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Gerold Stucki

Ludwig-Maximilian University Munich; Swiss Paraplegic Research

Jan Dietrich Reinhardt

Swiss Paraplegic Research; University of Lucerne


Gunnar Grimby

Institute of Neuroscience and Physiology

John Melvin

Department of Rehabilitation Medicine, Jefferson Medical College, Thomas Jefferson University

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SPECIAL REPORT

DEVELOPING “HUMAN FUNCTIONING AND REHABILITATION RESEARCH” FROM THE COMPREHENSIVE PERSPECTIVE*

Gerold Stucki, MD, MS^{1,2,3}, Jan Dietrich Reinhardt, PhD^{3,4}, Gunnar Grimby, MD, PhD⁵
and John Melvin, MD, MMSc⁶

From the ¹Department of Physical Medicine and Rehabilitation, ²ICF Research Branch of the WHO CC FIC (DIMDI), Institute for Health and Rehabilitation Sciences, Ludwig-Maximilian University Munich, Germany, ³Swiss Paraplegic Research, Nottwil, ⁴Faculty of Humanities, University of Lucerne, Lucerne, Switzerland, ⁵Rehabilitation Medicine, Institute of Neuroscience and Physiology, Sahlgrenska Academy, Göteborg University, Göteborg, Sweden and ⁶Department of Rehabilitation Medicine, Jefferson Medical College, Thomas Jefferson University, Philadelphia, USA

With the International Classification of Functioning, Disability and Health (ICF) the World Health Organization (WHO) has prepared the ground for a comprehensive understanding of Human Functioning and Rehabilitation Research, integrating the biomedical perspective on impairment with the social model of disability. This poses a number of old and new challenges regarding the enhancement of adequate research capacity. Here we will summarize approaches to address these challenges with respect to 3 areas: the organization of Human Functioning and Rehabilitation Research into distinct scientific fields, the development of suitable academic training programmes and the building of university centres and collaboration networks.

Key words: rehabilitation, functioning, disability, ICF, research.

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Correspondence address: Gerold Stucki, Department of Physical Medicine and Rehabilitation, University Hospital Munich, Marchioninistrasse 15, DE-81377 Munich, Germany. E-mail: gerold.stucki@med.uni-muenchen.de

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INTRODUCTION

The integrative model of human functioning and disability provided by the World Health Organization (WHO) with its International Classification of Functioning, Disability and Health (ICF) (1) has provided the scientific community with a paradigm change (2) in rehabilitation and related research. At least, a competitor for the long-time dominant biomedical paradigm has been introduced with regard to a wider understanding of human functioning. The term “human functioning” points at the inter-relatedness of body functions and structures, individual activity and societal participation within health-related human experience. Likewise, disability may no longer be seen as an attribute of the person, but as an experience (3–6) that may

comprise some, or all, of the following: impairment at the body level, limitation in activities, and restriction in participation.

The universal human experiences of functioning and disability are not only related to health conditions but occur in the context of facilitating or hindering environments and personal resources (Fig. 1 shows the integrative or comprehensive model of functioning in contrast to the traditional biomedical perspective). Against the background of the integrative model of functioning and disability, rehabilitation can be understood as one out of 4 health strategies also including prevention, cure and support. Rehabilitation can be defined briefly as the health strategy that aims to enable people with health conditions experiencing or likely to experience disability to achieve and maintain optimal functioning in interaction with the environment (6). Accordingly, physical and rehabilitation medicine (PRM) is the medical specialty applying rehabilitation as its main strategy (7).

Given that “about six hundred million people live with physical and mental disabilities of various types”, that there is a “rapid increase in the number of persons with disabilities” (8), and that “today’s investments in rehabilitation research are investments in improved rehabilitation care in the future”

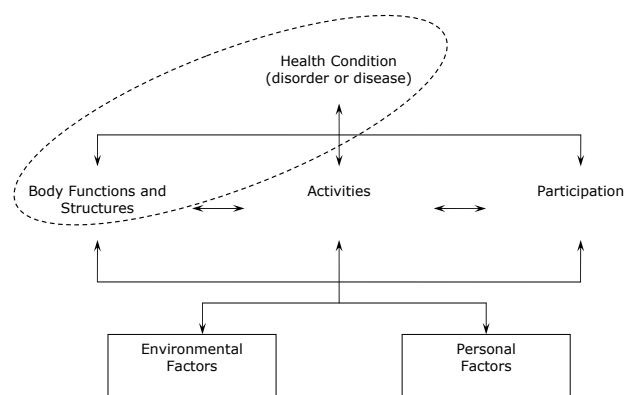


Fig. 1. The focused perspective based on the biomedical model (dotted circle) vs the comprehensive perspective based on the integrative model (whole figure).

