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The new frontiers of rehabilitation medicine in people with chronic disabling illnesses

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ABSTRACT

Because of the demographic shift and the increased proportion of patients surviving acute critical illnesses, the number of people living with severely disabling chronic diseases and, consequently, the demand for rehabilitation are expected to increase sharply over time. As underscored by the World Health Organization, there is substantial evidence that the provision of inpatient rehabilitation in specialized rehabilitation units to people with complex needs is effective in fostering functional recovery, improving health-related quality of life, increasing independence, reducing institutionalization rate, and improving prognosis. Recent studies in the real world setting reinforce the evidence that patients with ischemic heart disease or stroke benefit from rehabilitation in terms of improved prognosis. In addition, there is evidence of the effectiveness of rehabilitation for the prevention of functional deterioration in patients with complex and/or severe chronic diseases. Given this evidence of effectiveness, rehabilitation should be regarded as an essential part of the continuum of care. Nonetheless, rehabilitation still is underdeveloped and underused. Efforts should be devoted to foster healthcare professional awareness of the benefits of rehabilitation and to increase referral and participation.

1. Introduction

In the last few decades, the demographic shift, accompanied by a parallel growth in the burden of chronic noncommunicable disease, and the increased proportion of patients surviving acute critical illnesses has led to the rise in the number of people living with chronic diseases and disability, which eventually result in an increased demand for rehabilitation services over time [1]. Multimorbidity and intervening admissions to intensive care units for critical illnesses exacerbate the risk of severe disability and worsen prognosis [2–5]. In addition to intervening complications, weakness acquired in intensive care unit has been recognized as a substantial contributor to long-lasting and severe functional impairment [5].

In Western Europe, life expectancy in women has increased from 79.5 years in 1990 to 84.1 years in 2016, the corresponding figures in men being 72.9 years and 79.2 years, respectively [6]. Longer life, however, is accompanied by an increase in disabled life expectancy [7]. Indeed, the prevalence of reported moderate-to-severe disability among European populations sharply increases above the age of 65 years, reaching > 50% among people aged 75 years or more [8]. With particular regard to Italy, for example, life expectancy at age 65 is 22.8 years in women and 19.2 years in men [8]. However, at age 65, the percentage of years of life free of disability is low, being estimated at 32% and 41%, respectively [8].

As defined by the World Health Organization (WHO), rehabilitation is "*a set of interventions designed to optimize functioning and reduce disability in individuals with health conditions* (e.g., acute or chronic diseases, injury, or trauma) *in interaction with their environment*" [1]. This definition, however, may underestimate the issue. Indeed, admission to post-acute rehabilitation services, where rehabilitation care is provided by an interdisciplinary team including internal medicine experts, can help achieve optimal outcome from other health interventions, prevent complications, facilitate recovery, optimize medical therapy, and reduce healthcare costs, especially in the current context of increased "pressure to discharge patients without involving all relevant professionals, often resulting in readmissions" [1,10,11,13]. Thus, in the current era, rehabilitation, strictly interacting with internal medicine, should be viewed as a health strategy to address the needs of patients surviving acute critical illnesses and/or living with chronic diseases [1,10,12].

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This article is focused on examining the clinical effects of rehabilitation in patients with ischemic heart disease (IHD), cerebrovascular disease, or chronic obstructive pulmonary disease (COPD), which have been ranked as leading causes of disability and mortality in high-income countries and represent relatively common causes of admissions to internal medicine wards [9,14–17].

2. Search methods

World Health Organization reports and clinical practice guidelines including recommendations relevant to the topic of rehabilitation for patients with chronic obstructive pulmonary disease, ischemic heart disease, and stroke were the main sources of information. Moreover, we performed an electronic search in PubMed for systematic reviews and the most up-to-date research articles addressing clinical outcomes of rehabilitation. The date of the last search was September 27, 2018.

2.1. Clinical evidence

Describing the core components of rehabilitation and the specific rehabilitation programmes for individual diseases is beyond the scope of this article. In this section, we focus on the clinical evidence of benefit from pulmonary, cardiac, and stroke rehabilitation. Evidence-based clinical practice guidelines recommend rehabilitation for patients with COPD, IHD, and stroke, generally with a high level of scientific evidence (Table 1).

