

## DEVELOPING HUMAN FUNCTIONING AND REHABILITATION RESEARCH PART II: INTERDISCIPLINARY UNIVERSITY CENTERS AND NATIONAL AND REGIONAL COLLABORATION NETWORKS

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**There is a strong movement towards interdisciplinary research around common and scientifically competitive themes, both at universities and at the national and regional level. Human functioning and rehabilitation is a new, highly innovative and relevant theme. It has the potential to attract researchers from a wide range of disciplines, institutions and organizations. It is thus of interest for universities seeking to embark upon a new and unique research area. Similarly, it is a promising theme for individual researchers, institutions and organizations aiming to develop a national or regional collaboration network for interdisciplinary research. Human functioning and rehabilitation complements established themes from the biomedical perspective. In the context of the life sciences, it can be seen as an extension of the biosciences towards a comprehensive understanding of human life, including human interaction and communication, against the background of the natural and social environment. Based on a better understanding of human functioning and disability, there is a wide range of largely unexplored possibilities to optimize populations' functioning and minimize persons' experience of disability in the presence of a health condition. Rehabilitation research is uniquely positioned to integrate and translate scientific advances into benefits for people and the society. Rehabilitation research from the comprehensive perspective can thus become a catalyst of interdisciplinary research that crosses the boundaries of the natural sciences and engineering research, the human and behavioral sciences, the social sciences and a wide range of related scientific areas. Rehabilitation research is also uniquely positioned to cross the boundaries of medicine and the health sector at large, and to translate knowledge across sectors including education, labor and social affairs.**

*Keywords:* education, rehabilitation, human functioning sciences.

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### INTRODUCTION

“Health research traditionally has been organized much like a series of cottage industries, lumping researchers into broad areas

of scientific interest and then grouping them into departmentally based specialties. But, as science has advanced over the past decade and the molecular secrets of life have become more accessible, two fundamental themes are apparent: the study of human biology is a wonderfully dynamic process, and the traditional divisions within health research may in some instances impede the pace of scientific discovery” (1).

The promotion of interdisciplinary research, as outlined in this quote, is at the core of the US National Institutes of Health (NIH) strategy to “accelerate research with an eye toward improving the nation’s public health” (1). In line with the NIH strategy, universities now promote interdisciplinary research around common and scientifically competitive themes by fostering the creation of *interdisciplinary centers* that integrate classic disciplines within and across faculties. By the same token, national and regional funding agencies, such as the NIH or the European Union (EU), are promoting interdisciplinary research around relevant themes by funding *national and regional collaboration networks* involving research groups across universities and extra-university institutions and organizations as well as across states and countries.

There is a wide range of conceivable themes for interdisciplinary research. Funding agencies responsible for medicine and the health sector currently focus largely on interdisciplinary research within the realms of the “life and physical sciences”, which are “important areas which historically have had limited interaction” (1). A most successful example are the neurosciences. There are now interdisciplinary and highly competitive university centers and collaborative networks in the neurosciences that integrate life sciences and physical or natural sciences around the globe.

Unlike these developments, virtually all centers and networks within the realms of medicine take the partial perspective of human functioning based on the biomedical model (2). There are currently virtually no interdisciplinary research centers or networks committed to research from the comprehensive perspective based on the integrative model of human functioning as conceptualized in the International Classification of Functioning, Disability and Health (ICF) (2, 3) and committed to the rehabilitation strategy (4).

The aim of this paper is to discuss the relevance, potential and unique opportunity to develop interdisciplinary university centers and national and regional collaboration networks com-

mitted to the theme “human functioning and rehabilitation”. Specific aims are to: (i) briefly describe the theme human functioning and rehabilitation as a research area; (ii) review its relevance and potential; (iii) outline issues relevant to the organization of interdisciplinary centers at universities; and (iv) discuss partnerships for national and regional collaboration networks.

**BRIEF DESCRIPTION OF THE RESEARCH AREA HUMAN FUNCTIONING AND REHABILITATION**

Human functioning and rehabilitation aims to understand functioning and to prevent or minimize the experience of disability of individuals and groups of people with a health condition, and hence to optimize functioning and minimize the burden associated with disability in the society. The comprehensive or umbrella perspective based on the integrative model of human functioning as conceptualized in the ICF (2, 3) provides common ground for the research area.