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(9), there is an urgent need to increase rehabilitation research capacity (10, 11). Comprehensively understood rehabilitation builds on fundamental knowledge about the biological, psychological and social dimensions as well as determinants of human functioning and disability. We therefore suggest referring to this needed research as “Human Functioning and Rehabilitation Research”.

Challenges in the building of research capacity in the area of Human Functioning and Rehabilitation include the lack of a globally agreed conceptualization and organization of Human Functioning and Rehabilitation Research (9, 10, 12), the absence of appropriate funding channels (9–11), the need for interdisciplinary research efforts as well as community-based collaboration networks (11,13), and the lack of appropriate training and education programmes as well as career opportunities for human functioning and rehabilitation researchers (11, 14, 15). These challenges have been outlined in detail elsewhere (16, 17).

Here we will summarize approaches to address these challenges with respect to 3 areas: the organization of Human Functioning and Rehabilitation Research into distinct sci-

entific fields; the development of suitable academic training programmes; and the building of university centres and collaboration networks.

The aim of this paper is to stimulate the discussion initiated by a recent special issue of the *Journal of Rehabilitation Medicine* (17).

DISTINCT SCIENTIFIC FIELDS OF HUMAN FUNCTIONING AND REHABILITATION RESEARCH

Currently, the organization of Human Functioning and Rehabilitation Research into distinct scientific fields is lacking (9, 10, 14). However, distinct scientific fields are pivotal for the meaningful structuring of any research area, the fruitful division of labour, the advancement of innovations, and the development of a common identity among researchers. We have therefore suggested 5 distinct scientific fields for human functioning and rehabilitation, covering research from the cell to society (18, 19). The basis for the delineation of these distinct scientific fields is the general distinction in basic, applied and professional sciences applicable to research in

