	2.7.1 No 2.7.2 Inpatients 2.7.3 No
Hsieh et al. (32), 2018 ^M	No	Improvement in motor performance	2.3.1 Patients with stroke 2.3.2 Motor function 2.3.3 Age 44–70 years	Referred by health professionals	2.5.1 No 2.5.2 No	Yes, (therapy room and system)	2.7.1 No 2.7.2 No 2.7.3 Post-acute rehabilitation
Chen et al. (33), 2018 ^M	No	Improvement in functional capacity	2.3.1 Patients with CHF 2.3.2 Function 2.3.3 Veterans, age 44–76 years	Referred by health professionals	2.5.1 Hospital or home-based 2.5.2 No	No	2.7.1 No 2.7.2 Outpatients or home-based 2.7.3 Chronic rehabilitation
Manji et al. (34), 2018 ^M	No	Improvement in walking speed	2.3.1 Patients with stroke 2.3.2 Gait/balance 2.3.3 Adults 45–79 years	Referred by health professionals	2.5.1 No 2.5.2 No	No	2.7.1 No 2.7.2 Inpatients 2.7.3 Acute rehabilitation

Table III. Cont.

Part I service delivery descriptions								
RCTs (n = 29)**	2.1 Health Strategies	2.2 Service goals	2.3 Target group(s)		2.5 Location of Service Delivery		2.7 Setting	
			2.3.1 Health Conditions	2.3.2 Functioning	2.4 Modes of Referrals	2.5.1 Location characteristic	2.5.2 Catchment Area	2.6 Facility
Wu et al. (35), 2018 ^H	No	Improvement In muscle spasticity and gate problem	2.3.1 Patients with chronic stroke	2.3.2 Spasticity	No	2.5.1 No	No	2.7.1 Tertiary
			2.3.3 Age 18 years or older			2.5.2 No		2.7.2 Outpatients
Cho et al. (36) 2018 ^H	No	Improvement of inspiratory function, walking, endurance, and fatigue	2.3.1 Patients with stroke	2.3.2 Function	No	2.5.1 No	No	2.7.1 No
			2.3.3 Age 20 years or older			2.5.2 No		2.7.2 No
Sunamura et al. (37), 2018 ^H	No	Other, to promote healthy life style	2.3.1 Patients with acute coronary syndrome	2.3.2 Others	Referred by health professionals	2.5.1 No	No	2.7.1 No
			2.3.3 Age 47–67 years			2.5.2 No		2.7.2 Outpatients or home
Munari et al. (43), 2018 ^H	No	Improvement in gait, QOL, cardiorespiratory fitness	2.3.1 Patients with stroke	2.3.2 Gait/QOL/fitness	Referred by health professionals	2.5.1 No	No	2.7.1 No
			2.3.3 Age 18–75 years			2.5.2 No		2.7.2 Outpatients
Maciaszek (44), 2018 ^M	No	Improvement of balance	2.3.1 Patients with stroke	2.3.2 Balance	No	2.5.1 No	No	2.7.1 No
			2.3.3 Age 60–72 years			2.5.2 No		2.7.2 Inpatients
Lewthwaite et al. (45), 2018 ^M	No	Trajectory of functional change	2.3.1 Patients with stroke	2.3.2 PROMs	No	2.5.1 No	No	2.7.1 No
			2.3.3 Age 19–58 years			2.5.2 No		2.7.2 Outpatients
Picelli et al. (46), 2018 ^H	No	Improvement of gait	2.3.1 Patients with stroke	2.3.2 Gait	Referred health professionals	2.5.1 No	No	2.7.1 No
			2.3.3 Age 18 years or older			2.5.2 No		2.7.2 Outpatients
Bergmann et al. (47), 2018 ^H	No	Other (Feasibility of intervention study)	2.3.1 Patients with stroke	2.3.2 Walk	Referred by health professionals	2.5.1 No	Yes	2.7.1 No
			2.3.3 Age 18–75 years			2.5.2 No		2.7.2 Inpatients
Nazligul et al. (38), 2018 ^M	No	Recovery of subacromial impingement syndrome	2.3.1 Patients with subacromial syndrome	2.3.2 Others	Referred by health professionals	2.5.1 No	No	2.7.1 No
			2.3.3 Age 25–65 years			2.5.2 No		2.7.2 Outpatients
Farias-Godoy et al. (39), 2018 ^M	Primary and secondary Prevention	Improve exercise capacity and reduce cardiac risk ¹	2.3.1 Patients with cardiac risk	2.3.2 Others	Referred by health professionals	2.5.1 No	No	2.7.1 Tertiary
			2.3.3 Age 50–72 years			2.5.2 No		2.7.2 Outpatients
Jansen et al. (40), 2018 ^H	No	Improvement in ankle motion	2.3.1 Patients with ankle fracture	2.3.2 Gait	Referred by health professionals	2.5.1 Level 1 trauma center/ home	No	2.7.1 No
			2.3.3 Age 18 years or older			2.5.2 No		2.7.2 Inpatient or home
Horton et al. (41), 2018 ^H	No	Improvement in respiratory function	2.3.1 Patients with COPD	2.3.2 Other	Referred by health professionals	2.5.1 Rehabilitation centre/ home	No	2.7.1 No
			2.3.3 Age 59–77 years			2.5.2 No		2.7.2 Outpatient or home
Cannell et al. (42), 2018 ^H	No	Improvement In physical functioning	2.3.1 Patients with stroke	2.3.2 Function	Referred by health professionals	2.5.1 No	No	2.7.1 Secondary
			2.3.3 Age 63–87 years			2.5.2 No		2.7.2 Inpatient
Blitz et al. (48), 2018 ^L	No	Improvement in activity level	2.3.1 Patients with juvenile idiopathic arthritis and lower extremity involvement	2.3.2 Functional walking capacity	Referred by health professionals	2.5.1 No	No	2.7.1 No
			2.3.3 Age 11–19 years			2.5.2 No		2.7.2 Outpatients
% of Any report, %	3	100	100		55	21	17	93
% of Sub-item report, %			2.3.1 100			2.5.1 21		2.7.1 10
			2.3.2 100			2.5.2 3		2.7.2 82
			2.3.3 100					2.7.3 86

