

ORIGINAL REPORT

VALIDATION OF THE COMPREHENSIVE ICF CORE SETS FOR PATIENTS RECEIVING REHABILITATION INTERVENTIONS IN THE ACUTE CARE SETTING

Martin Müller, RGN, Dipl. Nurs. Mngt^{1,2}, Eva Grill, DrPH, PhD^{1,2}, Marita Stier-Jarmer, PhD^{1,2}, Ralf Strobl, Dipl. Stat^{1,2}, Christoph Gutenbrunner, MD³, Veronika Fialka-Moser, MD⁴ and Gerold Stucki, MD, MS^{2,5,6}

From the ¹Institute for Health and Rehabilitation Sciences (IHRS), Ludwig-Maximilians-Universität München, Munich, Germany, ²ICF Research Branch of WHO Collaborating Centre for the Family of International Classifications in German, Nottwil, Switzerland, ³Department of Physical Medicine and Rehabilitation, University Hospital Vienna, Vienna, Austria, ⁵Swiss Paraplegic Research, Nottwil and ⁶Seminar of Health Sciences and Health Policy, University of Lucerne, Switzerland

Objective: To examine the relevance and completeness of the comprehensive International Classification of Functioning, Disability and Health (ICF) Core Sets for patients with rehabilitation needs in acute hospital care.

Design: Multi-centre cohort study.

Patients: A total of 391 patients (50.1% female, mean age 63.4 years) from 4 university hospitals in Austria, Germany and Switzerland and one Austrian general hospital.

Methods: Data on functioning were collected using the respective comprehensive acute ICF Core Sets. Data were extracted from patients' medical record sheets and interviews with health professionals and patients.

Results: Most of the categories of the comprehensive ICF Core Sets describing impairments, limitations or restrictions occurred in a considerable proportion of the study population. The most outstanding limitations and restrictions of the patients were problems with sleep and blood vessel functions, walking and moving and self-care. Thirty-eight aspects of functioning not previously covered by the comprehensive ICF Core Sets were ranked as relevant.

Conclusion: Categories of the comprehensive ICF Core Sets for the acute hospital situation were confirmed. Some additional categories not covered by the Set in its present version emerged from the interviews, and should be considered for inclusion in a finalized version.

Key words: ICF; cohort study; intensive care; outcome assessment; classification.

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Correspondence address: Eva Grill, Institute for Health and Rehabilitation Sciences, Ludwig-Maximilians-Universität München, DE-81377 Munich, Germany. E-mail eva.grill@med.uni-muenchen.de

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INTRODUCTION

Despite the rapid progress in survival after an acute injury or disease, which has been afforded by modern medicine, long-term

outcomes can be less favourable. Typically, the risk for subsequent disability is particularly elevated in critically ill patients, in patients with complications or long-term intensive care stays, in persons with disabilities or pre-existing chronic conditions, and in older patients. Any of these circumstances may result in prolonged immobilization, which can give rise to contractures ultimately restricting the patients' ability for self-care (1), or otherwise engender a wide range of adverse neuropsychological effects (2) specifically due to immobilization.

It is increasingly recognized that an appropriate and early start to rehabilitation contributes importantly to the maintenance of functioning, prevention of disability, and optimal recovery of patients in the acute situation (3–4). Thus, the needs for rehabilitative intervention of those patients in acute hospital care with an increased risk for considerable loss of functioning should be identified as early as possible (5). To this end, healthcare professionals in the acute hospital should be able to make a brief assessment of their patients' functioning, and set in motion timely strategies for meeting their subsequent rehabilitation needs. The acute care providers have first to identify especially vulnerable patients, such as the aged, or those with co-morbidity. In order to communicate the patients' particular needs with rehabilitation professionals, there must be a standard system of describing human functioning and rating disability.

The International Classification of Functioning, Disability and Health (ICF) (6), a part of the international family of classifications of the World Health Organization, was established as just such an approach to standardizing the assessment of functioning of individuals and populations. The ICF endeavours to organize all domains of functioning and their contextual factors that are encountered in human life, and may thus arguably constitute the prototypical framework for all medicine. Comprising over 1400 categories, the ICF must nonetheless be adapted to the perspectives and needs of different users. This task is the primary motivation behind the ICF Core Set project, which aims to extract a selection of ICF categories from the entire classification that are relevant for specific health conditions or care situations. This on-going selection of the

comprehensive ICF Core Sets shall define common standards for what should properly be measured and reported.

In general, the ICF Core Set project defines on an empirical basis a category as relevant when it describes a problem that is frequently encountered in typical patients, measured as an endpoint in clinical trials, or was otherwise identified as being relevant following discussion among health professionals. The resultant information is then summarized and implemented as part of a formalized consensus process involving expert health professionals (7). Comprehensive ICF Core Sets for the acute hospital have already been developed for patients with neurological, cardiopulmonary and musculoskeletal conditions (8–10).

Comprehensive ICF Core Sets can be used for the assessment of problems and needs in the acute situation, as well as for the estimation of prognosis and rehabilitation potential (8). Likewise, they can be used to coordinate rehabilitation interventions, e.g. at the intensive care unit. Finally, the Sets can serve as a list of potential candidate categories for creating new measures tailored to the needs of the respective user.

In order to validate the comprehensive ICF Core Sets designed for use in particular contexts, one must possess an adequate understanding of the methodological framework used for creating measures. For example, the Outcome Measures in Rheumatology (OMERACT) project identifies 3 different properties relevant to the applicability of measures, namely truth, discrimination and feasibility (9). The first two of these criteria, truth and discrimination, can be applied to test the validity of the comprehensive sets. The criterion *truth* refers to the question of what should be measured. As noted above, the process for generating the comprehensive ICF Core Set assured that all the relevant aspects of functioning were included, but the empirical validation of the choice of categories remains to be completed. The criterion *discrimination* refers to the ability of a measure to discriminate between different states of functioning or medical conditions. A discriminating measure must distinguish between different patient groups in a cross-sectional manner, and assess change in functioning over time.