2.1.1. Pulmonary rehabilitation

The clinical benefits of pulmonary rehabilitation have been investigated in many randomized controlled, though unblinded, studies. The results of these studies unequivocally show that pulmonary rehabilitation decreases the severity of dyspnea and improves health status and exercise tolerance [33]. Consistent results were observed by Lacasse et al. in a meta-analysis of 31 randomized controlled trials [34]. The Authors concluded, "*The results of this meta-analysis strongly support respiratory rehabilitation as part of the spectrum of management for patients with COPD. We found clinically and statistically significant improvements in important domains of quality of life, including dyspnea, fatigue emotional function and mastery. When compared with the treatment effect of other important modalities of care for patients with COPD such as inhaled bronchodilators or oral theophylline and its new derivatives, rehabilitation resulted in greater improvements in important domains of health-related quality of life and functional exercise capacity*" [34]. Importantly, an audit of clinical outcomes of pulmonary rehabilitation, which is part of the England and Wales national COPD audit programme, confirms the beneficial effects of rehabilitation in the real-world setting [35,36]. Ninety one percent of all rehabilitation services across England and Wales were involved [35]. The clinical report presents data from 7000 patients with COPD and a Medical Research Council dyspnoea scale grade 3 or worse referred to pulmonary rehabilitation services over a 3-month period [35]. Forty two percent of the patients completed the program [36]. Rehabilitation resulted in clinically and statistically significant increases in walking performance, as assessed by the incremental shuttle walk test, the endurance shuttle walk test, and the 6-min walk test; improvements in measures of health status were also seen [36]. Surprisingly, however, spirometry and body mass index were not recorded at assessment in 38% and 34% of the cases, respectively [36]. Finally, there is evidence that pulmonary rehabilitation following admissions for exacerbation of COPD improves health-related quality of life and exercise capacity [37]. Some studies also suggest a reduction in the number of readmissions in the year following pulmonary rehabilitation [38].

Despite the documented benefits, many suitable patients are not referred to pulmonary rehabilitation [39]. Remarkably, only 5% to 15% of patients hospitalized for exacerbation of COPD are referred to early rehabilitation [40]. The American Thoracic Society and the European Respiratory Society recognized suboptimal healthcare professional and patient awareness and knowledge of pulmonary rehabilitation and shortfall in funding as major barriers to access to pulmonary rehabilitation programs and identified key areas of research with the ultimate goal of enhancing provision of pulmonary rehabilitation [39].

2.1.2. Cardiac rehabilitation

Referral of patients after ST-segment elevation myocardial infarction, coronary artery bypass grafting, or percutaneous coronary intervention for acute myocardial infarction to comprehensive cardiac rehabilitation is recommended with the highest level of scientific evidence, i.e. class I - level of evidence A [25,26]. This level of evidence is based on data derived from multiple randomized clinical trials or meta-analyses and evidence and/or general agreement that a given treatment or procedure is beneficial, useful, and effective [26]. According to the 2018 European Society of Cardiology/ European Association for Cardio-Thoracic Surgery Guidelines on myocardial revascularization, "*secondary prevention and cardiac rehabilitation are an integral part of management after revascularization because such measures reduce future morbidity and mortality in a cost-effective way, and can further improve symptoms*" [26].

Early cardiac rehabilitation programs have been proven effective in fostering functional recovery, providing education, promoting the adoption of a healthy lifestyle and risk factor modification, and managing psychological distress characterized by depression and anxiety symptoms [25–27]. Ensuring proper titration and monitoring of life-saving therapies is an additional benefit provided by participation in cardiac rehabilitation after an acute coronary event, especially in the current context of "pressure to discharge" and short hospital stay [26]. Recent studies strongly support the concept that cardiac rehabilitation can be effective in reducing the risk of death and readmissions. In a nation-wide study performed in the United States of America, Ford et al. estimated how much of the decrease in mortality from coronary disease between 1980 and 2000 could be explained by the use of medical and surgical treatments as opposed to changes in cardiovascular risk factors [41]. They found that rehabilitation contributed significantly to the reduction in coronary disease mortality [41]. In the Cardiac Rehabilitation Outcome Study (CROS), a meta-analysis of 25 studies including 219,702 patients with coronary disease, Rauch et al. investigated the prognostic effect of cardiac rehabilitation exclusively in the current era of statins and early revascularization for acute coronary syndromes [42]. Cardiac rehabilitation was associated with significantly reduced mortality after acute coronary syndromes and after coronary artery bypass grafting [42]. The findings of this study suggest that structured and multi-component cardiac rehabilitation managed by a team of skilled health professionals provides an incremental survival benefit on top of the recommended treatments. In another population-based cohort study in the Netherlands covering approximately 22% of the Dutch population, de Vries et al. assessed the effects of multi-disciplinary cardiac rehabilitation on survival after acute coronary syndrome, coronary revascularization, or heart valve surgery [43]. Cardiac rehabilitation was associated with a substantial survival benefit (hazard ratio 0.65; 95% confidence intervals 0.56–0.77), regardless of age, gender, and qualifying diagnosis/type of intervention [43]. Patients who had undergone coronary artery bypass grafting and/or valve surgery benefited the most [43]. Finally, in a recently published study, Doimo et al. investigated the clinical impact of the application of cardiac rehabilitation early after discharge on the 5-year incidence of cardiovascular mortality and hospitalization for cardiovascular causes in the real-world setting [44]. After adjusting for confounders, cardiac rehabilitation was associated with 42% reduced risk of the combined end-point of hospitalization for cardiovascular causes and cardiovascular mortality.