*RCT: randomized controlled trials; ICSO-R: International Classification of Service Organizations in Rehabilitation; No: not described; Yes: described.
 **Superscript letters denote the methodological quality of each study, as presented in Appendix Table S1: H: high quality; M: medium quality; L: low quality.
 ICU: intensive care unit; QOL: quality of life; COPD: chronic obstructive pulmonary disease; CHF: chronic heart failure; PROMs: patient reported outcome measures.

Table IV. Current rehabilitation-related randomized controlled trial (RCT) reports vs International Classification of Service Organizations in Rehabilitation (ICSO-R) (version 2)'s recommendations on descriptions of service deliveries*

Part II service delivery descriptions							
RCTs (n = 29)***	2.8 Integration of Care	2.9 Patient-Centeredness	2.10 Aspect of Time and Intensity	2.11 Rehabilitation Team 2.11.1 Professions, competencies 2.11.2 Interaction approaches	2.12 Reporting and Documentation**	2.13 Funding of Service Delivering the Research Study 2.13.1 Source of Money 2.13.2 Criteria of Payment	2.14 Other Categories of service delivery
Fossat et al. (20), 2018 ⁱⁱ	Yes (Collaboration)	No	Yes (Weekdays, 15-min of leg cycling and 50-min electrical stimulation each day)	2.11.1 Licensed physiotherapists 2.11.2 No	A global muscle strength, ICU mobility scale, functional autonomy (Body function and activities) and HRQL	2.13.1 No 2.13.2 No	No
Peng et al. (21), 2018 ⁱⁱ	No	Yes (Patient education and empowerment)	Yes (32 sessions, five days a week)	2.11.1 Physiotherapists and nurses 2.11.2 Multi-profs. team	Heart function, walking distance depression and anxiety measure, HRQL (Body function) and HRQL	2.13.1 Scientific funding/ No state funding 2.13.2 No	No
Schuster-Amft et al. (22), 2018 ⁱⁱ	No	Yes (Programmes tailored to each patient's preferences)	Yes (4 weeks 16 sessions, 45 min each session)	2.11.1 Physiotherapists and occupational therapists 2.11.2 Multi-profs. team	Hand dexterity Box and Block Test, Stroke Impact Scale, Cognitive screening, (Body function/activities and participation)	2.13.1 Research funding 2.13.2 No	No
Tanaka et al. (23), 2018 ⁱⁱ	No	No	Yes (10 days, 1–2 h each day)	2.11.1 Physiotherapists 2.11.2 No	The maximum walking speed (cm/s), step lengths, walking speed (Body function and activities)	2.13.1 no 2.13.2 No	No
Fotakopoulos & Kotila (24), 2018 ⁱ	Yes (Collaboration of medical care and rehabilitation)	Yes (Individualized supervision and guidance; music was tailored to patient's age)	Yes (6 months, 4 training sessions per week, 45 min each session)	2.11.1 Physicians and medical students 2.11.2 No	Barthel Index, CBV, cerebral blood flow, MTT, Mini Mental Test, (Body function and activities)	2.13.1 No 2.13.2 No	No
Kim et al. (25), No 2018 ⁱⁱ	No	Yes (Individualized programmes)	Yes (4 weeks, 1.5 h each day)	2.11.1 Physiotherapists and occupational therapists 2.11.2 Multi-prof. team	The Manual Muscle Test, the total UEMS, Spinal Cord Independence Measurement (Body function and activities)	2.13.1 Research funding 2.13.2 No	No
Charususin et al. (26), 2018 ⁱⁱ	No	No	Yes (20–36 sessions, 3–5 sessions per week. 60min each session)	2.11.1 Physical therapists 2.11.2 No	The 6-min walking distance test, Respiratory muscle function, cycling exercise capacity, pulmonary function, limb muscle forces and physical activity (Body function and activities)	2.13.1 Research funding/ No state funding 2.13.2 No	No