The objective of this study was to examine the relevance and completeness of the comprehensive ICF Core Sets for patients receiving rehabilitation interventions in the acute care setting. Specifically, we wanted to examine which aspects of functioning included in the comprehensive acute ICF Core Set:

- were frequent at admission to and at discharge from acute care,
- changed during hospital stay, and
- also to identify new relevant aspects for inclusion in the revised ICF Core Set.

METHODS

Study design

A full description of the methods used in this study has been reported elsewhere (10). In brief, study design was a prospective multi-centre cohort study conducted from May 2005 to August 2008. The study population was recruited from 4 university hospitals in Austria, Germany and Switzerland and one Austrian general hospital; approxi-

mately 57% of the patients were recruited from the Austrian centres, 24% from the German centres, and 19% from the Swiss centre. Patients were eligible if they were at least 18 years of age and received team integrated multiprofessional rehabilitation interventions for acute musculoskeletal, neurological, or cardiopulmonary injury or disease. As such, rehabilitation interventions could be provided either at a dedicated rehabilitation ward situated in the acute hospital or by mobile rehabilitation teams caring for patients on medical or surgical wards. Written informed consent was obtained from the patients or from the patient's caregiver in cases where the patient was unable to make an informed decision. Approval was obtained from institutional ethics committees from all involved institutions prior to starting the study.

Measures

For the assessment of functioning, we used the 3 comprehensive ICF Core Sets for patients in the acute hospital situation, which were earlier developed to address the specific situations of patients with neurological, musculoskeletal, or cardiopulmonary conditions (11–13). For all patients, impairments in categories of the component Body Structures were graded as present or absent. Limitations or restrictions in categories of the components Body Functions and Activities and Participation were graded as “none”, “slight/moderate/severe” or “complete” limitation or restriction. The categories of the component Environmental Factors were graded either as facilitator or barrier, or both facilitator and barrier, or neither facilitator nor barrier.

We elected to report only those impairments, limitations and restrictions directly associated with the conditions causing the need for rehabilitation. The interviewers obtained information from the ward staff in charge about which of the impairments, limitations or restrictions resulted from the referring condition or principal diagnosis, and which occurred as a result of a specific co-morbidity. In order to validate the completeness of the comprehensive ICF Core Sets, the interviewers were furthermore asked to identify any aspects of functioning relevant to the patient, but not currently covered by the comprehensive ICF Core Sets. Additionally, socio-demographic (sex, age, education, living and occupation situation) and condition-specific data (underlying diagnosis, time until rehabilitation, number of co-morbidities and length of stay) were recorded.

Data collection procedures

Data were collected primarily from patients' medical record sheets, health professionals in charge of the patients, and from patients' interviews. Interviewers collecting data had been trained in the application and principles of the ICF, and provided with a manual. All interviewers were health professionals (physicians, medical students in clinical training, physical therapists, or nurses). During data collection interviewers obtained support and information from the ward staff in charge. Ongoing supervision of the interviewers was ensured by periodic telephone calls.

Data collection took place within the first 24 h after admission to the hospital (baseline) and within the last 36 h before discharge or, if length of stay was longer than 6 weeks, at 6 weeks after admission (end-point). ICF categories from the component Environmental Factors were assessed only at admission, since we did not expect any change in these categories during hospital stay.

Statistical analysis

For the categories of the ICF components Body Functions, Body Structures and Activities and Participation we calculated the absolute and relative frequencies (prevalences) of impairment, limitation or restriction at baseline and end-point. For the categories of the ICF component Environmental Factors, we calculated the absolute and relative frequencies (prevalences) of persons who regarded a specific category as constituting either a barrier or facilitator. Relative frequencies of persons for whom the ICF category changed during the study period were calculated, along with their 95% confidence intervals (CI). Frequencies were calculated based on all available participants; change was calculated based on participants with data at baseline and at

end-point. A difference between baseline and endpoint was considered as change if the percentage of change was different from null and the confidence interval did not include the null.

Aspects of functioning not covered by the comprehensive ICF Core Sets but identified as relevant were extracted and translated into the best corresponding ICF category. Absolute and relative frequencies of occurrence of those ICF categories were reported; any such category with prevalence below 5% was considered as not relevant.

RESULTS

Sociodemographics

In total, 391 patients were included. Mean age at admission was 63.4 years (median 65.6; standard deviation (SD) 18.2 years). Mean length of stay was 14.9 days (median 10; SD 13.7). Fifty percent of the patients were female. Ninety-one had a neurological, 109 a cardiopulmonary and 191 a musculoskeletal condition. Twenty patients (5%; 3 neurological, 3 cardiopulmonary, 14 musculoskeletal) were lost to follow-up because of unplanned discharge from hospital or death. The most frequent admission diagnoses classified according ICD-10 in patients with neurological conditions were “cerebrovascular diseases” (including cerebral haemorrhages and infarctions) ($n=46$; 50.5%), and “diseases of the nervous systems”, including transient cerebral ischaemic attack, hemi- or tetraplegia ($n=18$; 19.8%). The most frequent admission diagnoses in patients with cardiopulmonary conditions were “Other forms of heart disease” (including cardiomyopathy, myocarditis, and heart failure) ($n=30$; 27.5%) and “Ischaemic heart diseases” (including myocardial infarction) ($n=22$; 20.2%). The most frequent admission diagnoses in patients with musculoskeletal conditions were “Other dorsopathies” (including disc disorders and low back pain) ($n=46$; 24.1%) and “Arthropathies” (including arthritis and arthrosis) ($n=24$; 12.6%). For further socio-demographic and condition-related variables see Table I.

Functioning and disability

Tables II–IV give the prevalence of impairment or restriction both at admission and discharge as well as the corresponding

95% CI for the frequency of change in impairment or restriction, for each category of underlying condition.