Collectively, available data clearly indicate the cardiac rehabilitation is a valuable healthcare strategy to improve risk factors, lifestyle habits, exercise capacity, psychological profile, health-related quality of

Table 1
Recommendations for rehabilitation.

Guidelines/statements	Key points/recommendations	Level of evidence
2010 NICE Guidelines [18]	Pulmonary rehabilitation should be made available to all appropriate people with COPD including those who have had a recent hospitalisation for an acute exacerbation.	
Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Lung Disease 2017 Report. GOLD Executive Summary [19].	Pulmonary rehabilitation improves symptoms, quality of life, and physical and emotional participation in everyday activities.	Evidence A
	Pulmonary rehabilitation reduces hospitalizations in patients with recent exacerbation (< 4 weeks from prior hospitalization)	Evidence B
Management of COPD exacerbations: a European Respiratory Society/American Thoracic Society guideline [20].	For patients who are hospitalised with a COPD exacerbation, we suggest the initiation of pulmonary rehabilitation within 3 weeks after hospital discharge.	Conditional recommendation
Australian and New Zealand Pulmonary Rehabilitation Guidelines [21].	Patients with mild-to-severe COPD should undergo pulmonary rehabilitation to improve quality of life and exercise capacity and to reduce hospital admissions.	Strong recommendation
Increasing implementation and delivery of pulmonary rehabilitation: key messages from the new ATS/ERS policy statement [22].	Increased provision of pulmonary rehabilitation as an evidence-based, standard component of the overall integrated care of symptomatic patients with chronic respiratory diseases will not only improve the physical and emotional health and quality of life of individual participants, but will also markedly improve the quality of patient care across the trajectory of illness and over time has the potential to significantly reduce healthcare costs.	
An Official American Thoracic Society/European Respiratory Society Policy Statement: Enhancing Implementation, Use, and Delivery of Pulmonary Rehabilitation [23].	The American Thoracic Society and European Respiratory Society commit to undertake actions that will improve access to and delivery of pulmonary rehabilitation services for suitable patients.	
2014 AHA/ACC Guideline for the Management of Patients With Non–ST-Elevation Acute Coronary Syndromes. A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines [24].	All eligible patients with Non-ST-Elevation acute coronary syndromes should be referred to a comprehensive cardiovascular rehabilitation program either before hospital discharge or during the first outpatient visit.	Level of evidence B
2017 ESC Guidelines for the management of Acute myocardial infarction in patients presenting with ST-segment elevation [25].	A short hospital stay implies limited time for proper patient education and up-titration of secondary prevention treatments. Consequently, these patients should have early post-discharge consultations with a cardiologist, primary care physician, or specialized nurse scheduled and be rapidly enrolled in a formal rehabilitation programme, either in-hospital or on an outpatient basis.	Class I Level of Evidence A
2018 ESC/EACTS Guidelines on myocardial revascularization [26].	After coronary artery bypass grafting or percutaneous coronary intervention for acute myocardial infarction, participation in a cardiac rehabilitation programme is recommended to improve patient outcomes.	Class I Level of Evidence A
2016 European Guidelines on cardiovascular disease prevention in clinical practice [27]	Participation in a cardiac rehabilitation programme for patients hospitalized for an acute coronary event or revascularization, and for patients with heart failure, is recommended to improve patient outcomes.	Class I Level of Evidence A
Management of Adult Stroke Rehabilitation Care: a clinical practice guideline [28].	The provision of comprehensive rehabilitation programs with adequate resources, dose, and duration is an essential aspect of stroke care and should be a priority.	Class I Level of Evidence A
Guidelines for Adult Stroke Rehabilitation and Recovery. A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association [29].	It is recommended that stroke patients who are candidates for postacute rehabilitation receive organized, coordinated, interprofessional care. Every patient should have access to an experienced multidisciplinary rehabilitation team to ensure optimal outcome. Rehabilitation interventions initiated early after stroke can enhance the recovery process and minimize functional disability. Improved functional outcomes for patients also contribute to patient satisfaction and reduce potential costly long-term care expenditures. Better clinical outcomes are achieved when post-acute stroke patients who are candidates for rehabilitation receive coordinated, multidisciplinary evaluation and intervention. The patient and family/caregivers should be given information and provided with an opportunity to learn about the causes and consequences of stroke, potential complications, and the goals, process, and prognosis of rehabilitation.	
National Institute for Health and Care Excellence. Stroke rehabilitation: long-term rehabilitation after stroke [30,31].	People with disability after stroke should receive rehabilitation in a dedicated inpatient unit and subsequently from a specialist stroke team within the community. The core stroke rehabilitation team should comprise the following professionals with expertise in stroke rehabilitation: physician, nurse, physiotherapist, occupational therapist, speech and language therapist, clinical psychologist, rehabilitation assistant, and social worker.	
Guidelines for the Management of Spontaneous Intracerebral Hemorrhage. A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association [32].	Given the potentially serious nature and complex pattern of evolving disability and the increasing evidence for efficacy, it is recommended that all patients with intracerebral hemorrhage have access to multidisciplinary rehabilitation	Class I Level of Evidence A