The ICF integrates concepts of earlier models, such as the NIH model (5) and models from the partial biomedical, behavioral or social perspective (6). It serves as a unifying model for the conceptualization of the rehabilitation strategy (4) and the rehabilitation professions (7), the organization of human functioning and rehabilitation research into distinct scientific fields (2, 8), the development of academic curricula in human functioning and rehabilitation (9) and the development of rehabilitation research facilities focusing on the comprehensive perspective. The ICF model is increasingly accepted by researchers and practitioners committed to the understanding of human functioning and the application of the rehabilitation strategy. It can thus be seen as the new paradigm for human functioning and rehabilitation shared by the scientific community (6, 10).

According to this new paradigm, disability is understood both in relation to and as interaction between characteristics of the individual, including health conditions, impairments and personal resources on one hand, and characteristics of the natural as well as the social environment on the other (11, 12). The experience of disability of people with health conditions

may thus be minimized by the application and integration of biomedical and engineering approaches to optimize a person’s capacity, approaches that build on and strengthen the resources of the person, approaches that provide a facilitating environment and approaches that develop a person’s performance in the interaction with the environment (4). It is thus obvious, that human functioning and rehabilitation is closely related to a wide range of disciplines, including public health and biomedicine (8).

*Human functioning and rehabilitation research and public health*

The aim of human functioning and rehabilitation research is not only to minimize the experience of disability of individuals, but also of groups of people and in the population. Human functioning and rehabilitation research thus shares the population perspective with public health. Also, the ICF paradigm mirrors the ecological model, which sees health as determined by a wide range of biomedical, psychological and social factors. A more detailed description of the close relation of human functioning and rehabilitation research with public health research can be found in the accompanying paper on the domains for research in the section on integrative rehabilitation sciences (8).

*Human functioning and rehabilitation research and biomedicine*

Human functioning and rehabilitation research applies a biomedical approach when aiming to minimize people’s experience of disability by optimizing a person’s capacity. Human functioning and rehabilitation is thus closely related to the research areas “biology and medicine” or “biomedicine” (2).

Table I shows the characteristics of human functioning and rehabilitation research and of biomedicine. In a “bio-centric world”, people’s functioning is seen as a consequence, and hence the unidirectional outcome of health conditions. Conversely, in a “functioning-centric world”, biomedicine is seen as one among several other important perspectives. Fig. 1 illustrates the overlap and differences between the 2 views.

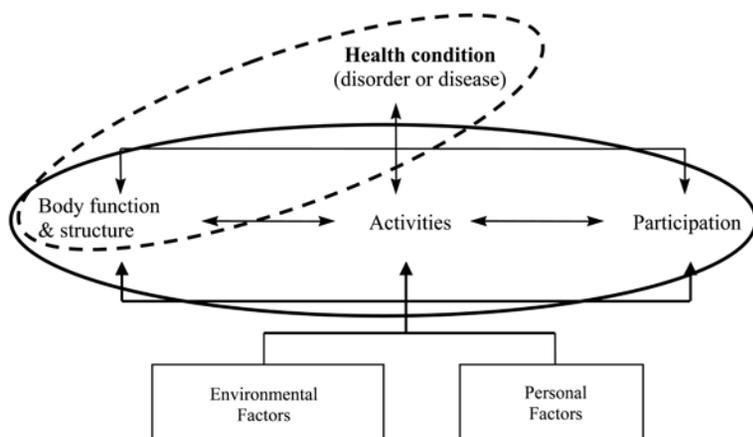


Fig. 1. Illustration of the partial perspective based on the biomedical aspects of functioning (dotted circle) vs the comprehensive perspective based on the integrative model of functioning (solid line circle).

Table I. Characteristics of human functioning and rehabilitation vs biomedicine.