Of the categories of the components Body Functions and Structures and Activities and Participation from the comprehensive ICF Core Sets, 55% were impaired or restricted for patients with neurological conditions in at least one-third of the patients, vs 71% from the cardiopulmonary patient group, and 57% from the musculoskeletal patient group.

Functioning and disability in patients with neurological conditions

The frequency of impairments or restrictions in patients with neurological conditions ranged from 2% to 86% (mean 38%) at admission and from 1% to 82% (mean 26%) at discharge. There were 3 categories with prevalence below 5% at admission or discharge: *Heart functions* (b410), *General metabolic functions* (b540), *Structure of respiratory system* (s430), and *Hearing functions* (b230).

The Body Functions and Body Structures most frequently impaired both at admission and discharge were *Muscle power functions* (b730) (81% at admission/72% at discharge), *Control of voluntary movement functions* (b760) (69%/53%), *Blood vessel functions* (b415) (60%/52%) *Muscle tone functions* (b735) (60%/51%), *Structure of brain* (s110) (86%/82%), and *Structure of cardiovascular system* (s410) (72%/61%).

The ICF categories from the component Activities and Participation (A&P) most frequently limited at admission were *Caring for body parts* (d520) (76%), *Moving around using equipment* (d465) (75%) and *Hand and arm use* (d445) (73%), the most frequently limited at discharge were *Fine hand use* (d440) (51%), *Hand and arm use* (d445) (49%) and *Moving around using equipment* (d465) (45%).

The percentage of patients reporting an improvement in functioning at discharge ranged from 0% to 44% for the different ICF categories. The most frequent improvements were observed in A&P categories *Moving around using equipment* (d465) (44%), *Toileting* (d530) (42%), *Changing basic body position* (d410)

Table I. Characteristics of participants

Variable	All conditions	Neurological conditions	Cardiopulmonary conditions	Musculoskeletal conditions
Number of participants, n	391	91	109	191
Mean age (SD)	63.4 (18.2)	64.6 (16.9)	68.9 (16.1)	59.7 (19.2)
Mean number of comorbidities (SD)	2.7 (2.2)	2.9 (2.0)	3.4 (2.1)	2.3 (2.2)
Mean length of stay (SD)	14.9 (13.7)	17.7 (14.7)	14.4 (14.1)	13.9 (12.8)
Female gender, %	50.1	50.5	45.9	52.4
Diagnosis, n (%)				
Diseases of the respiratory system (J00–J99)	28 (7.2)	2 (2.2)	26 (23.9)	0 (0)
Diseases of the circulatory system other than cerebrovascular diseases (I00–I52 and I70–I99)	69 (17.6)	3 (3.3)	66 (60.6)	0 (0)
Cerebrovascular diseases (I60–I69)	46 (11.8)	46 (50.5)	0 (0)	0 (0)
Diseases of the nervous system (G00–G99)	18 (4.6)	18 (19.8)	0 (0)	0 (0)
Diseases of the musculoskeletal system and connective tissue (M00–M99)	87 (22.3)	3 (3.3)	1 (0.9)	83 (43.5)
Injury, poisoning and certain other consequences of external causes (S00–T98)	80 (20.5)	4 (4.4)	0 (0)	76 (39.8)
Neoplasms (C00–D48)	37 (9.5)	11 (12.1)	7 (6.4)	19 (9.9)
Other diagnoses	26 (6.6)	4 (4.4)	9 (8.3)	13 (6.8)

SD: standard deviation.

Table II. International Classification of Functioning, Disability and Health (ICF) categories of the component Body Functions – percentage of participants with impairment at admission/discharge and the extent of change over time