life and prognosis after acute coronary syndromes and/or coronary revascularization [45–48]. Nonetheless, cardiac rehabilitation still is underdeveloped and underused in Europe, with participation rates ranging between 30 and 50% of eligible patients [49,50]. As for pulmonary rehabilitation, insufficient healthcare professional and patient awareness and knowledge of the benefits of cardiac rehabilitation and funding constraints have been regarded as major drivers of the underutilization of cardiac rehabilitation [49,50]. In a paper published in 2013, the European Heart Network stated, a) "*Improving the implementation of cardiac and stroke rehabilitation programs makes economic sense. These services are cost-saving and cost-effective and represent an investment rather than an expense*". b) "*Cardiac and stroke rehabilitation programs must be an integral part of the patient's treatment plan.*" c) *Rehabilitation programs should be accessible for all eligible patients, regardless of gender, age, socio-economic status, ethnicity or their place of living*" [50]. Because these recommendations remain largely unmet, further efforts should be dedicated by stakeholders to enhance availability and affordability of quality cardiac rehabilitation for suitable patients with coronary disease.

2.1.3. Stroke rehabilitation

In an influential article published in Lancet in 2011, Langhorne et al. underscored the complexity of stroke recovery after rehabilitation [51]. Stroke recovery, indeed, probably results from the variable combination of spontaneous neurological recovery and learning-dependent processes, including restitution, substitution, and compensation [51]. The relative contribution of spontaneous neurological recovery and learning-dependent processes to recovery in patients with stroke remains however substantially undefined.

Rehabilitation is an essential component of the care of patients after stroke [52]. According to the American Heart Association/American Stroke Association -Endorsed Practice Guidelines, the primary goals of stroke rehabilitation are to prevent complications, minimize impairments and maximize function. In addition, secondary prevention aimed at preventing stroke recurrence as well as coronary vascular events was recognized as a fundamental goal of stroke rehabilitation [29]. Although motor impairment accounts for most disability post-stroke, the presence of other common stroke-related impairments adds complexity to initial assessment and goal setting and may influence rehabilitation outcome. Research addressing basic mechanisms of neurological recovery, neuroplasticity-promoting strategies, and novel treatments is being actively conducted [53–56]. So far, however, rehabilitation remains the standard of care for motor impairment post-stroke [53].