Theme/ Research area	Biomedicine	Human functioning and rehabilitation			
Scientific fields	Biosciences Medical sciences	Human functioning sciences	Biomedical Rehabilitation sciences and engineering	Integrative rehabilitation sciences	Professional rehabilitation sciences
Goal	How to explain and influence phenomena of the human body	How to explain and influence human functioning	How to optimize a persons capacity	How to best provide care and services	How to enable a person and his/her immediate environment to achieve optimal performance
Underlying scientific model	Biomedical	Integrative	Biomedical	Integrative	Integrative
Level of reference	Organ system, cell, molecule, genes	Population	Human body Body functions and structures Activities	Groups of people experiencing or at risk of disability	Human being and his/her immediate environment
Sector and area	Health Biology	Health (reference sector) All sectors, society as a whole	Health Medicine	Health (reference sector) Social Labor Education	Health (reference sector) Social Labor Education
Main type of science	Basic science	Basic science	Applied science	Applied science	Professional science
Scientific perspective	Life sciences Physical or natural sciences	Economics Humanities Social sciences	Natural sciences Physical or natural sciences	Behavioral sciences Economics and Management Health sciences Humanities Social sciences	Medical sciences Health sciences Psychology
Examples of related scientific disciplines and fields	Molecular biology Molecular medicine Neurosciences Physiology Pathophysiology	Architecture and design Anthropology and cultural geography Biostatistics, decision science and epidemiology Economics Health policy and management History Macroeconomics Philosophy Political science Sociology and social psychology	Applied, transitional and exercise physiology Movement science Nutrition and pharmacology Rehabilitation engineering Sports science	Behavioral science Economics Education Environmental Engineering Health services research Health management Psychology	Physical and rehabilitation medicine Family and community medicine Geriatric medicine Other medical specialties applying the rehabilitation strategy  Clinical psychology Neuro-psychology Nursing Occupational therapy Rehabilitation counseling Physiotherapy Social work Speech therapy Medicine Health sciences
Possible collaborating faculties	Biology	Medicine Health sciences Public health Social or human sciences	Biology Medicine Health sciences Human sciences Movement science	Medicine Health sciences Public health	Medicine Health sciences
Typical sample sizes in studies	Not applicable	10–10,000	10–100	10–1,000	10–200

A more detailed description of the close relation of the theme human functioning and rehabilitation with biomedicine can be found in the accompanying paper on how to organize rehabili-

tation research in distinct scientific fields of study, e.g. in the section on “the basic sciences: human functioning sciences and human biosciences” (2).

## RELEVANCE AND POTENTIAL OF HUMAN FUNCTIONING AND REHABILITATION RESEARCH

### *Disability: a major public health challenge*

Functioning, disability and health are universal human experiences. Functioning of people varies on a continuum embedded into personal and environmental factors and the presence of health conditions. People can experience disability at any point in their lives. They may experience disability from birth, or as a result of an accident, a chronic disease, the aging process or a multitude of other causes (13). If we do not experience disability at some point in our lives, perhaps we will be caring for a child, spouse, parent or friend who does. The chances that we will be affected by disability have increased due to advances in medical technology that have increased survival after trauma and severe disease, and that have expanded average life expectancy. Disability now ranks among the biggest public health concerns (10, 14).

### *Potential of human functioning and rehabilitation research*

Table II shows a quote of an eloquent summary of the potential of human functioning and rehabilitation research by Professor Harvey Fineberg, president of the American Institute of Medicine and former Dean of the Harvard School of Public Health (15). Based on a better understanding of human functioning and disability there is a wide range of largely unexplored possibilities to optimize populations' functioning and minimize people's experience of disability in the presence of a health condition.

Rehabilitation research from the comprehensive perspective, which is based on the integrative model of human functioning (2, 8) is uniquely positioned to integrate and translate the advances of sciences into benefits for people and the society. Rehabilitation research from the comprehensive perspective can thus become a catalyst of interdisciplinary research, which truly crosses the boundaries of the natural sciences and engineering research, the human and behavioral sciences, the social sciences and a wide range of related scientific fields (2, 8). In interdisciplinary collaborations we can learn from and combine biomedical and engineering approaches with approaches developed by psychology and the behavioral sciences and the social sciences, and translate them into clinical and community practice and policy and law making. Rehabilitation research can thus facilitate the timely and effective implementation of new

approaches to address people's needs. Rehabilitation research is also uniquely positioned to cross the boundaries of medicine and the health sector at large and to translate knowledge across sectors including education, labor and social affairs.