ICF	ICF Code Description	Neurological conditions, n=91						Cardiopulmonary conditions, n=109						Musculoskeletal conditions, n=191						
		Admission		Discharge		Change % (95% CI) ^a		Admission		Discharge		Change % (95% CI) ^a		Admission		Discharge		Change % (95% CI) ^a		
		n ^a	% ^b	n ^a	% ^b	n ^a	% ^b	n ^a	% ^b	n ^a	% ^b	n ^a	% ^b	n ^a	% ^b	n ^a	% ^b	n ^a	% ^b	
b110	Consciousness functions	91	27	88	14	23 (14–33)	109	7	105	4	10 (5–17)	191	3	177	0	2 (1–6)				
b114	Orientation functions	89	20	87	14	13 (7–22)	109	10	106	6	11 (6–19)	191	31	177	20	18 (12–24)				
b130	Energy and drive functions	89	53	88	27	38 (28–49)	109	48	106	31	22 (14–31)	191	66	177	44	29 (23–37)				
b134	Sleep functions	90	57	87	37	36 (26–47)	109	58	106	41	25 (17–34)	191	66	177	44	29 (23–37)				
b140	Attention functions	90	36	88	31	25 (17–36)														
b147	Psychomotor functions	90	37	88	23	22 (14–32)														
b152	Emotional functions	88	35	87	22	25 (16–36)														
b156	Perceptual functions	89	33	86	26	26 (17–37)														
b167	Mental functions of language	89	33	88	19	24 (16–35)														
b180	Experience of self and time functions	89	25	88	15	15 (8–24)														
b210	Seeing functions	91	13	87	17	11 (6–20)														
b215	Function of structures adjoining the eye	89	10	85	7	10 (4–18)														
b230	Hearing functions	91	8	87	3	9 (4–17)														
b235	Vestibular functions	84	36	84	23	30 (20–41)														
b240	Sensations associated with hearing and vestibular function	88	40	85	28	34 (24–45)														
b260	Proprioceptive function	90	49	87	37	23 (15–34)														
b265	Touch function	88	43	85	31	23 (15–34)														
b270	Sensory functions related to temperature and other stimuli	86	36	84	24	17 (10–27)														
b280	Sensation of pain	90	48	88	33	36 (26–47)	109	47	106	27	26 (18–36)	191	91	177	66	35 (28–43)				
b310	Voice functions	90	20	88	10	20 (12–29)														
b410	Heart functions	88	2	86	1	4 (1–10)	109	62	106	59	15 (9–23)									
b415	Blood vessel functions	90	60	88	52	45 (34–56)	109	61	106	55	16 (10–24)	191	55	177	34	26 (20–33)				
b420	Blood pressure functions	91	16	87	10	11 (6–20)	109	44	106	42	18 (11–27)									
b430	Haematological system functions	87	24	83	14	14 (8–24)	109	43	106	37	12 (7–20)									
b435	Immunological system functions	86	15	83	16	5 (1–12)	109	37	106	24	14 (8–22)									
b440	Respiration functions	91	16	88	7	12 (6–21)	109	70	106	49	31 (22–41)	191	18	177	5	13 (8–19)				
b445	Respiratory muscle functions						109	54	106	42	25 (17–34)									
b450	Additional respiratory functions	90	13	88	6	7 (3–14)	109	60	106	44	32 (23–42)									
b455	Exercise tolerance functions	76	21	82	20	5 (2–13)	106	98	103	87	34 (25–44)	186	45	172	31	22 (16–28)				
b460	Sensations associated with cardiovascular and respiratory functions						109	83	105	64	29 (20–38)									
b510	Ingestion functions	91	23	88	14	23 (14–33)	109	21	106	16	19 (12–28)	191	37	177	15	29 (22–36)				
b525	Defecation functions	88	23	87	17	24 (15–34)														
b535	Sensations associated with the digestive system	89	20	86	12	18 (10–28)														
b540	General metabolic functions	85	5	84	7	7 (3–15)														
b545	Water, mineral and electrolyte balance functions						109	26	106	15	19 (12–28)									
b610	Urinary excretory functions	85	20	83	12	13 (7–23)	109	11	106	8	10 (5–18)									
b620	Urination functions	91	34	88	16	33 (23–44)														
b710	Mobility of joint functions	90	28	88	27	22 (14–32)	109	21	106	21	11 (6–19)	191	29	177	6	24 (18–31)				
b715	Stability of joint functions	90	28	87	31	21 (13–31)														
b730	Muscle power functions	88	81	87	72	25 (16–35)	106	49	105	49	15 (8–23)	187	94	175	85	26 (20–33)				
b735	Muscle tone functions	91	60	87	51	25 (17–36)														
b755	Involuntary movement reaction functions	89	49	88	38	24 (16–35)														
b760	Control of voluntary movement functions	91	69	88	53	36 (26–47)														
b810	Protective functions of the skin																			
b820	Repair functions of the skin	91	25	88	18	11 (6–20)	109	22	106	15	12 (7–20)	141	14	174	13	6 (2–11)				

^aNumber of valid answers; ^bProportion of impairments in the category; ^cProportion of patients experiencing change (improvement or worsening) in the category; 95% CI: 95% confidence interval.

Table III. International Classification of Functioning, Disability and Health (ICF) categories of the component Body Structures – percentage of participants with impairment at admission/discharge and the extent of change over time

ICF	ICF Code Description	Neurological conditions n=91					Cardiopulmonary conditions n=109					Musculoskeletal conditions n=191				
		Admission		Discharge		Change % (95% CI) ^c	Admission		Discharge		Change % (95% CI) ^c	Admission		Discharge		Change % (95% CI) ^c
		n ^a	% ^b	n ^a	% ^b		n ^a	% ^b	n ^a	% ^b		n ^a	% ^b	n ^a	% ^b	
s110	Structure of brain	90	86	88	82	3 (1–10)										
s120	Spinal cord and related structures	90	13	88	16	2 (0–8)										
s410	Structure of cardiovascular system	89	72	84	61	14 (8–24)	109	72	106	69	4 (1–9)	182	41	171	28	13 (8–19)
s430	Structure of respiratory system	88	3	85	7	6 (2–13)	108	55	106	46	12 (7–20)	183	7	172	4	3 (1–7)
s710	Structure of head and neck region	90	19	86	17	4 (1–10)					183	6	172	6	1 (0–4)	
s720	Structure of shoulder region											183	15	172	15	3 (1–7)
s730	Structure of upper extremity											183	16	177	16	4 (1–8)
s740	Structure of pelvic region											182	31	172	28	8 (4–13)
s750	Structure of lower extremity											182	53	172	55	4 (1–8)
s760	Structure of trunk						109	27	106	25	3 (1–8)	183	37	172	31	9 (5–14)
s810	Structure of areas of skin						108	31	106	31	5 (2–11)	182	64	172	59	7 (3–11)

^aNumber of valid answers.

^bProportion of impairments in the category.

^cProportion of patients experiencing change (improvement or worsening) in the category. 95% CI: 95% confidence interval.

(41%), and *Caring for body parts* (d520) (41%). The Body Functions which improved most frequently were *Blood vessel functions* (b415) (38%), *Energy and drive functions* (b130) (30%), and *Control of voluntary movement functions* (b760) (28%). The

most frequent improvement in Body Structures was found in the *Structure of cardiovascular system* (s410) (13%).