While a favourable outcome in terms of improved motor impairment after rehabilitation may reasonably be expected in patients with mild or moderate stroke, those with severe stroke have a poor prognostic outlook. Approximately 20–25% of stroke survivors present severe disability [57,58]. Such patients are more often referred to convalescent or skilled nursing facilities rather than to inpatient rehabilitation facilities, possibly reflecting a medical attitude to favour patients with relatively less disability for inpatient rehabilitation facility care [57–59]. Indeed, because of several reasons including perceived low potential for improvement, expected long length of stay, and concerns about increased resources use, patients with severe disability are generally perceived as poor candidates for inpatient rehabilitation facility care, leading to inequities in access [60–64]. Inequities in access to inpatient rehabilitation facilities for patients with severe stroke have been recognized as an international issue [63]. Rehabilitation outcomes of patients with the most severe disability are poorly characterized [61,62]. To fill this gap of knowledge, we studied 1265 patients classified as case-mix groups 0108, 0109, and 0110 of the current Medicare case-mix classification system [65]. The Medicare classification system is based on the Functional Independence Measure and distinguishes 10 case-mix groups for stroke rehabilitation. Patients are assigned into 1 of the 10 case-mix groups based on age, the sum of weighted ratings for 12 Functional Independence Measure motor items (transfer to tub or shower item is excluded), and the sum of Functional Independence Measure cognitive ratings [65]. The case-mix groups 0108, 0109 and 0110 encompass the most severely disabled patients. We found that early rehabilitation ($\leq$30 days from the occurrence of stroke) was associated with an incremental benefit with respect to late rehabilitation, possibly reflecting the greater contribution of spontaneous recovery in the first weeks after stroke occurrence, and that more than half of the patients derived a clear benefit from rehabilitation in terms of motor impairment [65]. We used the Functional Independence Measure, which is the most commonly used measure of functioning worldwide, for initial assessment of the severity of stroke and as outcome measure. The WHO's International Classification of Function, Disability, and Health (ICF), "*which provides a framework for the effect of stroke on the individual in terms of pathology (disease or diagnosis), impairment (symptoms and signs), activity limitation (disability), and participation restriction*" could be more informative about the effect of stroke on individual and help developing a more comprehensive treatment plan in the rehabilitation setting [51].

With regard to the possible effect of stroke rehabilitation on survival, two recent studies showed that the magnitude of improvement in motor impairment after rehabilitation was positively associated with long-term survival, regardless of age, gender, cardiovascular comorbidities, the etiology and severity of stroke (as assessed by the National Institutes of Health Stroke Scale), and the initial severity of disability [66,67]. This effect was confirmed in the most severely disabled post-stroke patients [65]. Although the demonstration of an association does not prove causality, these findings should prompt the multidisciplinary team to maximize the efforts to improve functioning as much as possible. Coordination and communication among the team members are key to maximizing the effectiveness of rehabilitation [29]. Early referral to inpatient rehabilitation facilities after stroke is essential. Langhorne et al. recently published the INTERSTROKE study, including 12,342 patients with stroke from 108 hospitals in 28 countries [68]. After adjustment for patient case-mix and country wealth, the provision of antiplatelet treatment to the patients with cerebral infarction, the availability of stroke unit care and post-discharge rehabilitation were each associated with a greater chance of survival without severe dependency [68].

Table 2 summarizes the clinical benefits of pulmonary, cardiac and stroke rehabilitation.

Table 2
Clinical benefits of pulmonary, cardiac and stroke rehabilitation [18–34,50,52,69].

Outcomes	Pulmonary rehabilitation	Cardiac rehabilitation	Stroke rehabilitation
Education	✓	✓	✓✓
Risk factor modification	✓✓	✓✓	✓✓
Secondary prevention	✓	✓✓	✓✓
Adoption of a healthy lifestyle	✓✓	✓	
Health-related quality of life	✓✓	✓	✓✓
Mastery	✓	✓	✓✓
Symptom improvement	✓✓	✓	✓✓
Functional improvement			✓✓
Exercise tolerance	✓✓	✓✓	
Prevention of Falls			✓
Disability	✓✓	✓✓	✓✓
Prevention of complications (early referral)	✓	✓✓	✓
Mortality		✓✓	✓
Unplanned hospital readmissions	✓	✓✓	