### *Why developing the research area now?*

As Professor Fineberg has argued (Table II) rehabilitation research is interdisciplinary by nature. This may have been a weakness in times of discipline- and disease-focused funding and academic structures. With the new emphasis on interdisciplinary research, the inherently interdisciplinary character of human functioning and rehabilitation research can now be turned into a strength. However, to thrive in an interdisciplinary research environment, scientists committed to human functioning and rehabilitation research must address a number of challenges (10, 15, 16). This includes the adoption of a unifying conceptual model (6, 10), the development of a globally accepted conceptualization of the rehabilitation strategy based on this model (4) and the organization of human functioning and rehabilitation research in distinct scientific fields of study based on the unifying conceptual model and the rehabilitation strategy (2, 8). These challenges can be addressed successfully, as we have shown in accompanying papers in this special issue of the *Journal of Rehabilitation Medicine*.

## ORGANIZING INTERDISCIPLINARY RESEARCH CENTERS FOR HUMAN FUNCTIONING AND REHABILITATION AT UNIVERSITIES

### *Mission and name*

A center developing comprehensive and coordinated programs of research and related activities committed to: (i) the understanding of human functioning of people with health conditions in relation to personal and environmental factors; and (ii) the development of rehabilitation approaches suited to maximize functioning and social integration of individuals and groups of people with health conditions including, for example, employment and independent living, may be named a "center for human functioning and rehabilitation". Alternative names are "center for human functioning and rehabilitation research" or "center for human functioning and rehabilitation sciences". We have discussed the advantage of using the term "functioning" instead of "disability" in an accompanying paper (2).

Table II. Professor Harvey Fineberg, President of the American Institute of Medicine and former Dean of the Harvard School of Public Health on the potential of rehabilitation to address disability (15).

"First, there is hardly any field I can imagine which better exemplifies the value and importance of multidisciplinary collaboration in the solution of practical problems. If you think about it, the role of engineering and biomedicine as one example is so evidently necessary in coming to grips with the needs of individual patients and the environment-patient interface.

Second, there is hardly any area, I believe, that is better positioned to promote and capitalize on critical areas of advanced science today, including stem cell research, biomechanics, nanotechnology, robotics, and much, much more. This is an opportunity for those concerned with the very practical improvement of people's lives to join in partnership with those performing research at the cutting edge of science to hasten the translation of those advances into practical benefits. These collaborations between the bench and the field can both inform the nature of the basic science that needs to be done and enable patients to take faster advantage of advances as they come along.

If you look at the roadmap for the National Institute of Health, many of the strategies of multidisciplinary research, of translational medicine, and of training scientist/clinicians who can move between the patient and leading edge research can be fulfilled by research in the field of rehabilitation."

While it is true that the term functioning is currently hardly known and understood, the ongoing and successful worldwide implementation of the ICF will facilitate the familiarization of the name in the next years. Indeed, if used consistently, the terms human functioning and human functioning sciences have the potential to become as widely known and accepted as the terms human biology or biosciences.

*Collaborating disciplines and faculties*

Given the breadth of human functioning and rehabilitation research and the attractiveness of the theme to a wide range of scientists, almost any academic discipline and faculty may become a partner in an interdisciplinary research center for human functioning and rehabilitation.

Table I denotes scientific disciplines and possible partner faculties in relation to 5 fields for human functioning and rehabilitation research, which are described in more detail in 2 accompanying papers (2, 8).

A practical way to identify partners for an interdisciplinary research center is to consider the interest of scientific and professional disciplines in relation to selected components of human functioning, as conceptualized in the ICF. Fig. 2 denotes scientific disciplines and Fig. 3 professional disciplines in relation to the ICF components. According to their commitment to patient-focused care, professional disciplines applying the rehabilitation strategy always take the comprehensive perspective. However, according to their specialization and expertise they may focus their research on one or several ICF components or interactions between these components. To simplify the figure, each professional discipline is denoted only once under a component of particular relevance. Similarly, many scientific disciplines focus on more than one component or examine the interactions between components. Since we simply want to illustrate the breadth of possible partners, we denote each discipline only once.

*Anchor faculty*

Interdisciplinary centers across faculties and disciplines are generally anchored or rooted at one of the participating fa-

culties. Depending on the envisioned structure of the center, the specific context at a university and the selected research domains possible and optimal anchor faculties may differ. In principle any faculty representing a partial perspective on human functioning may serve as the anchor faculty. Since human functioning and rehabilitation is dedicated to people with health conditions experiencing, or likely to experience, disability, a faculty with a strong link to health seems preferable. Therefore, a medical faculty, a faculty for health sciences or a faculty or school for public health are certainly most suitable anchor faculties.