The percentage of patients who reported deterioration in any of the different ICF categories ranged from 0% to 11%, which

Table IV. International Classification of Functioning, Disability and Health (ICF) categories of the component Activities and Participation – percentage of participants with restrictions at admission/discharge and the extent of change over time

ICF	ICF Code Description	Neurological conditions n=91					Cardiopulmonary conditions n=109					Musculoskeletal conditions n=191				
		Admission		Discharge		Change % (95% CI) ^c	Admission		Discharge		Change % (95% CI) ^c	Admission		Discharge		Change % (95% CI) ^c
		n ^a	% ^b	n ^a	% ^b		n ^a	% ^b	n ^a	% ^b		n ^a	% ^b	n ^a	% ^b	
d240	Handling stress and other psychological demands						109	48	105	35	16 (10–25]	189	47	177	31	18 (13–25]
d315	Communicating with (receiving) nonverbal messages	90	19	88	8	17 (10–27)										
d330	Speaking	91	40	88	22	33 (23–44)					109	28	106	11	23 (15–32)	
d335	Producing nonverbal messages	91	26	88	12	18 (11–28)										
d360	Using communication devices and techniques	86	45	88	18	37 (27–48)										
d410	Changing basic body position	90	67	88	36	44 (33–55)	109	46	106	27	34 (25–44)	191	95	177	60	58 (50–65)
d415	Maintaining a body position	89	63	88	30	42 (31–53)	109	36	106	22	28 (20–38)	191	81	177	45	56 (49–64)
d420	Transferring oneself	89	61	87	32	42 (31–53)	109	44	106	22	34 (25–44)	191	90	177	36	64 (57–71)
d440	Fine hand use (picking up, grasping)	91	70	88	51	34 (24–45)										
d445	Hand and arm use	91	73	88	49	43 (33–54)					191	24	177	18	12 (7–18)	
d450	Walking						109	61	106	36	36 (27–46)	191	88	177	71	49 (41–56)
d465	Moving around using equipment	77	75	69	45	45 (32–58)										
d510	Washing oneself	91	71	88	38	43 (33–54)	109	58	106	30	36 (27–46)	191	81	177	42	47 (40–55)
d520	Caring for body parts	91	76	88	42	43 (33–54)	109	56	106	28	38 (29–48)	191	81	177	49	46 (38–53)
d530	Toileting	89	67	86	28	45 (34–56)	109	53	106	22	38 (29–48)	191	72	177	24	58 (50–65)
d540	Dressing	88	69	86	37	45 (34–56)	109	56	106	27	38 (29–48)					
d550	Eating	91	51	88	28	34 (24–45)					191	32	177	16	20 (14–26)	
d560	Drinking	91	41	88	20	31 (21–41)										
d760	Family relationships	85	26	83	14	17 (10–27)					181	22	168	12	12 (8–18)	
d940	Human rights	82	11	83	6	11 (5–21)										

^aNumber of valid answers.

^bProportion of restrictions in the category.

^cProportion of patients experiencing change (improvement or worsening) in the category. 95% CI: 95% confidence interval.

was observed in both *Attention functions* (b140) and *Stability of joint functions* (b715).

Functioning and disability in patients with cardiopulmonary conditions

The frequency of impairments or restrictions in patients with cardiopulmonary conditions ranged from 7% to 98% (mean 46%) at admission and from 4% to 87% (mean 33%) at discharge. There was no category with prevalence below 5% at admission.

Body function categories had the highest prevalence of impairment both at admission and at discharge. As expected, impairments in *Functions of the respiratory system* (b440–b449) and *Additional functions and sensations of the cardiovascular and respiratory systems* (b450–b499) were most frequent in this patient group.

The Body Functions most frequently impaired at admission were *Exercise tolerance functions* (b455) (98%), *Sensations associated with cardiovascular and respiratory function* (b460) (83%), and *Respiration functions* (b440) (70%), the most frequently impaired at discharge were *Exercise tolerance functions* (b455) (87%), *Sensations associated with cardiovascular and respiratory function* (b460) (64%), and *Heart functions* (b410) (59%).

The Body Structures most frequently impaired both at admission and at discharge were *Structure of cardiovascular system* (s410) (72% at admission/69% at discharge), and *Structure of respiratory system* (s430) (55%/46%).

The ICF categories from the component A&P most frequently limited at admission were *Walking* (d450) (61%), *Washing oneself* (d510) (58%), *Caring for body parts* (d520) (56%), and *Dressing* (d540) (56%), the most frequently limited at discharge were *Walking* (d450) (36%), *Handling stress and other psychological demands* (d240) (35%), and *Washing oneself* (d510) (30%).

The percentage of patients reporting an improvement in functioning at discharge ranged from 2% to 35% for the different ICF categories. The most frequent improvements were observed in A&P categories *Toileting* (d530) (35%), *Dressing* (d410) (33%), *Walking* (d450) (32%), and *Caring for body parts* (d520) (32%). The Body Functions which improved most frequently were *Exercise tolerance functions* (b455) (33%), *Respiration functions* (b130) (25%), and *Additional respiratory functions* (b450) (25%). However, impairments in *Exercise tolerance functions* (b455) were highly frequent also at discharge. The most frequent improvement in Body Structures was found in the *Structure of respiratory system* (s410) (10%).

For the different ICF categories, the percentage of patients reporting a deterioration of functioning at discharge ranged from 0% to 8%, which was observed in 5 categories: *Blood pressure functions* (b420), *Additional respiratory functions* (b450), *Ingestion functions* (b510), *Changing basic body position* (d410), and *Maintaining a body position* (d415).

Functioning and disability in patients with musculoskeletal conditions

The frequency of impairments or restrictions in patients with musculoskeletal conditions ranged from 3% to 95% (mean 46%) at admission and from 0% to 85% (mean 31%) at dis-

charge. There were two categories with prevalence below 5% at admission *Consciousness functions* (b110) and *Experience of self and time functions* (b180).

The Body Functions and Body Structures most frequently impaired both at admission and at discharge were *Muscle power functions* (b730) (94% at admission/85% at discharge), *Mobility of joint functions* (b710) (92%/84%), *Sensation of pain* (b280) (91%/66%), *Structure of areas of skin* (s810) (64%/59%), and *Structure of lower extremity* (s750) (53%/55%).

The ICF categories from the component A&P most frequently limited at admission were *Changing basic body position* (d410) (95%), *Transferring oneself* (d420) (90%), and *Walking* (d450) (88%), the most frequently limited at discharge were *Walking* (d450) (71%), *Changing basic body position* (d410) (60%), and *Caring for body parts* (d520) (49%).