Erbil et al. (27), 2018 ⁱⁱ	No	No	Yes (3 weeks, weekdays, 90 min each day)	2.11.1 Physician and physical therapists 2.11.2 No	Spasticity, gait and balance functioning, TUG (Body function and activities)	2.13.1 No 2.13.2 No	No
Cha et al. (28), No 2018 ⁱⁱ	No	No	Yes (6 weeks, three times a week, 50 min each time)	2.11.1 Therapists 2.11.2 No	The 10-min walking test and a functional gait assessment (Body function and activities)	2.13.1 Research funding 2.13.2 No	No
Klomjai et al. (29), 2018 ⁱⁱ	No	No	Yes (2 experiments with an intervention interval of at least 1 week + PT for 1 h)	2.11.1 Physical therapists and researchers 2.11.2 No	Muscle strength and functional assessments (sit-to-stand and walking) (Body function and activities)	2.13.1 Research funding 2.13.2 No	No
Martens et al. (30), 2018 ⁱⁱ	Yes (Collaboration)	Yes (Family or other caregivers' education and empowerment)	Yes (20 sessions for 4 weeks)	2.11.1 Multi-prof team including caregivers 2.11.2 Delegated team involvement	Change in the CRS-R total score after 4 weeks of tDCS. (Body structure and body function)	2.13.1 Multiple (State, health insurance, research funding) 2.13.2 No	No
Zintchouk et al. (31), 2018 ⁱⁱ	Yes (Continuum of care)	Yes (Tailored to patient's needs)	Yes (5 weeks)	2.11.1 Geriatrician, physical therapist, occupational therapist, Nutritionist, General practitioner 2.11.2 Multi-prof. team	The number of hospital admissions, ED visits in the 90 days following admission to the rehabilitation units, mortality, number of days in hospital, number of ambulatory contacts, ADL, (Activities) and QOL	2.13.1 Multiple (State, research donations) 2.13.2 No	No
Hsieh et al. (32), 2018 ⁱⁱ	No	No	Yes (4 weeks, 5 days per week, 90–100 min per day)	2.11.1 Therapists 2.11.2 No	Fugl-Meyer Assessment and Medical Research Council scale, Motor Activity Log (MAL). The MAL is a self-report scale that assesses how patients rate the amount of use (MAL-AOU) and quality of movement (MAL-QOM) (Body Function and Activities)	2.13.1 Multiple (National, university and hospital research funding) 2.13.2 No	No
Chen et al. (33), 2018 ⁱⁱ	No	Yes (Individualized rehabilitation programs, education)	Yes (3 months, 3 times per week, 30 minutes each time)	2.11.1 Cardiologists, physical therapists, nurses, and case manager 2.11.2 Counselling	Functional heart capacity Minnesota Living With HF Questionnaire, VO ₂ peak, anaerobic threshold (AT) through use of the Cardiopulmonary Exercise Test (CPET) and the 6 Minutes Walking Test (Body function and activities) and HRQL	2.13.1 Multiple (National, hospital research funding) 2.13.2 No	No
Manji et al. (34), 2018 ⁱⁱ	No	No	Yes (2 treadmill training periods, 1 week each, 20 min each week)	2.11.1 No 2.11.2 No	The 10-m Walk Test and Timed Up and Go Test (Body function and activities)	2.13.1 No 2.13.2 No	No
Wu et al. (35), No 2018 ⁱⁱ	No	No	Yes (3 sessions of either focused or radial shock wave therapy at 1-week intervals)	2.11.1 Physiatrist 2.11.2 No	The change of MAS scores at the gastrocnemius muscle Tardieu Scale, ankle passive range of motion, dynamic foot contact area and gait speed. (Body function and activities)	2.13.1 research funding 2.13.2 No	No