If the focus is on the environmental perspective, a faculty for social sciences would also be a possible anchor. At many faculties for social sciences there is a tradition in disability studies (17). Also, social inequality in health, inclusion/exclusion, labeling processes (e.g. stigma) and social identity are common topics at faculties for social sciences and of high relevance to human functioning and rehabilitation research. A relevant current research domain at some faculties for the social sciences is the exploration of the structures of the modern society and how they impact human life. Human functioning and rehabilitation are a perfectly suitable research area to explore this topic. Additionally, the study of differential meanings of disability across cultures is a very interesting and challenging topic for social and cultural anthropology (18).

Other suitable anchor faculties include psychology, sports sciences or human sciences. At technical universities, a center concentrating on biomedical rehabilitation sciences and engineering may be anchored at an appropriate faculty. It is also possible to anchor envisioned centers at a faculty for natural sciences if the focus is, for example, on the exploration of the mechanism of rehabilitation interventions.

*Domains for research*

Interdisciplinary research centers for human functioning and rehabilitation may be organized according to the mentioned 5 distinct scientific fields of human functioning and rehabilitation research (2, 8).

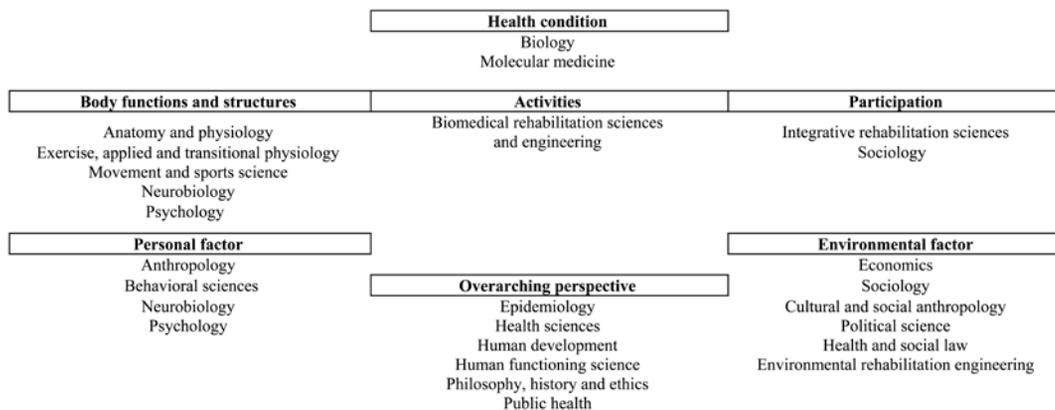


Fig. 2. Selected scientific disciplines related to human functioning and rehabilitation sciences. A scientific field may be relevant, focus or integrate more than 1 International Classification of Functioning, Disability and Health (ICF) component. For practical reasons it is only listed under 1 component.

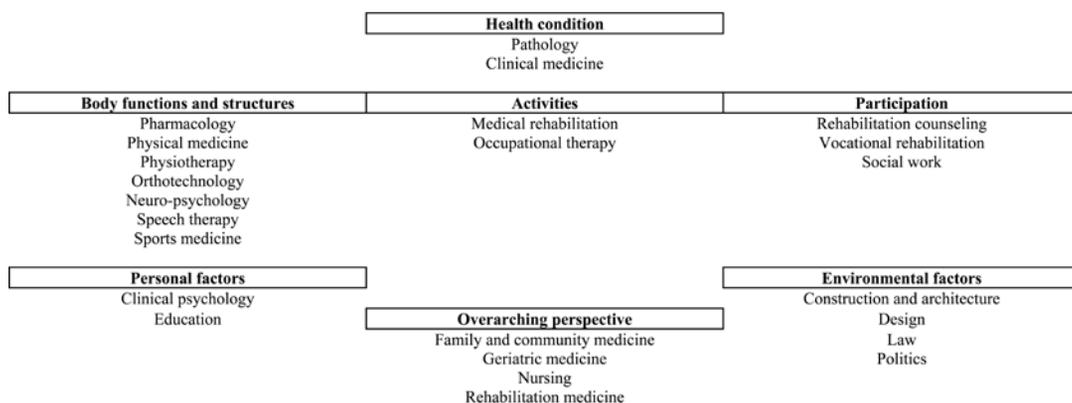


Fig. 3. Selected professional disciplines related to human functioning and rehabilitation sciences according to the unifying conceptual model ICF. A professional discipline may be relevant, focus or integrate more than 1 International Classification of Functioning, Disability and Health (ICF) component. For practical reasons it is only listed under 1 component.