The percentage of patients reporting an improvement in functioning at discharge ranged from 1% to 64% for the different ICF categories. The most frequent improvements were observed in A&P categories *Transferring oneself* (d420) (64%), *Changing basic body position* (d410) (58%), *Maintaining a body position* (d415) (55%), and *Toileting* (d530) (55%). The Body Functions which improved most frequently were *Sensation of pain* (b280) (33%), *Mobility of joint functions* (b710) (31%), and *Stability of joint functions* (b715) (31%). The most frequent improvement in Body Structures was found in the *Structure of cardiovascular system* (s410) (12%).

For the different ICF categories, the percentage of patients reporting a deterioration of functioning at discharge ranged from 0% to 5%, which was seen for two categories: *Emotional functions* (b152) and *Muscle tone functions* (b735).

Common aspects of functioning and disability in the 3 patient groups

A comparison of the 3 condition groups showed that there were several categories with highly frequent impairment (> 50% of patients) irrespective of the category at admission. These frequently occurring impairments were *Sleep functions* (b134) (57–66%), *Blood vessel functions* (b415) (55–60%), *Walking and moving categories* (*Walking* (d450) in patients with cardiopulmonary and musculoskeletal conditions and *Moving around using equipment* (d465) in patients with neurological conditions) (61–88%), and some of the *Self-care* categories (d510–d540) (53–81%). In patients with neurological or musculoskeletal conditions at admission, the most frequent impairments and limitations were in *Muscle Functions* (b730–b735) (55–94%) and *Changing and maintaining body positions* (d410–d420) (61–95%).

Contextual factors

Table V gives an overview of the prevalence of categories from the component Environmental Factors, which served as facilitators or presented barriers, stratified by condition.

Environmental factors in patients with neurological conditions

The frequency of facilitators in patients with neurological conditions ranged from 16% to 100% (mean 75%), whereas the frequency of barriers ranged from 1% to 42% (mean

Table V. International Classification of Functioning, Disability and Health (ICF) categories of the component Environmental Factors described as either facilitator or barrier at admission

ICF	ICF Code Description	Specification	Neurological conditions n=91		Cardiopulmonary conditions n=109		Musculoskeletal conditions n=191	
			n ^a	% ^b	n ^a	% ^b	n ^a	% ^b
e110	Products or substances for personal consumption	Barrier	87	11	107	16	188	24
		Facilitator	87	86	107	87	188	82
e115	Products and technology for personal use in daily living	Barrier	84	20	105	15	187	16
		Facilitator	84	80	104	77	186	78
e120	Products and technology for personal indoor and outdoor mobility and transportation	Barrier	67	16	96	4	180	14
		Facilitator	67	84	96	81	180	72
e125	Products and technology for communication	Barrier	82	17				
		Facilitator	82	74				
e150	Design, construction and building products and technology of buildings for public use	Barrier	78	17				
		Facilitator	78	73				
e240	Light	Barrier	88	18				
		Facilitator	86	50				
e250	Sound	Barrier	88	42	108	30		
		Facilitator	86	16	108	22		
e260	Air quality	Barrier			109	33		
		Facilitator			108	44		
e310	Immediate family	Barrier	81	4	98	3	179	10
		Facilitator	81	93	98	90	179	88
e315	Extended family	Barrier	73	3				
		Facilitator	73	78				
e320	Friends	Barrier	69	1	76	9	171	4
		Facilitator	69	88	76	78	172	73
e355	Health professionals	Barrier	88	6	109	2	190	8
		Facilitator	88	97	109	98	191	98
e360	Health related professionals	Barrier	65	2				
		Facilitator	64	70				
e410	Individual attitudes of immediate family members	Barrier	79	10	97	5	178	6
		Facilitator	78	88	97	86	178	88
e415	Individual attitudes of extended family members	Barrier	70	6				
		Facilitator	69	75				
e420	Individual attitudes of friends	Barrier	67	1	74	9	169	1
		Facilitator	66	80	74	74	169	72
e450	Individual attitudes of health professionals	Barrier	80	4	109	5	186	8
		Facilitator	79	100	109	95	186	94
e455	Individual attitudes of other professionals	Barrier	64	3				
		Facilitator	63	68				
e465	Social norms, practices and ideologies	Barrier	61	23				
		Facilitator	60	43				
e550	Legal services, systems and policies	Barrier	64	11				
		Facilitator	64	61				
e570	Social security, services, systems and policies	Barrier	77	10	104	8		
		Facilitator	76	75	103	85		
e580	Health services, systems and policies	Barrier	82	11	106	8	186	11
		Facilitator	81	96	106	89	188	92

^aNumber of valid answers; ^bProportion of patients experiencing the category as barrier or facilitator, respectively.

11%). There were no facilitators with prevalence below 5%, but 7 barriers had prevalence below 5%. The most frequent facilitators were *Individual attitudes of health professionals* (e450) (100%), *Health professionals* (e355) (97%), *Health services, systems and policies* (e580) (96%), and *Immediate family* (e310) (93%). The most frequent barriers were *Sound* (e250) (42%), *Social norms, practices and ideologies* (e465) (23%), and *Products and technology for personal use in daily living* (e115) (20%).

Environmental factors in patients with cardiopulmonary conditions

The frequency of facilitators in patients with cardiopulmonary conditions ranged from 22% to 98% (mean 77%); there were no categories serving as facilitators in less than 5% of the patients. The most frequent barriers, which ranged from 2% to 33% (mean 11%), were *Air quality* (e260) (33%), *Sound* (e250) (30%), *Products or substances for personal consumption* (e110) (16%), and *Products and technology for personal*

use in daily living (e115) (15%); 5 categories were a barrier for less than 5% of the patients.