2.2. Rehabilitation and internal medicine across the continuum of care

In the last years, the role of rehabilitation has evolved as patients with increasing levels of medical complexity and disease severity are increasingly being admitted to rehabilitation programs. As underscored by the WHO, there is strong evidence that the provision of inpatient rehabilitation in specialized rehabilitation units to people with complex needs is effective in reducing mortality, increasing independence and keeping people at home [69]. In addition, there is substantial evidence that rehabilitation is effective for the prevention of functional deterioration and hence of further disability in patients with complex and/or severe chronic diseases [69]. This evidence of effectiveness indicates that rehabilitation should be regarded as an essential part of the continuum of care and should therefore more efficiently be integrated at all levels of the health system and made available across the continuum of care for suitable patients [11,69]. In the current scenario of chronicity, multiple pathologic conditions, and medical complexity, the strict interaction between rehabilitation and the holistic clinical vision of internal medicine would represent an added value for the continuum of care for chronic multi-pathologic patients.

2.3. The international classification of functioning, disability and health: a framework for improving functional assessment and outcomes in the rehabilitation setting

The ICF is nowadays universally established as the landmark for rehabilitation medicine, since its launch by the WHO in 2001 [70,71]. Its structure characteristics, based on a hierarchic and progressive encoding system, allows the patient description from a bio-psycho-social perspective, where the ICF components represent the four factors that play a crucial role in a person's description: b, body functions (physiological performing of the body, mental functions included); s, body structures (anatomical parts of the body); d, activities and participation (set of relevant tasks that represent what one is able to do in everyday life); e, environmental factors (which include facilitators and barriers). The operational value of the classification is represented by qualifiers that describe the severity of the impairment or the restrictions in everyday life activities (ranging from 0 - total absence impairment/restriction of ability and participation - to 4 - complete impairment/restriction of ability and participation). Its major strength is represented by the ability to integrate disparate functioning domains (such as physical, personal, social and environmental aspects) into a holistic vision of health and disability. A second gain of its implementation in healthcare is the possibility to provide a shared, specific language, able to connect multi-professional teams, where the predominance of the organic components yields place to a complex, mutual-related and mutual-dependent network of biopsychosocial factors that altogether outline the current functioning “portrait” of the patient. Furthermore, the relevance of the ICF implementation in healthcare lays the groundwork for the growing importance of personalized and patient-centered medicine, as it recognizes the necessity to tailor interventions along all life situations and towards patient-relevant issues. Nowadays, personalized and patient-centered medicine should be regarded as major issues of internal medicine due to the multi-faceted complexity of most chronic patients.

In synthesis, when coming to assessment and patient description in rehabilitation medicine, the ICF framework is supported by a sound international literature, mainly focused on research, covering chronicity over a wide perspective [72], ranging from spinal cord injury [73,74] to cancer [75], from stroke [76] to palliative care [77]. Even if the debate upon being the ICF a sound tool for outcome measure is still open [78], mainly related to inter-rater reliability and validity issues [79,80] and to its clinimetric properties [81], when coming to consider the ICF as a framework to guide outcome assessment, literature supports its central role in providing sound information able to describe both rehabilitation medicine objectives and outcome [82–84]. In fact, ICF cannot be considered as an outcome measure by itself, but when the qualifiers are operationalized, proper training on the framework is provided, and the ICF codes are associated with reliable already existing assessment tools, following the well-established linking rules [85], new perspectives are provided as to goals and outcome, both in rehabilitation [86] and in acute settings [81,87]. Given the wide number of the ICF codes available, in order to simplify clinical practice implementation, core sets were identified as being able to describe specific patients' conditions [88,89] and ICF codes were linked to specific assessment tools, in order to enhance comparability of health information and set the ground to a common language across all levels of health care systems [85]. A sound and extensive literature is available on the strengths of the ICF model in providing a holistic patient's description, but when coming to real life implementation, few experiences are described, mainly focusing to single conditions or confined to a restricted period of time [90–92] and only one describes the framework implementation in every day clinical practice in rehabilitation medicine [93].