At the core of any interdisciplinary research center for human functioning and rehabilitation are the 3 distinct scientific fields from the comprehensive perspective based on the integrative model of functioning including human functioning sciences, integrative rehabilitation sciences and professional rehabilitation sciences. They provide the common ground for the centers theme and a common identity for researchers with a background in varying disciplines and affiliated with different faculties, departments and institutes.

To promote a common understanding of human functioning and rehabilitation, and to develop a common cause for all researchers in a center, it is advisable to offer a course, e.g. in rehabilitation effectiveness as described in an accompanying paper (9), to all scientists joining the center. The teaching of the comprehensive perspective also invites researchers from distinctive scientific disciplines to question the exclusiveness of their own perspective. In doing so, a truly transdisciplinary basis for rehabilitation research would emerge, serving as starting point for specialization and interdisciplinary programs. Most importantly, the comprehensive perspective is able to promote real transdisciplinary thinking through the provision of a common language and identity.

It is generally not possible or advisable to cover all domains of biomedical rehabilitation sciences and engineering, but to focus on research in relation to specified organ-systems and/or intervention approaches (8). One may, for example, develop inter-disciplinary programs in musculoskeletal, neurological or cardio-pulmonary rehabilitation. Rehabilitation engineering is an interesting option for technical universities or universities with a strength in this domain. When developing units in the field of biomedical rehabilitation sciences and engineering, it is worthwhile studying the successful models of rehabilitation engineering research in the USA (5).

Whether or not it makes sense for an interdisciplinary center for human functioning and rehabilitation to develop a program in biosciences and rehabilitation depends again on the university environment. Interdisciplinary centers for human functioning and rehabilitation are attractive partners for bio-scientists

who develop an interest in topics relevant to rehabilitation and the possibilities for translational research offered by a collaboration with an interdisciplinary center for human functioning and rehabilitation. Research in relation to rehabilitation may, for example, focus on tissue injury and protective approaches to prevent or minimize permanent damage and tissue repair including, for example, neuro-regeneration. Another area is the study of the biologic mechanism of rehabilitation interventions and how to translate gains, for example, from neuro-regeneration into better patient relevant outcomes.

*Developing research capacity*

Interdisciplinary research centers in a new area are faced with the challenge to develop the necessary research capacities to achieve its goals. The core aspects of research capacity building have been summarized recently in the context of a summit on rehabilitation (16). They include: (i) researchers (their training, mentoring, recruitment, and retention; the value of a career in research and incentives for research); (ii) research culture, environment, and infrastructure (academic institutions, the creation and maintenance of core facilities, the role of chairpersons and deans, collaborations, institutional research administration and social culture, and policies governing incentives and job security); (iii) funding (sources, advocacy for changing policies, peer-review procedures, funding mechanisms, grantsmanship and fundraising, timing of funding requests, and conflicts of interest); (iv) partnerships with other disciplines and disability consumer groups (the purposes of these partnerships; choices of research topics, disciplines, and consumer groups; modes of participation; and potential conflicts of interest when partnering with industry); and (v) the metrics of research capacity (quality and quantity of the pool of available researchers, the productivity of their research, and its impacts).

Arguably the key aspect for the success of an interdisciplinary center for human functioning and rehabilitation is structured and focused research training. Research training ranges from certificate to Masters and PhD programs (9). With the

implementation of the Bachelors, Masters and PhD concept according to the Bologna process and its related restructuring of university curricula, there is now the unique opportunity to attract qualified students early into a research-oriented Master degree and possibly into a research career in human functioning and rehabilitation. A description of research training in human functioning and rehabilitation can be found in an accompanying paper (9). Centers may either develop their own training program or co-operate in an international program, for example, offered in collaboration between Swiss Paraplegic Research and the Ludwig-Maximilian University in Munich, Germany (9).

The development of research capacity can also be facilitated by establishing the emerging distinct scientific fields of human functioning sciences and integrative rehabilitation sciences as academic disciplines. Most importantly, this would open a new perspective for researchers considering a career in this area. An academic career perspective is essential to attract the brightest and to retain the trained (19).