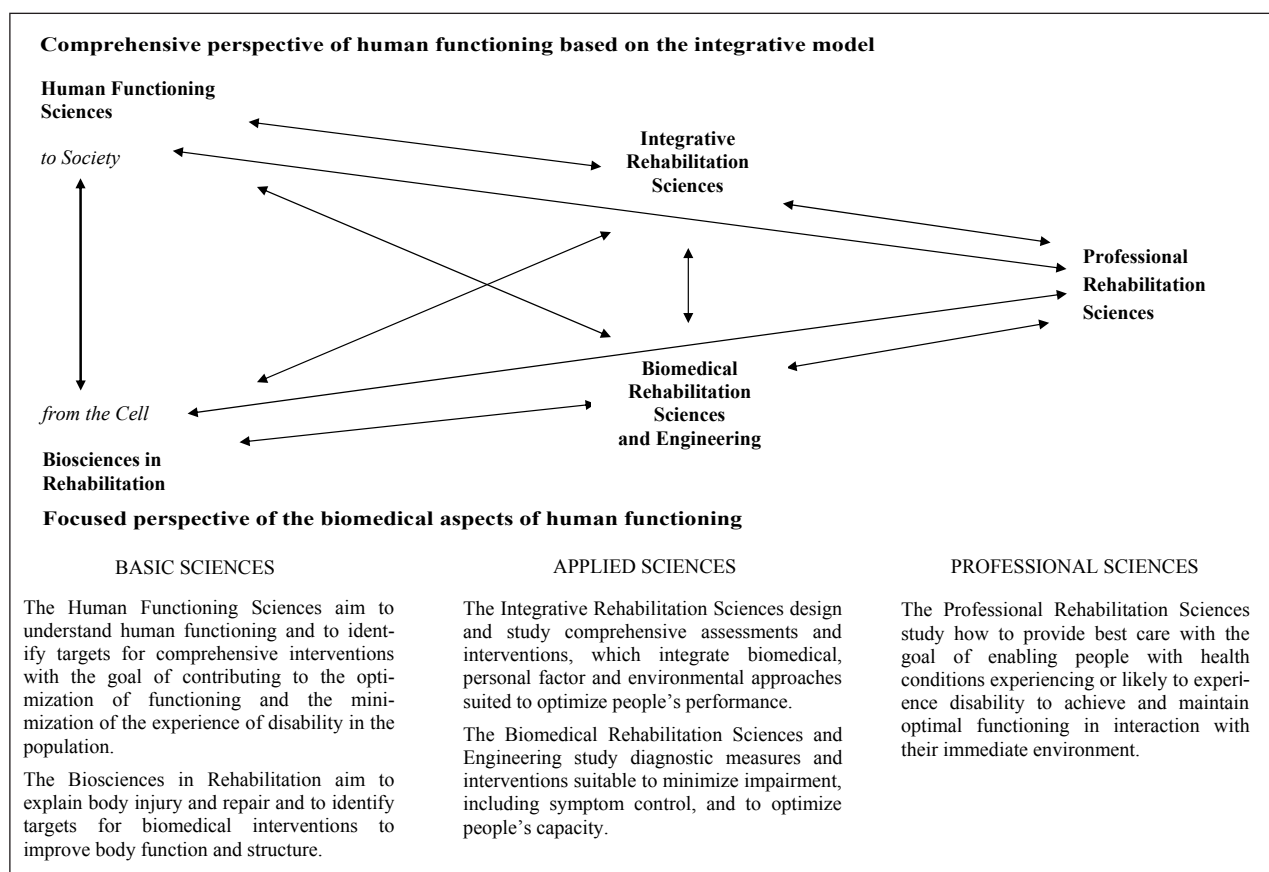


Fig. 2. Distinct scientific fields in Human Functioning and Rehabilitation Research. The figure illustrates relationships in the process of communication of scientific knowledge between distinct scientific fields. The double arrows indicate that knowledge may be communicated in both directions. The horizontal dimension symbolizes the confluence of knowledge generated by the basic and applied sciences to serve the professional sciences, and vice versa. The vertical dimension distinguishes the comprehensive perspective based on the integrative model of functioning from the focused perspective of the biomedical aspects of functioning. Diagonal arrows thus display flows of knowledge with respect to both dimensions. Adopted from (18).

general, and the rehabilitation relevant distinction between the comprehensive perspective based on the WHO's integrative model of human functioning and the more focused perspective of the biomedical aspects of functioning.

Fig. 2 shows a graphical depiction of the organization of Human Functioning and Rehabilitation Research into five distinct scientific fields (18). The figure also includes a short description of these fields. The Biosciences in relation to rehabilitation and the Biomedical Rehabilitation Sciences and Engineering are well established. There is now the need to systematically develop research from the comprehensive perspective in the emerging Human Functioning Sciences and Integrative Rehabilitation Sciences. It is also time to further develop the Professional Rehabilitation Sciences that are situated at the interface of research and practice as well as the focused and comprehensive perspectives of functioning. "Scientific discovery" in particular needs to be established "as an institutional core set of values within professional organizations" (11).

A better understanding of the distinct scientific fields can be gained by describing their particular research domains (19). Accordingly, Table I shows the domains of research. While the research domains of the Human Functioning Sciences can be identified and described with regard to the generic research process,

which involves theory building and observation, the research domains of the Integrative Rehabilitation Sciences can be identified and described by drawing on the public health approach. The research domains of the Professional Rehabilitation Sciences are geared to domains established in the clinical sciences.

Research relevant to the five distinct scientific fields in the area of Human Functioning and Rehabilitation is presented at a wide range of conferences and is published in a wide range of journals. A list of scientific journals assigned to the five distinct scientific fields has been provided elsewhere (20). This list may serve scientists interested in human functioning and rehabilitation research as an initial guideline, while identifying possibilities for the submission of papers as well as sources of scientific information and platforms for scientific exchange and discourse.

The organization of Human Functioning and Rehabilitation Research into the five distinct scientific fields facilitates the development of academic training programmes and career building as well as the development of research structures dedicated to Human Functioning and Rehabilitation Research, as described in the following sections. Before we do this, we would like to sketch the potential of the emerging distinct scientific field of Human Functioning Sciences.