Environmental factors in patients with musculoskeletal conditions

The frequency of facilitators in patients with musculoskeletal conditions ranged from 72% to 98% (mean 83%). The most frequent facilitators were *Health professionals* (e355) (98%), *Individual attitudes of health professionals* (e450) (94%), and *Health services, systems and policies* (e580) (92%); there were no categories as facilitators with prevalence below 5%. The frequency of barriers ranged from 1% to 24% (mean 10%). The most frequent barriers were *Products or substances for personal consumption* (e110) (24%), *Products and technology for personal use in daily living* (e115) (16%), and *Products and technology for personal indoor and outdoor mobility and transportation* (e120) (14%); two categories had prevalence as barriers below 5%.

Additional ICF categories

Thirty-eight aspects of functioning not previously covered by the comprehensive acute ICF Core Sets were identified as relevant. However, many of these aspects were only mentioned by one person, and so cannot be considered as representative. Aspects which were mentioned by at least 1% of the participants are presented in Table VI. All of these newly identified aspects could be translated into corresponding ICF categories. Ten aspects referred to categories and chapters of the component Body Functions, 17 to categories and chapters of the component Body Structures, 7 to categories and chapters of

the component Activities and Participation and 3 to categories of the component Environmental Factors.

DISCUSSION

The results of the present multi-centre cohort study provide further insight into the course of functioning and health and its related contextual factors in patients with rehabilitation needs in acute hospital care. The results of our study generally confirm the first version of the comprehensive ICF Core Sets for patients in the acute hospital. We could show that a large number of the categories included in the comprehensive ICF Core Sets address relevant aspects of functioning and disability, and detected a few additional candidates for inclusion.

Irrespective of the health condition, there were high prevalences of impairment in *Sleep functions* (b134) and *Blood vessel functions* (b415), and also limitations in *Walking and moving* (d450–d469) and in all categories pertaining to *Self-care* (d510–d540). Sleep loss, sleep disruption and a disturbed circadian rhythm are reported frequently at acute and intensive care units, and have been attributed to several factors, such as interventions, diagnostic procedures, underlying disease or ambient noise (14–15). Impaired blood vessels functions frequently correspond to venous thromboembolism, which is a life-threatening and frequent complication of surgery, and also arising due to prolonged immobility and the use of central venous catheters (16–17).

Limitations in walking and moving, as well as self-care patterns are to be expected in critically ill patients in acute hospitals, in intensive care or in intermediate care units, such

Table VI. Additional International Classification of Functioning, Disability and Health (ICF) categories not covered by the comprehensive ICF Core Sets

ICF	ICF Code Description	All conditions n=391		Neurological conditions n=91		Cardiopulmonary conditions n=109		Musculoskeletal conditions n=191	
		n ^a	% ^b	n ^a	% ^b	n ^a	% ^b	n ^a	% ^b
<i>Body Functions and Structures</i>									
b810	Protective functions of the skin	122	31	–	–	4	4	118	62
b430	Haematological system functions	25	6	–	–	–	–	25	13
b265	Touch function	10	3	–	–	0	0	10	5
b535	Sensations associated with the digestive system	7	3	–	–	0	0	7	4
b525	Defecation functions	6	2	–	–	6	6	–	–
<i>Body Structures</i>									
s810	Structure of areas of skin	24	6	24	26	–	–	–	–
s560	Structure of liver	8	2	2	2	2	2	4	2
s750	Structure of lower extremity	5	1	2	2	2	2	1	1
s520	Structure of oesophagus	4	1	2	2	2	2	0	0
s760	Structure of trunk	4	1	4	4	–	–	–	–
<i>Activities and Participation</i>									
d455	Moving around	87	22	21	23	18	17	48	25
d450	Walking	30	8	30	33	–	–	–	–
d920	Recreation and leisure	9	2	0	0	0	0	9	5
d850	Remunerative employment	6	2	0	0	0	0	6	3
<i>Environmental Factors</i>									
e330	People in positions of authority	4	1	3	3	0	0	1	1

^aNumber of patients in whom the interviewers found the respective category relevant to describe the patient comprehensively.

^bProportion of patients in relation to all in whom the interviewers found the respective category relevant to describe the patient comprehensively.

as those in the present study. In general, the frequency of impairments and limitations in these categories reflects the seriousness of the underlying illness or disability (18). The present finding of frequently reported impairments in muscle functions and limitations in changing and maintaining body positions in patients with neurological and musculoskeletal conditions agrees with earlier reports on the need of rehabilitative interventions (18–19).

As expected, ICF categories related to brain and vascular systems were impaired in a high proportion of patients with neurological conditions, both at admission and discharge. The high prevalence of impairments related to perception and cognition is also in line with the literature (19–20).

Problems with *General metabolic functions* (b540), such as diabetes mellitus, were observed in only a small proportion of patients with neurological conditions, although approximately 50% had a cerebrovascular disease (Table I). This is surprising since diabetes is a risk factor for cerebrovascular diseases and should therefore be highly prevalent in patients with neurological conditions (21–23). Since disability after stroke is significantly higher in patients with diabetes (24), the category metabolic functions should be included in a final version of the comprehensive Set as a parameter to be monitored.

The most frequently observed improvements in patients with neurological conditions were in categories of the component Activities and Participation, namely in *Changing basic body position* (d410), *Moving around using equipment* (d465), *Toileting* (d530), and *Caring for body parts* (d520), which are all categories from mobility and self-care. These improvements reflect the major goals of rehabilitation and nursing care in the acute situation, which are primarily the ability to attain a sitting and standing position (included in *Changing basic body position*) and ultimately the obtaining of independent mobility with assistive devices such as wheelchairs, walking frames or crutches, as well as regaining independence in very personal activities such as toileting or brushing of teeth (included in *Caring for body parts*).

We identified some aspects as tending to deteriorate during hospitalization, namely *Attention functions* (b140) and *Stability of joint functions* (b715). Arguably, those functions are likely to be disregarded at the initiation of therapy, when survival and stabilization of vital functions are the main concerns. Additionally, joint problems such as subluxation of the shoulder joint, are common in patients with hemiplegia, and tend to exacerbate with time (25).