Table IV. *Cont.*

Part II service delivery descriptions							
RCTs (n = 29)***	2.8 Integration of Care	2.9 Patient- Centeredness	2.10 Aspect of Time and Intensity	2.11 Rehabilitation Team 2.11.1 Professions, competencies 2.11.2 Interaction approaches	2.12 Reporting and Documentation**	2.13 Funding of Service Delivering the Research Study 2.13.1 Source of Money 2.13.2 Criteria of Payment	2.14 Other Categories of service delivery
Cho et al. (36), No 2018 ^H	No	No	Yes (6 weeks, 5 days a week, 3 sets of 30 breaths in addition to gait training, and stair climbing training for 60 minutes each day)	2.11.1 Qualified trainer 2.11.2 Peer counsellors	The respiratory function, 6-min walking test Fatigue severity scale (Body function and activities)	2.13.1 Multiple (State, research funding) 2.13.2 No	No
Sunamura et al. (37), 2018 ^M	No	Yes (Individual patient education and Coaching)	Yes (12 weeks, 2 times a week group exercise programme plus 5-6 individual telephone coaching during the period)	2.11.1 Physiotherapist and specialized nurses, 2.11.2 Supervision and counselling	The SCORE risk functionals, QOL and QOL	2.13.1 Multiple (Investigators, Health insurance, research funding) 2.13.2 No	No
Munari et al. (43), 2018 ^M	No	No	Yes (3 month, 3 times per week)	2.11.1 Physician 2.11.2 No	The 6-min walking distance test 10-m Walk Test, Health Survey Questionnaire SF-36, Stroke Impact Scale and instrumental tests (gait analysis, VO _{2peak} and walking energy cost). (Body function and activities) and HRQL	2.13.1 No 2.13.2 No	No
Maciaszek (44), 2018 ^M	No	Yes (Intervention process was individualized to patient's biopsychosocial needs)	Yes (15 days, up to 4-stage exercise)	2.11.1 Physician and physical therapist 2.11.2 No	One-leg standing test, timed up and go test. (Body function and activities)	2.13.1 No 2.13.2 No	No
Lewthwaite et al. (45), 2018 ^M	Yes (Collaboration)	Yes (Customized task-oriented training)	Yes (16 weeks, 30 sessions, 1 h each session)	2.11.1 Physicians, physical therapist and occupational therapist, 2.11.2 Multi-profs. team	Primary outcome not reported Fugl-Meyer Assessment of Upper Extremity motor ability and Stroke Impact Scale (Body function and activities)	2.13.1 (State, research funding) 2.13.2 No	No
Picelli et al. (46), 2018 ^M	No	No	Yes (2 weeks, 5 days a week, 20-min each day)	2.11.1 No 2.11.2 No	The 6-Min Walk Test, Functional Ambulation Category, Motricity Index leg sub-score, Ashworth scale (Body function and activities)	2.13.1 No 2.13.2 No	No
Bergmann et al. (47), 2018 ^M	No	No	Yes (4 weeks, 3 sessions per week, 60 min each session)	2.11.1 Trained physiotherapist and therapist 2.11.2 No	The Functional Ambulation Classification, the 10-m walk test, a 10-m dual task, the 6-min walk test, and muscle strength of the lower extremity (Body function and activities)	2.13.1 Research funding 2.13.2 No	No
Nazligul et al. (38), 2018 ^M	No	No	Yes (2 weeks, 5 days per week, 20 min per day)	2.11.1 Physician and physical therapist 2.11.2 No	Visual analogue scale, Constant-Murley Scale, Shoulder Disability Questionnaire Scores (Body function and activities)	2.13.1 No 2.13.2 No	No
Farias-Godoy et al. (39), 2018 ^M	No	Yes (Patient education)	Yes (4 months, 32 vs 10 in-hospital exercise sessions)	2.11.1 Cardiologist, nurse, dietitian and exercise specialist 2.11.2 Counselling	Total time (in s) on the treadmill Minnesota Leisure Time Physical Activity questionnaire (Body function and activities)	2.13.1 Research funding 2.13.2 No	No
Jansen et al. (40), 2018 ^M	Yes (Collaboration)	Yes (Patient education)	Yes (6 weeks, partial weight-bearing training)	2.11.1 No 2.11.2 No	The Range of motion, visual analogue scale for foot and ankle, the Phillips and Mazur scores and the AOFAS score. (Body function)	2.13.1 Research funding 2.13.2 No	No
Horton et al. (41) 2018 ^H	No	Yes (Structured home-based rehabilitation)	Yes (Home-based program, including a hospital visit, a self-management manual and two telephone calls)	2.11.1 Healthcare professionals 2.11.2 No	Chronic Respiratory Questionnaire (HRQL)	2.13.1 Industrial research funding 2.13.2 No	No
Cannell et al. (42), 2018 ^M	Yes (Collaboration)	Yes (Individually prescribed physical therapy)	Yes (8-40 sessions, week days, up to 1 h each day)	2.11.1 Rehabilitation Physical therapists and rehabilitation assistant 2.11.2 No	Standing balance lateral reach, step test, sitting balance, arm function, and walking. (Body function and activities)	2.13.1 Research funding 2.13.2 No	No
Blitz et al. (48), 2018 ^L	Yes (Collaboration)	Yes (Patient education)	Yes (20 weeks)	2.11.1 Rheumatologist and physical therapist 2.11.2 Multi-prof. team	6-Min Walk Test Childhood Health Assessment Questionnaire (CHAQ) Borg scale (Body function and activities)	2.13.1 Research funding 2.13.2 No	No
% of Any report, %	28	52	100	90	100	69	0
% of Sub-item report, %				2.11.1 90 2.11.2 38		2.13.1 69 2.13.2 0	

*RCT: randomized controlled trials; ICSO-R: International Classification of Service Organizations in Rehabilitation; No: not described; Yes: described.