Table I. *Domains of research in five distinct scientific fields of Human Functioning and Rehabilitation Research. Adopted from (19)*

<i>Human Functioning Sciences</i>
Theory and models of functioning
Classification and measurement of functioning
Functioning epidemiology
Functioning impact assessment
<i>Integrative Rehabilitation Sciences</i>
Rehabilitation services research
including health policy and law, rehabilitation economics and community-based participatory research
Rehabilitation intervention research
including rehabilitation intervention programme research; rehabilitation technology assessment in clinical and community settings, technology transfer; and applying research designs ranging from randomized controlled trials to observational studies
Rehabilitation administration and management
including the development of integrated care and service concepts and ICF-based case management programmes as well as the design of other structures and processes in rehabilitation institutions
<i>Biosciences in Rehabilitation (examples)</i>
Tissue injury and repair
Plasticity
Homeostatic mechanisms of muscle contraction
<i>Biomedical Rehabilitation Sciences and Engineering</i>
Research in relation to organ systems, e.g. cardiopulmonary, musculoskeletal or neurological rehabilitation research
Research in relation to intervention principles, e.g. rehabilitation engineering, occupational therapy and physiotherapy research, drug trials
<i>Professional Rehabilitation Sciences</i>
Standards and guidelines for the provision of best care
Rehabilitation quality management
Scientific education and training of professionals in rehabilitation
Development and evaluation of the rehabilitation team

ICF: International Classification of Functioning, Disability and Health.

HUMAN FUNCTIONING SCIENCES: AN EMERGING BASIC SCIENCE FOR REHABILITATION FROM THE COMPREHENSIVE PERSPECTIVE

While the established Biosciences in Rehabilitation represent basic sciences interested in the fundamental understanding of the biomedical aspects of functioning, the Human Functioning Sciences have the potential to become basic sciences from the comprehensive perspective (18, 19). Basic research from the comprehensive perspective should take into account all components and determinants of functioning, and particularly their interdependency and interactions (21, 22). Firstly, the Human Functioning Sciences thus should comprise the development of theory and models addressing the complex interplay of various factors from the physiological to the societal level. Secondly, it is also indispensable that they encompass systematic efforts to classify and measure all involved variables. On the basis of theory and classification the Human Functioning Sciences should then guide respective scientific observation. This includes, thirdly, the accomplishment of epidemiological studies suited to comprehensively describe functioning at the population level as well as to test respective theories. Fourthly, it should entail the modelling of the impact of intended and non-intended changes in the physical and social environment on future functioning. (19). Table II shows an ICF-based conceptual description of the Human Functioning Sciences.

ACADEMIC TRAINING PROGRAMMES IN HUMAN FUNCTIONING AND REHABILITATION RESEARCH

Research without people is impossible. A key to building research capacity in Human Functioning and Rehabilitation

Table II. ICF-based conceptual description of Human Functioning Sciences. Terms referring to components of the ICF model are written in bold. Adopted from (19)

Human Functioning Sciences

are basic sciences which
based on WHO's integrative **model of human functioning and disability**

and focusing on populations:

- 1 develop and test theories and models of **functioning**;
- 2 develop classifications and measurements of **functioning**;
- 3 study the incidence, prevalence, and distribution of factors associated with **functioning** and **disability** across **health conditions**, populations and **environments**, and over time;
- 4 predict the impact of intended and non-intended changes in the physical and social **environment** on **functioning** including the impact of:
 - proposals (policies, programmes and projects) in the health sector and across sectors;
 - changes in the provision of and the payment for services;
 - the costs and benefits of implementing new products and procedures;
- 5 inform and advise the public, policy- and decision-makers
 - about the burden associated with **health conditions** and the consequences of intended and non-intended changes in the physical and social **environment** on **functioning**.

with the goal:

to contribute to the understanding of **functioning** of people with **health conditions** and the minimization of the experience of **disability** in the population and in specific groups.

ICF: International Classification of Functioning, Disability and Health.

Research is thus the development of a qualified workforce. We currently face a double challenge regarding firstly the establishment of academic training programmes, and secondly the creation of attractive career opportunities for Human Functioning and Rehabilitation researchers (11, 14, 15). The adoption of the ICF as unifying conceptual model for rehabilitation, the emergence of distinct scientific fields in the area and the change to Bachelor and Masters in Europe provide opportunities now to initiate innovative academic training programmes in Human Functioning and Rehabilitation Research.

Applied training may include certificate programmes in rehabilitation effectiveness and Master and Doctoral programmes in rehabilitation with concentration, e.g. in rehabilitation studies, management, education and rehabilitation counselling. Scientifically oriented training may include certificate, Master of Science and PhD programmes in the Human Functioning Sciences and Integrative Rehabilitation Sciences. Collaborative Master and Doctoral programmes with the rehabilitation professions, the movement sciences, psychology, the behavioural sciences, and the social sciences are also a promising approach. When initiating the process to develop these programmes one may learn from and co-operate with programmes established in public health.