*Funding*

The serious development of a research area is only possible if there is appropriate funding by national science foundations and regional programs, for example the EU. This requires that governments and funding agencies establish or considerably increase investment in human functioning and rehabilitation research. With the establishment of interdisciplinary centers for human functioning and rehabilitation at universities, governments and funding agencies will have to recognize rehabilitation research as a funding priority in the competition for limited funding with other powerful interests, e.g. based on the disease perspective and the natural sciences (15). Other, complementary, funding sources include industry (rehabilitation technology), ministries and governmental agencies (health, social, labor and educational sector), public and private insurers and service providers.

NATIONAL AND REGIONAL COLLABORATION NETWORKS

Human functioning and rehabilitation is a very promising theme for individual researchers, institutions and organiza-

tions aiming to develop a national or regional collaboration network for interdisciplinary research. Conversely, national and regional collaborative networks for human functioning and rehabilitation research can provide a wide range of conceivable partners with the opportunity to become involved in a research area of highest individual and socio-economic importance.

The obvious partners for national and regional collaboration networks are universities, schools for health professionals, research institutions and research-oriented clinical institutions. Other, similarly important, partners include a wide range of stakeholders who have an intrinsic interest in research results.

Table III shows the potential partners in relation to distinct scientific fields of human functioning and rehabilitation research and their research results. The results are obviously relevant, not only to the directly involved stakeholders denoted on the same row of the table, but may also be of interest to other partners. Also, the different distinct scientific fields can contribute across the different research results.

All aspects of functioning and rehabilitation research are relevant to all people and hence the *public* and of special relevance to *people experiencing disability* and hence organizations representing "people with disabilities".

Research in the human functioning sciences is of particular relevance to inform *policy* and law-makers and decision-makers responsible for the implementation of national or regional *programs* and *projects* (2). This holds true not only for policies, programs and projects directly aimed at people experiencing disability, but for all policies, programs and projects across sectors including education, labor and social affairs that may impact on the life of people experiencing or likely to experience disability.

Research in the integrative rehabilitation sciences is of particular relevance for *payers* and *service providers* (8), clinical managers or program directors responsible for the delivery of *intervention programs* and for *rehabilitation counselors* advising consumers and service and program providers along the continuum of care from the acute hospital to the community.

Research in biomedical rehabilitation sciences and engineering results in *products*, including aids and devices, prosthesis, therapeutic and health maintenance equipment, physical diagnostics and physical therapeutics or *procedures* including training and exercise schemes. These products and procedures are directly relevant to professionals performing or applying

Table III. Partners for national networks in relation to distinct scientific fields of human functioning and rehabilitation research and research results.

Field	Research results	Experts	Consumer
Human functioning sciences	Proposal (policy, program, project)	Policy- and law-maker; Program and project decision-maker	
Integrative rehabilitation sciences	Service provision concept; Payment scheme; Intervention program; Integrated program	Service provider; Payer; Intervention program director; Rehabilitation professional (e.g. rehabilitation counselor)	Public People experiencing disability
Biomedical rehabilitation sciences and engineering	Product; Procedure	Rehabilitation professional (e.g. physical and rehabilitation medicine, physiotherapy, occupational therapy) Industry	

*professional interventions* to people experiencing or likely to experience disability.

#### *Collaboration with disability rights organizations*

To assure its scientific importance and clinical relevance, human functioning and rehabilitation research requires both interdisciplinary and multi-stakeholder partnerships. Not only collaborations among researchers of different scientific and professional disciplines, but also with the *public* and in particular with disability rights organizations need to be promoted and cultivated. A possibility to integrate people experiencing disability is community-based participatory research (20, 21). The traditional research process usually includes only scientists. The less traditional research process includes both scientists and consumers. Community-based participatory research involves a mix of scientists and consumers. An important possibility is the involvement of physicians, health professionals and scientists and other knowledgeable consumers who themselves experience disability.