**Report and documentation: grouping based on ICF components.

***Superscript letters denote the methodological quality of each study as presented in Appendix Table SI: H: high quality; M: medium quality; L: low quality.

AOFAS: American orthopaedic foot & ankle society score; HRQL: health-related quality of life; CHF: chronic heart failure; MTT: mean transit time; SF-36: short form (36) health survey; TUG: timed up and go; CBV: cerebral blood volume; ICU: intensive care unit; VO₂: oxygen uptake; CRS-R: coma recovery scale - revised.

health-related quality of life (HRQL), whereas only one study used an outcome measurement that can be linked to the participation level.

In this review, reports regarding the category 2.13.1 Funding to Service Delivery were mostly related to the sources and modalities of the payment (i.e. research grants for trials (38%) or multiple sources, such as a combination of research grants, state funding and health insurance (31%)). However, 2.13.2 Criteria of Payment was not reported in the studies.

DISCUSSION

The aim of this topic review was to determine how health-related rehabilitation services were described in RCTs published in 2018, using ICSO-R 2.0 as a framework (15). The review identified 29 RCTs that met the inclusion criteria. Considerable heterogeneity in service descriptions is exhibited in the study design and setting, targeted population, and provided interventions in the trials. However, the results indicate that only half of the recommended categories of provider and service delivery dimensions were frequently reported in the reviewed literature.

Concerning the provider dimension, most trials were performed in hospitals or independent rehabilitation units or centres. Few studies were performed in multiple settings. It is challenging to design and conduct multicentre RCTs; therefore, these results are unsurprising. Furthermore, most trials did not report the ownership of the provider (i.e. the legal and contextual characteristics of the owning entity). Both public and private service organizations are important aspects for policymakers and stakeholders, and such characteristics may influence the outcomes (49).

None of the studies reported information regarding the governance/leadership category, which is defined as “political, economic and administrative authority in the management of the provider”, and its corresponding subcategories: mission, vision and involvement in governance and management. Quality assurance and management, funding of provider, source of money, and other categories of provider were not reported. This may reflect the fact that this review captured rehabilitation interventions trials and not trials directly targeting the organizational aspects of rehabilitation services. It cannot be excluded that organizational research is insufficiently covered in Medline, but the scarce body of research in rehabilitation services has also been well documented by the World Health Organization (WHO) (50). The governance and leadership category of service provision has been documented to affect services, the target group choices and treatment programmes (51). However, the extent to which these factors also influence the outcome of rehabilitation

interventions and thus are relevant to clinical trials is not clearly documented.

Concerning the service delivery dimension, only one study was identified that focused on health strategioneother than rehabilitation. Important contextual factors, such as the location of services, were described in only one-fifth of the studies. Most trials addressed post-acute and chronic rehabilitation care phases, whereas only one-quarter of the studies addressed acute/subacute care phases. The limited number of trials from these phases may reflect the practical and ethical restraints imposed on the randomization of severely affected individuals for whom no realistic alternatives to specialist intervention are available (52).

The rehabilitation team category and professions and competencies subcategories were mentioned in the majority of trials, but team interaction and methods of team organization and communication pathways were described less frequently. However, multi-disciplinary team interactions and team members with relevant expertise are suggested as key features of a successful specialist rehabilitation service (52). The other characteristics of successful rehabilitation services, such as integration of care (i.e. timely, comprehensive and well-coordinated care along the continuum of care) and patient-centredness (i.e. rehabilitation tailored to patient needs and shared decision-making) were also less frequently reported categories. The majority of studies that identified these categories were from Europe and the USA or Canada (20, 22, 24, 26, 30, 31, 37, 39–42, 44, 45, 47, 48). This may reflect the conceptual definitions of integration of care and patient-centeredness from these geographical regions (53) or the type of intervention provided in the studies. Further research studies should investigate whether these categories apply to all regions of the world and address various types of rehabilitation trials.

In the reporting and documentation category, which is defined as “health and functioning parameters in individual patient’s records”, primary and secondary outcome measurements were extracted from trials and reported along with the ICF dimensions (18). Most measurements used in the reviewed studies were previously linked to the ICF domains of body functions and activities, whereas only one study reported a participation outcome measurement. One-quarter of the studies reported HRQL measurements. The results regarding the participation domain and HRQL were somewhat unexpected, because the main goal of rehabilitation is to provide people with disabilities with a meaningful existence and a life within their expectations.

The ICSO-R 2.0 was specifically developed to cover rehabilitation services at the meso-level (15), acknowledging the lack of classification systems at this level and the importance of the meso-level in the quality and effectiveness of rehabilitation interventions. The

present review indicates some awareness of the service organization (meso-level factors) in studies focused on rehabilitation interventions at the micro-level. However, the distinction between service delivery at the meso-level and the interventions at the micro-level is not always clear, as reported in a recent review by Røe et al. (54). The current review found a similar situation; thus, guidelines or standards for reporting rehabilitation service organization in clinical trials are needed. However, a current version of ICSO-R 2.0 with 23 categories is too extensive for such use and provides categories in clinical rehabilitation trials beyond those reported. Thus, a shorter version of ICSO-R may be considered for minimum reporting standards for service organization in clinical trials.