Table III shows envisioned academic training programmes in Human Functioning and Rehabilitation Research. A detailed description of the careers and training programmes can be found elsewhere (15).

Table III. Academic training programmes in Human Functioning and Rehabilitation Research. Adopted from (15)

Programmes from the comprehensive perspective based on the integrative model of human functioning

<i>Programme</i>	<i>Diploma specification</i>	<i>Target group</i>
Certificate Programme	Human Functioning and Rehabilitation	Related professional disciplines*
Applied Master/Doctorate	Rehabilitation Management Rehabilitation Counselling Rehabilitation Education Rehabilitation Studies	Related professional disciplines*
Collaborative Applied Master/Doctorate	Physiotherapy and Occupational Therapy (or another related professional discipline) Professional Rehabilitation Sciences	Related professional disciplines*
Master of Science/PhD	Human Functioning Sciences Integrative Rehabilitation Sciences	Related professional disciplines* Related scientific disciplines and fields†
Collaborative Master of Science/PhD	Human Functioning and Rehabilitation Sciences Sociology (or another related scientific discipline) and Human Functioning Sciences Integrative Rehabilitation Sciences Human Functioning and Rehabilitation Sciences	Related scientific disciplines and fields†
<i>Programmes from the focused perspective of the biomedical aspects of human functioning</i>		
Master of Science/PhD	Biomedical Rehabilitation Sciences	Related scientific disciplines and fields‡
Collaborative Master of Science/PhD	Movement Sciences (or another related scientific discipline) and Biomedical Rehabilitation Sciences	Related scientific disciplines and fields‡

*Related professional disciplines: Clinical Psychology, Physical and Rehabilitation Medicine and other medical specialties applying the rehabilitation strategy as a major strategy (6), Neuro-Psychology, Nursing, Occupational Therapy, Physiotherapy, Rehabilitation Counselling, Social Work, Speech Therapy.

†Related scientific disciplines and fields: Integrative Rehabilitation Sciences: Economics, Education, Environmental Engineering, Health Services Research, Health Management, Psychology; Human Functioning Sciences: Anthropology and Cultural Geography, Architecture and Design, Behavioural Sciences, Biostatistics, Decision Science and Epidemiology, Health Policy, History, Political Sciences and Economics, Public health, Sociology and Social Psychology.

‡Related scientific disciplines and fields: Applied and Exercise Physiology, Movement and Sports Sciences, Nutrition Science and Pharmacology, Rehabilitation Engineering, Molecular and Genetic Biology, Neurobiology, Sensory Physiology.

INTERDISCIPLINARY UNIVERSITY CENTRES AND COLLABORATION NETWORKS

There is hardly an academic discipline that is not at least partially relevant to Human Functioning and Rehabilitation Research from the comprehensive perspective. Conversely, Human Functioning and Rehabilitation Research offers practice-driven research questions to scholars of the most diverse disciplines. It thus bears an enormous potential for the establishment of interdisciplinary research centres across university faculties and research institutes. It also fits well into an academic landscape in which interdisciplinarity is more and more valued, e.g. in international calls (13).

Moreover, a better understanding of human functioning and disability will uncover unexplored possibilities to optimize populations’ functioning and minimize individuals’ experience of disability in the presence of a health condition. The ultimate goal of all Human Functioning and Rehabilitation Research is to integrate and translate scientific advances into benefits for people and society. It is thus highly interesting for, and relevant to, a wide range of different social groups and professions, such as people with disabilities and advocacy organizations, families and friends of people experiencing disability, doctors and other health professionals, social workers, politicians, architects, etc. Human Functioning and Rehabilitation Research therefore offers manifold possibilities for the creation of national, regional or international collaboration networks (13) comprising all groups of people that are affected by the research results. Although, largely, it has not been explored so far, community-based participatory research (23) will probably be an important means to increase the potential of Human Functioning and Rehabilitation Research to learn from people’s life worlds for people’s quality of life.

Figs 3 and 4 show selected scientific and professional disciplines that are related to Human Functioning and Rehabilitation

Research, while Fig. 5 shows groups of stakeholders in Human Functioning and Rehabilitation Research.

CONCLUDING REMARKS

Comprehensively understood Human Functioning and Rehabilitation Research holds an enormous potential to become a multi-faceted, but coherent, research area in which researchers from various disciplines and stakeholders from various backgrounds connect knowledge and efforts to improve functioning and quality of life of people experiencing disability. The integrative perspective of Human Functioning and Rehabilitation provides a new option for biomedical researchers and health professionals to look beyond their immediate fields of expertise. It also constitutes a particular opportunity for researchers from related disciplines, such as Psychology or Sociology, to embark into a research area that is highly relevant to both individual lives and societal practice.