Even if the ICF implementation in real life is in its early steps, one of the strongest points of the ICF framework relies in its ability to describe functioning with a language that can be transversally acknowledged, through nationalities, races, age cohorts and health conditions. This universality of a common language has led to propose the ICF in rehabilitation medicine as the “third health indicator, complementing the established indicators of mortality and morbidity” [94]. Taken these three aspects together they could allow to monitor the health care systems in goal setting and outcome assessment. Moreover, when dealing with Diagnosis-Related Group case-mix systems, information on functioning could become an important factor being able to describe resource use: by adding functioning information, the system in hospital settings could be improved by better describing resource use, such as higher costs and lengths of stay for the frail elderly and for the severely impaired patients [95]. Integrating both the International Classification of Diseases and the ICF classification in patient's description could help to shed light on the complexity that rehabilitation medicine has to deal with in the modern society [96–98]. Complexity is not to be considered as a synonymous of complicated, but stays for the necessary integration of interrelated information (i.e. internal medicine issues, rehabilitation goals, pharmacotherapy, diagnostic and rehabilitation procedures, social environment, aids): the computational models that may describe rehabilitation medicine are necessarily nonlinear and need to integrate networks of actors and multiple nodes of interrelations [99]. The joint use of the WHO classification could provide, through a comprehensive approach, cues in patient's holistic description and assessment and could aid to better define rehabilitation goals and to identify the specific procedures linked to specific objectives and outcomes, by catching information on disability and on recovery in functioning. In Fig. 1 are synthesized the principal steps that should characterize the patient's process in rehabilitation medicine, by integrating International Classification of Diseases and ICF classification in the clinical care pathways [93,98].

Joint International Classification of Diseases and ICF implementation in every day clinical practice could allow standardizing the information reported in digital health records and providing a benchmark by which research and clinical data could be compared internationally. Nowadays data comparison is considered mandatory worldwide and big data analysis require a shared standard, often a challenge more than a reached objective, where digital transformation is unfortunately not as straightforward as needed [100]. Usability problems are tackled every day and a lean perspective should always guide the digital transformation [101], where the centrality should always be provided to contents more than tools and to patient's clinical management.

3. Conclusions

In conclusion, there is substantial evidence that patients with COPD,

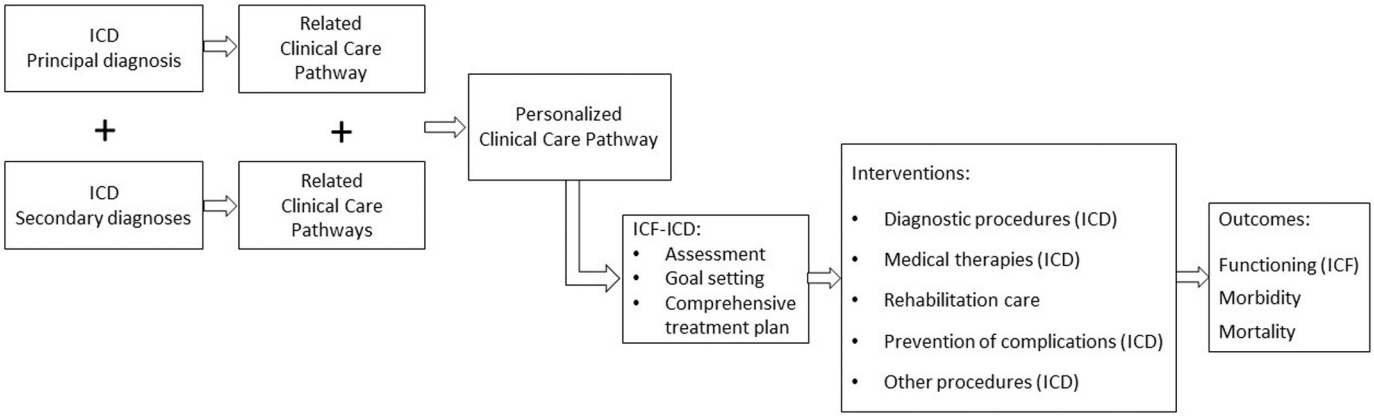

Fig. 1. The principal steps that should characterize the patient's process in rehabilitation medicine, by integrating ICD (International Classification of Diseases) and ICF (International Classification of Functioning Disability and Health) in the clinical care pathways, are represented. The ICD diagnosis is declined in the related Clinical Care Pathway and its aims are defined through the ICF framework. The ICF is intended as a tool enabling to define goals and to describe the rehabilitation outcome.

IHD, or stroke can significantly benefit from high-quality rehabilitation. Implementation of the ICF in the rehabilitation setting might allow achieving better outcomes. Despite the evidence of benefit, however, rehabilitation still is underdeveloped and underused. Further efforts should be devoted to foster healthcare professional awareness of the benefits of rehabilitation and to increase referral and participation.

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Conflict of interest

None declared.

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