Study limitations

Several limitations should be considered in interpreting the results. This is a topic review based on a literature search of Medline for 2018 and, thus, can serve only as an initial review of the subject. A further effort with an extensive study period, including a wide range of rehabilitation studies, is recommended to confirm the findings of this study. The current review includes only studies with experimental designs, which may limit the generalizability of the results to studies with other designs, such as longitudinal observational studies. Of all eligible studies, 52% were from Europe, 22% were in the pilot phase, 69% were single-centre studies, and the trial sizes were mostly small. These study characteristics may influence the results of this review. In addition, the generalizability of the study results may be limited by the fact that the majority of the studies were of targeted inpatients with stroke and heterogeneous rehabilitation intervention programmes and designs (e.g. 21% pilot RCTs). The evaluations of the studies may be biased by the outlook and experience of the authors, because the standardized evaluation manuals and value sets of ICSO-R 2.0 are still not developed.

Conclusion

Descriptions of service organization in rehabilitation varied widely among recently published RCTs. None of the reviewed RCTs described all of the ICSO-R 2.0 provider and service delivery categories. Use of the framework in classification of service organization and standardization of descriptions of services is recommended in future RCTs, in order to facilitate better comparisons in service research across studies.

ACKNOWLEDGEMENTS

This study was supported by funds from the Institute of Clinical Medicine and Institute of Health and Society, Research Centre for Habilitation and Rehabilitation Models and Services (CHARM) at the University of Oslo, Oslo, Norway.

The authors have no conflicts of interest to declare.

REFERENCES

1. Stucki G, Cieza A, Melvin J. The International Classification of Functioning, Disability and Health (ICF): a unifying model for the conceptual description of the rehabilitation strategy. *J Rehabil Med* 2007; 39: 279–285.
2. Meyer T, Gutenbrunner C, Bickenbach J, Cieza A, Melvin J, Stucki G. Towards a conceptual description of rehabilitation as a health strategy. *J Rehabil Med* 2011; 43: 765–769.
3. Kamenov K, Mills JA, Chatterji S, Cieza A. Needs and unmet needs for rehabilitation services: a scoping review. *Disabil Rehabil* 2018; 41: 1227–1237.
4. Graham L. Organization of rehabilitation services. In: Barnes M, Good D, editors. *Handbook of clinical neurology – neurological rehabilitation*. ScienceDirect; 2013, p. 113–120.
5. Gutenbrunner C, Nugraha B. 2.1 Rehabilitation: rehabilitation as a health strategy. *J Int Soc Phys Rehabil Med* 2019; 2 Suppl S1: 15–18.
6. Gutenbrunner C, Tederko P, Grabljevec K, Nugraha B. Responding to the World Health Organization Global Disability Action Plan in Ukraine: developing a national disability, health and rehabilitation plan. *J Rehabil Med* 2018; 50: 338–341.
7. Nugraha B, Gutenbrunner C. Situation analysis of rehabilitation service to support the national disability and rehabilitation plan in the Democratic People's Republic of Korea. *J Rehabil Med* 2018; 50: 342–345.
8. Nugraha B, Setyono GR, Defi IR, Gutenbrunner C. Strengthening rehabilitation services in Indonesia: a brief situation analysis. *J Rehabil Med* 2018; 50: 377–384.
9. Garrido M, Hanen J, Busse R. Mapping research on health systems in Europe: a bibliometric assessment. *J Health Serv Res* 2011; 16: 27–37.
10. Entwistle VA, Watt IS. Treating patients as persons: a capabilities approach to support delivery of person-centered care. *Am J Bioeth* 2013; 13: 29–39.
11. Meyer T, Gutenbrunner C, Kiekens C, Skempes D, Melvin JL, Schedler K, et al. ISPRM discussion paper: Proposing a conceptual description of health-related rehabilitation services. *J Rehabil Med* 2014; 46: 1–6.
12. Røe C, Kirkeveld M, Andelic N, Soberg HL, Svein U, Bautz-Holter E, et al. The challenges of describing rehabilitation services: a discussion paper. *J Rehabil Med* 2018; 50: 151–158.
13. Gutenbrunner C, Bickenbach J, Kiekens C, Meyer T, Skempes D, Nugraha B, et al. ISPRM discussion paper: proposing dimensions for an International Classification System for Service Organization in Health-related Rehabilitation. *J Rehabil Med* 2015; 47: 809–815.
14. Kiekens C, Meyer T, Gimigliano F, Baffone C, Gutenbrunner CM. European initiative for the application of the International Classification of Service Organization in Health-related Rehabilitation (ICSO-R). *Eur J Phys Rehabil Med* 2017; 53: 308–318.
15. Gutenbrunner C, Nugraha B, Gimigliano F, Meyer T, Kiekens C. International Classification of Service Organization in Rehabilitation: an updated set of categories (ICSO-R 2.0). *J Rehabil Med* 2020; 52: jrm00004.
16. Gutenbrunner C, Nugraha B. Decision-making in evidence-based practice in rehabilitation medicine: proposing a fourth factor. *Am J Phys Med Rehabil* 2020; 99: 436–440.
17. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *J Clin Epidemiol* 2009; 62z: 1006–1012.
18. World Health Organization. *The International Classification of Functioning, Disability and Health*. Geneva: WHO; 2001.
19. Cicerone KD, Azulay J, Trott C. Methodological quality of research on cognitive rehabilitation after traumatic brain injury. *Arch Phys Med Rehabil* 2009; 90 Suppl 11: S52–S59.
20. Fossat G, Baudin F, Courtes L, Bobet S, Dupont A, Bretagnol A, et al. Effect of in-bed leg cycling and electrical stimulation of the quadriceps on global muscle strength