However, standardized funding channels of Human Functioning and Rehabilitation Research are rarely available at the moment. Most funding programmes clearly refer to a focused perspective, most commonly the biomedical perspective, or to the perspective of a specific discipline (10). In addition, programmes that foster interdisciplinary research often have specific aims that may not reflect the research agenda of integrative researchers (10). Interdisciplinary grants as well as the parallel establishment of national, regional, and international collaboration networks and interdisciplinary university centres (13) are an important step towards “normal science” (2). Equally important is the building of research institutions from the comprehensive perspective on Human Functioning and Rehabilitation and the provision of appropriate infrastructure. The development of Swiss Paraplegic Research, which has been presented elsewhere, may serve as an example (24).

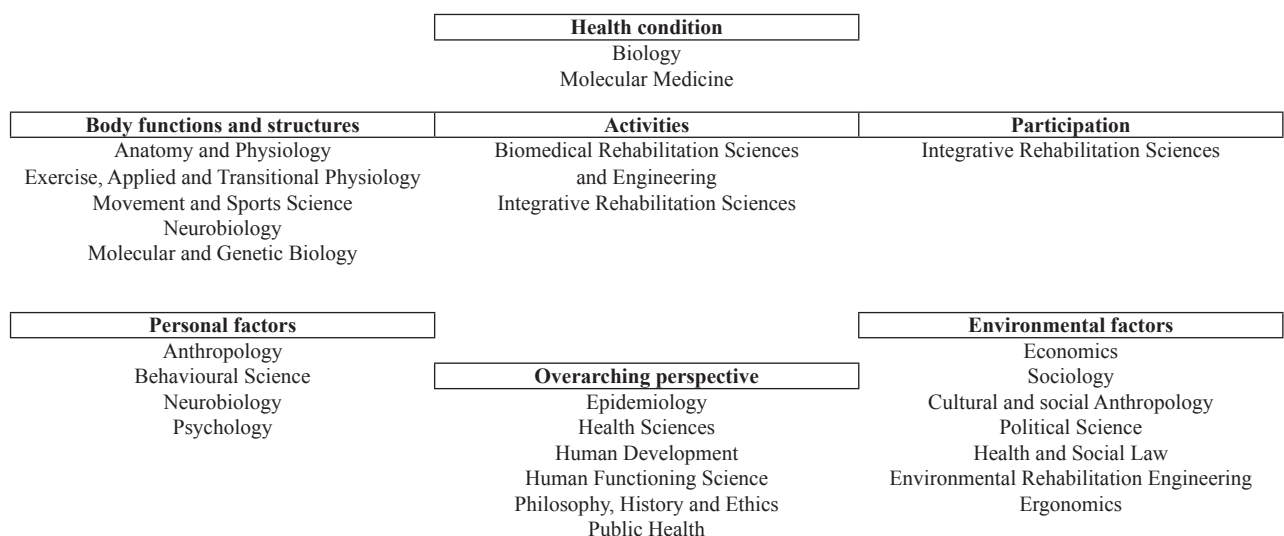


Fig. 3. Selected scientific disciplines related to Human Functioning and Rehabilitation Research. A discipline may be relevant to, focus on or integrate more than one International Classification of Functioning, Disability and Health (ICF) component. For practical reasons it is only listed under one component in most cases. Adopted from (13).