#### *Collaboration with policy-makers or program and project decision-makers*

From the perspective of *policies* and *programs*, interdisciplinary centers for human functioning and rehabilitation research may develop collaborations of mutual benefit with a wide range of governmental agencies in the health, social, educational and labor sector. A pertinent question is the development of valid and reliable ways for disability evaluation for example in the context of the qualification for disability benefits. Programs to prevent or minimize the experience of disability of selected groups of people at risk may be developed in close collaboration with ministries of health and/or other ministries. Examples for program aims are social integration of people with mental health conditions, employment of people with back pain or independent living of people with spinal cord injury or elderly with visual or musculoskeletal impairments. Initiatives to control tobacco or AIDS developed by public health research in collaboration with ministries of health may serve as examples. Indeed, supported by collaboration networks for human functioning and rehabilitation research, ministries may underwrite a contract with WHO about targets with respect to functioning and rehabilitation similar to existing contracts regarding tobacco control.

#### *Collaboration with payers and providers*

There is also much potential for the development of fruitful collaborations with public and private insurers as well as public and private providers of services in the health and across sectors. Collaboration networks for human functioning and rehabilitation may consider developing applied training programs tailored to the needs of their partners. In an accompanying paper we have described the option of offering a Master of Advanced Studies in Rehabilitation Management or Rehabilitation Counseling including the interesting option of peer counseling (9).

#### *Collaboration with clinical and clinical-research settings*

With respect to *intervention programs* and *professional interventions*, collaboration networks for human functioning and rehabilitation research may benefit from developing close links to rehabilitation clinics outside the university setting. Many rehabilitation clinics in Europe are traditionally located outside university hospitals and often at distant places. The same is true for rehabilitation centers, organizations and institutions across sectors providing community based services, including, for example, reintegration or support services to people experiencing disability.

Clinical rehabilitation centers increasingly develop their own research agenda or may initiate their own rehabilitation research institute dedicated to research in relation to the patient groups cared for by the clinical center. Because of their broad clinical and research expertise in a defined health condition, which can serve as a case in point, such combined clinical-research settings are most interesting partners for collaboration networks in human functioning and rehabilitation research. The focus on a defined health condition can be a catalyst of research and is also very useful to provide researchers at interdisciplinary research centers for human functioning and rehabilitation with a clear cause. A focus on one or more health conditions may help to develop a common understanding and identity of researchers. Participation in a collaboration network for human functioning and rehabilitation research may be of great interest to clinical-research settings who themselves lack the breadth of expertise of a university.

Collaboration networks are also of great interest for extra-university rehabilitation research institutions associated with clinical settings. Conversely, such institutions provide unique collaboration opportunities for network partners at universities. An example is the newly founded Swiss Paraplegic Research, which is located in close relation to the Swiss Paraplegic Clinical Center. The concept of Swiss Paraplegic Research focusing on the comprehensive perspective and taking a transdisciplinary approach has been described elsewhere.

#### *Collaboration with schools for health professionals*

At some universities, faculties for medicine or health sciences also include schools for health professionals. In many countries, the training of health professionals takes place at dedicated schools. Whatever the situation, schools for health professionals who apply rehabilitation as a major strategy are most attractive partners for national and regional collaboration networks. These include, for example, schools for physiotherapy, occupational therapy, nursing or social work. Similar to the medical specialty physical and rehabilitation medicine (PRM), the research productivity of these professions has been limited in the past (19). Currently, research productivity is increasing, for example in the USA (19). With the change of the curricula according to the Bologna process in Europe, there is the unique opportunity to develop collaborative research agendas. These may contribute to the seriously needed expansion of the research workforce.

*Collaboration with industry*

With respect to *products* and *procedures*, there is a wide range of possible collaborations with industry, product developers, private sector entrepreneurs and even hobbyists.

## CONCLUSION

We have shown that human functioning and rehabilitation is a new, highly innovative and relevant theme. It has the potential to attract researchers from a wide range of disciplines, institutions and organizations. It is thus of interest for universities seeking to embark upon a new and unique research area. Similarly, it is a most promising theme for the development of national or regional collaboration networks.

Human functioning and rehabilitation complements established themes from the biomedical perspective. In the context of the life sciences, it can be seen as extension of the biosciences towards a comprehensive understanding of life, including human interaction and communication, against the background of the natural and social environment.

The development of the research area is fostered by the adoption of the integrative model of human functioning. The new focus on the comprehensive perspective based on the integrative model will likely influence the research environment in the next years and may be associated with an important expansion of research capacity.

We encourage commentaries to the *Journal of Rehabilitation Medicine* regarding the need, the potential and the barriers and facilitators for the development of interdisciplinary research centers at universities and national and regional collaboration networks in human functioning and rehabilitation research.

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