in critically ill adults: a randomized clinical trial. *JAMA* 2018; 320: 368–378.

21. Peng X, Su Y, Hu Z, Sun X, Li X, Dolansky MA, et al. Home-based telehealth exercise training program in Chinese patients with heart failure: a randomized controlled trial. *Medicine (Baltimore)* 2018; 97: e12069.
22. Schuster-Amft C, Eng K, Suica Z, Thaler I, Signer S, Lehmann I, et al. Effect of a four-week virtual reality-based training versus conventional therapy on upper limb motor function after stroke: a multicenter parallel group randomized trial. *PLoS One* 2018; 13: e0204455.
23. Tanaka N, Matsushita S, Sonoda Y, Maruta Y, Fujitaka Y, Sato M, et al. Effect of stride management assist gait training for poststroke hemiplegia: a single center, open-label, randomized controlled trial. *J Stroke Cerebrovasc Dis* 2019; 28: 477–486.
24. Fotakopoulos G, Kotlia P. The value of exercise rehabilitation program accompanied by experiential music for recovery of cognitive and motor skills in stroke patients. *J Stroke Cerebrovasc Dis* 2018; 27: 2932–2939.
25. Kim J, Lee BS, Lee HJ, Kim HR, Cho DY, Lim JE, et al. Clinical efficacy of upper limb robotic therapy in people with tetraplegia: a pilot randomized controlled trial. *Spinal Cord* 2019; 57: 49–57.
26. Charususin N, Gosselink R, Decramer M, Demeyer H, McConnell A, Saey D, et al. Randomised controlled trial of adjunctive inspiratory muscle training for patients with COPD. *Thorax* 2018; 73: 942–950.
27. Erbil D, Tugba G, Murat TH, Melike A, Merve A, Cagla K, et al. Effects of robot-assisted gait training in chronic stroke patients treated by botulinum toxin-a: a pivotal study. *Physiother Res Int* 2018; 23: e1718.
28. Cha YJ, Kim JD, Choi YR, Kim NH, Son SM. Effects of gait training with auditory feedback on walking and balancing ability in adults after hemiplegic stroke: a preliminary, randomized, controlled study. *Int J Rehabil Res* 2018; 41: 239–243.
29. Klomjai W, Aneksan B, Pheungphrattannatrai A, Chantana-chai T, Choowong N, Bunleukhet S, et al. Effect of single-session dual-tDCS before physical therapy on lower-limb performance in sub-acute stroke patients: a randomized sham-controlled crossover study. *Ann Phys Rehabil Med* 2018; 61: 286–291.
30. Martens G, Lejeune N, O'Brien AT, Fregni F, Martial C, Wannez S, et al. Randomized controlled trial of home-based 4-week tDCS in chronic minimally conscious state. *Brain Stimul* 2018; 11: 982–990.
31. Zintchouk D, Gregersen M, Lauritzen T, Damsgaard EM. Geriatrician-performed comprehensive geriatric care in older adults referred to an outpatient community rehabilitation unit: a randomized controlled trial. *Eur J Intern Med* 2018; 51: 18–24.
32. Hsieh YW, Lin KC, Wu CY, Shih TY, Li MW, Chen CL. Comparison of proximal versus distal upper-limb robotic rehabilitation on motor performance after stroke: a cluster controlled trial. *Sci Rep* 2018; 8: 2091.
33. Chen YW, Wang CY, Lai YH, Liao YC, Wen YK, Chang ST, et al. Home-based cardiac rehabilitation improves quality of life, aerobic capacity, and readmission rates in patients with chronic heart failure. *Medicine (Baltimore)* 2018; 97: e9629.
34. Manji A, Amimoto K, Matsuda T, Wada Y, Inaba A, Ko S. Effects of transcranial direct current stimulation over the supplementary motor area body weight-supported treadmill gait training in hemiparetic patients after stroke. *Neurosci Lett* 2018; 662: 302–305.
35. Wu YT, Chang CN, Chen YM, Hu GC. Comparison of the effect of focused and radial extracorporeal shock waves on spastic equinus in patients with stroke: a randomized controlled trial. *Eur J Phys Rehabil Med* 2018; 54: 518–525.
36. Cho JE, Lee HJ, Kim MK, Lee WH. The improvement in respiratory function by inspiratory muscle training is due to structural muscle changes in patients with stroke: a randomized controlled pilot trial. *Top Stroke Rehabil* 2018; 25: 37–43.
37. Sunamura M, Ter HN, van den Berg-Emons RJG, Geleijnse ML, Haverkamp M, Stam HJ, et al. Randomised controlled trial of two advanced and extended cardiac rehabilitation programmes. *Heart* 2018; 104: 430–437.