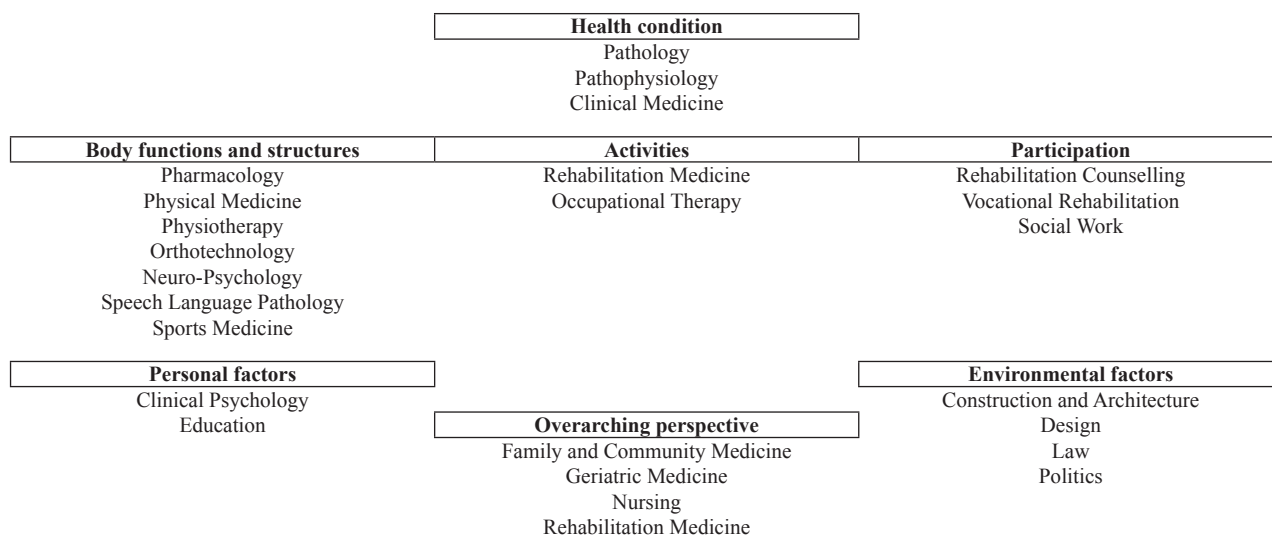


Fig 4. Selected professional disciplines related to Human Functioning and Rehabilitation Sciences according to the unifying conceptual model of the International Classification of Functioning, Disability and Health (ICF). A professional discipline may be relevant, focus or integrate more than one ICF component. For practical reasons it is only listed under one component. Adopted from (13).

Integrative research institutions can serve as centres of excellence and nodes for research and stakeholder collaboration as well as catalysts for research that crosses the boundaries of the Natural Sciences and Engineering Research, the Human and Behavioural Sciences and the Social Sciences (24).

Human Functioning and Rehabilitation Research that incorporates the comprehensive perspective may start from an interdisciplinary perspective. The ultimate goal, however, is to become transdisciplinary (25, 26), which “would not only cover interactions or reciprocity between specialized research projects, but would place these relationships within a total system without any firm boundaries between disciplines” (25). The goal is to

combine knowledge and models of differential disciplines in order comprehensively to understand human functioning across health conditions, individuals and environments.

REFERENCES

1. World Health Organization: International Classification of Functioning, Disability and Health: ICF. Geneva: WHO Publishing; 2001.
2. Kuhn TS. The structure of scientific revolutions. Chicago: University of Chicago Press; 1962.
3. Zola IK. Towards the necessary universalizing of disability policy. *The Milbank Quarterly* 1989; 67 Suppl 2 (Part 2: disability policy: restoring socioeconomic independence): 401–428.
4. Bickenbach JE, Chatterji S, Bradley EM, Üstün TB. Models of disablement, universalism and the international classification of impairments, disabilities and handicaps. *Soc Sci Med* 1999; 48: 1173–1187.
5. Grimby G, Melvin J, Stucki G. Foreword. Special issue: the ICF: a unifying model for the conceptualization, organization and development of human functioning and rehabilitation research. *J Rehabil Med* 2007; 39: 277–278.
6. Stucki G, Cieza A, Melvin J. The International Classification of Functioning, Disability and Health: a unifying model for the conceptual description of the rehabilitation strategy. *J Rehabil Med* 2007; 39: 279–285.
7. Stucki G, Melvin J. The International Classification of Functioning, Disability and Health: a unifying model for the conceptual description of physical and rehabilitation medicine. *J Rehabil Med* 2007; 39: 286–292.
8. 58th World Health Assembly. Resolution R114: disability, including prevention, management and rehabilitation. Adopted May 2005. Geneva: World Health Organization; 2005.
9. Fineberg HV. Science and medicine in the 21st century: opportunities for rehabilitation medicine. *Am J Phys Med Rehabil* 2005; 84: 928–931.
10. Frontera WR, Fuhrer MJ, Jette AM, Chan L, Cooper RA, Duncan PW, et al. Executive Summary. Rehabilitation medicine summit: building research capacity. *Am J Phys Med Rehabil* 2005; 84: 913–917.

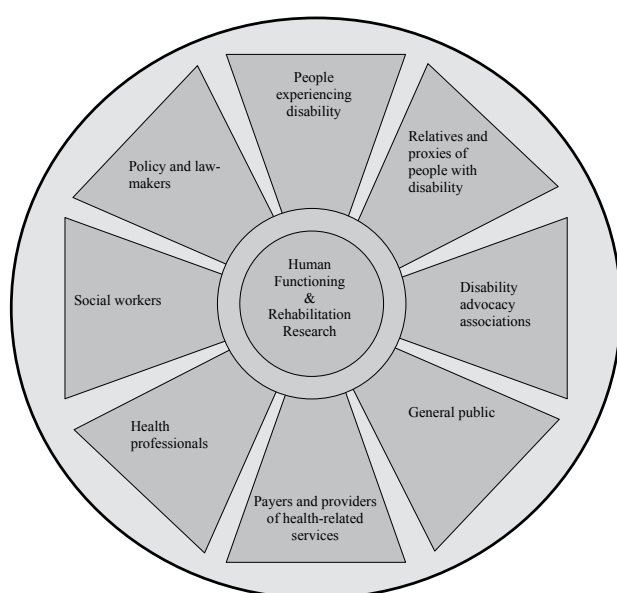


Fig. 5. Stakeholders in Human Functioning and Rehabilitation Research.

11. Grabois M. Through the looking glass: a personal view of the field of rehabilitation medicine. The 56th John Stanley Coulter Memorial Lecture. *Arch Phys Med Rehabil* 2007; 88: 408–412.
12. Stucki G. International Classification of Functioning, Disability and Health (ICF): a promising framework and classification for rehabilitation medicine. *Am J Phys Med Rehabil* 2005; 84: 733–740.
13. Stucki G, Celio M. Developing human functioning and rehabilitation research. Part II: interdisciplinary university centers and collaboration networks. *J Rehabil Med* 2007; 39: 334–342.
14. Whyte J. Training and retention of rehabilitation researchers. *Am J Phys Med Rehabil* 2005; 84: 969–975.
15. Stucki G. Developing human functioning and rehabilitation research. Part I: academic training programs. *J Rehabil Med* 2007; 39: 323–333.
16. Frontera WR, Fuhrer MJ, Jette AM, Chan L, Cooper RA, Duncan PW, et al., editors. Rehabilitation medicine summit: building research capacity. *Am J Phys Med Rehabil* 2005; 84: 913–1041.
17. Grimby G, Melvin J, Stucki G, editors. Special issue: the ICF: a unifying model for the conceptualization, organization and development of human functioning and rehabilitation research. *J Rehabil Med* 2007; 39: 277–342.
18. Stucki G, Grimby G. Organizing human functioning and rehabilitation research into distinct scientific fields. Part I: developing a comprehensive structure from the cell to society. *J Rehabil Med* 2007; 39: 293–298.
19. Stucki G, Reinhardt JD, Grimby G. Organizing human functioning and rehabilitation research into distinct scientific fields. Part II: conceptual descriptions and domains for research. *J Rehabil Med* 2007; 39: 299–307.
20. Reinhardt JD, Hofer P, Arenz S, Stucki G. Organizing human functioning and rehabilitation research into distinct scientific fields. Part III: scientific journals. *J Rehabil Med* 2007; 39: 308–322.
21. Wang PP, Badley EM, Gignac M. Exploring the role of contextual factors in disability models. *Disabil Rehabil* 2006; 28: 135–140.
22. Bartlett DJ, MacCnab J, MacArthur C, Mandich A, Magill-Evans J, Young NL, et al. Advancing rehabilitation research: an interactionist perspective to guide question and design. *Disabil Rehabil* 2006; 28: 1169–1176.
23. Israel BA, Schulz AJ, Parker EA, Becker AB. Review of community-based research: assessing partnership approaches to improve public health. *Annu Rev Public Health* 1998; 19: 173–202.
24. Stucki G, Reinhardt JD, Cieza A, Brach M, Celio M, Joggi D, et al. Developing Swiss paraplegic research: building a research institution from the comprehensive perspective. *Disabil Rehabil* 2007; July 14 [Epub ahead of print].
25. Piaget J. The epistemology of interdisciplinary relationships. In: Apostel L, Berger G, Briggs A, Machaud G, editors. *Interdisciplinarity – problems of teaching and research at universities*. Paris: OECD; 1972: p. 127–139.
26. Rosenfield PL. The potential of transdisciplinary research for sustaining and extending linkages between the health and social sciences. *Soc Sci Med* 1992; 35: 1343–1357.