38. Nazligul T, Akpinar P, Aktas I, Unlu OF, Cagliyan HH. The effect of interferential current therapy on patients with subacromial impingement syndrome: a randomized, double-blind, sham-controlled study. *Eur J Phys Rehabil Med* 2018; 54: 351–357.
39. Farias-Godoy A, Chan S, Claydon VE, Ignaszewski A, Mendell J, Park JE, et al. The Impact of reduced cardiac rehabilitation on maximal treadmill exercise time: a randomized controlled trial. *J Cardiopulm Rehabil Prev* 2018; 38: 24–30.
40. Jansen H, Jordan M, Frey S, Holscher-Doht S, Meffert R, Heintel T. Active controlled motion in early rehabilitation improves outcome after ankle fractures: a randomized controlled trial. *Clin Rehabil* 2018; 32: 312–318.
41. Horton EJ, Mitchell KE, Johnson-Warrington V, Apps LD, Sewell L, Morgan M, et al. Comparison of a structured home-based rehabilitation programme with conventional supervised pulmonary rehabilitation: a randomised non-inferiority trial. *Thorax* 2018; 73: 29–36.
42. Cannell J, Jovic E, Rathjen A, Lane K, Tyson AM, Callisaya ML, et al. The efficacy of interactive, motion capture-based rehabilitation on functional outcomes in an inpatient stroke population: a randomized controlled trial. *Clin Rehabil* 2018; 32: 191–200.
43. Munari D, Pedrinolla A, Smania N, Picelli A, Gandolfi M, Saltuari L, et al. High-intensity treadmill training improves gait ability, VO_2 peak and cost of walking in stroke survivors: preliminary results of a pilot randomized controlled trial. *Eur J Phys Rehabil Med* 2018; 54: 408–418.
44. Maciaszek J. Effects of posturographic platform biofeedback training on the static and dynamic balance of older stroke patients. *J Stroke Cerebrovasc Dis* 2018; 27: 1969–1974.
45. Lewthwaite R, Winstein CJ, Lane CJ, Blanton S, Wagenheim BR, Nelsen MA, et al. Accelerating stroke recovery: body structures and functions, activities, participation, and quality of life outcomes from a large rehabilitation trial. *Neurorehabil Neural Repair* 2018; 32: 150–165.
46. Picelli A, Chemello E, Castellazzi P, Filippetti M, Brugnera A, Gandolfi M, et al. Combined effects of cerebellar transcranial direct current stimulation and transcutaneous spinal direct current stimulation on robot-assisted gait training in patients with chronic brain stroke: a pilot, single blind, randomized controlled trial. *Restor Neurol Neurosci* 2018; 36: 161–171.
47. Bergmann J, Krewer C, Bauer P, Koenig A, Riener R, Muller F. Virtual reality to augment robot-assisted gait training in non-ambulatory patients with a subacute stroke: a pilot randomized controlled trial. *Eur J Phys Rehabil Med* 2018; 54: 397–407.
48. Blitz J, Stern SM, Marzan K. Do pedometers with or without education on exercise increase functional walking capacity and physical activity level in adolescents with juvenile idiopathic arthritis? *Physiother Theory Pract* 2018; 34: 359–366.
49. Van VJ. How to apply the evidence-based recommendations for greater health equity into policymaking and action at the local level? *Scand J Public Health* 2018; 46 Suppl 22: 28–36.
50. World Report On Disability. WHO and the World Bank; 2011.
51. McVeigh J, MacLachlan M, Gilmore B, McClean C, Eide AH, Mannan H, et al. Promoting good policy for leadership and governance of health related rehabilitation: a realist synthesis. *Global Health* 2016 24; 12: 49.
52. Turner-Stokes L, Disler PB, Nair A, Wade DT. Multi-disciplinary rehabilitation for acquired brain injury in adults of working age. *Cochrane Database Syst Rev* 2005; (3): CD004170.
53. Scholl I, Zill JM, Harter M, Dirmaier J. An integrative model of patient-centeredness – a systematic review and concept analysis. *PLoS One* 2014; 9: e107828.
54. Røe C, Tverdal C, Howe EI, Tenovuo O, Azouvi P, Andelic N. Randomized controlled trials of rehabilitation services in the post-acute phase of moderate and severe traumatic brain injury—a systematic review. *Front Neurol* 2019; 10: 557.