In patients with cardiopulmonary conditions, impairments in functions and structures connected with the cardiac and pulmonary system had the highest prevalence both at admission and discharge, especially *Exercise tolerance functions* (b455) and *Sensations associated with cardiovascular and respiratory function* (b460) (including dyspnoea and air hunger). Accordingly, limitations in a wide range of physical activities such as *Walking* (d450) and all self-care issues were reported most frequently in these patients. However, it was precisely these issues which improved most frequently during hospital stay, perhaps reflecting the importance of obtaining independence in daily activities as a major goal in cardiopulmonary rehabilita-

tion. On the other hand, the frequent occurrence of limitations in *Handling stress and other psychological demands* (d240) underscores the relevance of psychosocial interventions in the early course of cardiopulmonary rehabilitation (26–27).

Improvements in *Mobility* and *Self-care* again refer to the typical goals of physical therapy and nursing in the acute hospital. Our observations of decline in ingestion and respiratory functions can be attributed to the effects of prolonged immobilization in some patients. In particular, it is unsurprising that patients with musculoskeletal conditions experienced impairment in functions of muscles, bones and joints, as well as limitations in the corresponding categories of the component A&P, such as *Walking* (d450), *Moving around* (d455), and, consequently, *Self-care*. In the course of their recovery and rehabilitation therapy, the degree of pain, mobility and stability of joints had improved at discharge. The deterioration of emotional functions seen in our study is in line with earlier reports, for example on the occurrence of depression after hip fracture (28–29).

The detection of additional topics not covered by the present version of the comprehensive ICF Core Sets were rather infrequent, with the exception of *Protective functions of the skin*, which came up in almost two-thirds of the patients with musculoskeletal conditions, *Moving around*, seen in almost 25% of the patients with musculoskeletal and neurological conditions, and *Walking*, which was noted in more than 25% of the patients with neurological conditions. Those categories seem intuitively reasonable and fit for inclusion in the revised ICF Core Sets. Indeed, they had initially been excluded during the consensus conferences only because the experts on the acute hospital situation sought to derive parsimonious sets, which were not so comprehensive as to be impractical in the clinical situation.

Even though prevalence of impairment, limitation or restriction was rather low in some of the categories, all of those categories showed change. Since assessing change over time arguably is one of the important properties of an assessment instrument (9), we propose to include categories into the comprehensive ICF Core Sets not only on the basis of frequency, but also conditional on their propensity to change.

Some limitations of our study may restrict the generalizability of the results. The sample included only patients from German-speaking countries with comparable healthcare systems. The collection of data elsewhere in Europe, or in other continents, might well have yielded different results. Therefore, additional validation studies with patients from other countries and cultures should be carried out. Impairments and limitations may also be a direct consequence of the underlying diagnoses encountered in the particular study. We are, however, confident that the current sample of older patients reflected the prototypical spectrum of diagnoses seen in Europe. Nevertheless, the best validation for comprehensive ICF Core Sets is to use them in practice as often as possible, and in many different settings.

In conclusion, the categories of the comprehensive ICF Core Sets for the acute hospital situation were confirmed. Due to their sensitivity to change no categories of the com-

prehensive ICF Core Sets should be excluded. The categories *Moving around* (d455) and *Walking* (d450) have to be included in the final version of the comprehensive ICF Core Set for neurological conditions in the acute hospital. The categories *Protective functions of the skin* (b810) and *Moving around* (d455) should be included in the final version of the comprehensive ICF Core Set for musculoskeletal conditions in the acute hospital.

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REFERENCES

- Clavet H, Hebert PC, Fergusson D, Doucette S, Trudel G. Joint contracture following prolonged stay in the intensive care unit. *CMAJ* 2008; 178: 691–697.
- Herridge MS, Batt J, Hopkins RO. The pathophysiology of long-term neuromuscular and cognitive outcomes following critical illness. *Crit Care Clin* 2008; 24: 179–199.
- Gosselink R, Bott J, Johnson M, Dean E, Nava S, Norrberg M, et al. Physiotherapy for adult patients with critical illness: recommendations of the European Respiratory Society and European Society of Intensive Care Medicine Task Force on Physiotherapy for Critically Ill Patients. *Intensive Care Med* 2008; 34: 1188–1199.
- Morris PE, Goad A, Thompson C, Taylor K, Harry B, Passmore L, et al. Early intensive care unit mobility therapy in the treatment of acute respiratory failure. *Crit Care Med* 2008; 36: 2238–2243.
- Stucki G, Stier-Jarmer M, Grill E, Melvin J. Rationale and principles of early rehabilitation care after an acute injury or illness. *Disabil Rehabil* 2005; 27: 353–359.
- World Health Organisation (WHO). International Classification of Functioning, Disability and Health: ICF. Geneva: WHO; 2001.
- Grill E, Ewert T, Chatterji S, Kostanjsek N, Stucki G. ICF Core Set development for the acute hospital and early post-acute rehabilitation facilities. *Disabil Rehabil* 2005; 27: 361–366.
- Gutenbrunner C, Fialka-Moser V, Grill E, Stucki G. ICF-Core-Sets im Akutkrankenhaus und in der Frührehabilitation fuer Patienten mit Erkrankungen des muskuloskeletalen Systems. *Phys Med Rehab Kuror* 2009; 19: 14–21.
- Boers M, Brooks P, Strand CV, Tugwell P. The OMERACT filter for Outcome Measures in Rheumatology. *J Rheumatol* 1998; 25: 198–199.
- Grill E, Stucki G. Criteria for validating comprehensive ICF Core Sets and developing brief ICF Core Set versions. *J Rehabil Med* 2011; 43: 87–91.
- Boldt C, Grill E, Wildner M, Portenier L, Wilke S, Stucki G, et al. ICF Core Set for patients with cardiopulmonary conditions in the acute hospital. *Disabil Rehabil* 2005; 27: 375–380.
- Ewert T, Grill E, Bartholomeyczik S, Finger M, Mokrusch T, Kostanjsek N, et al. ICF Core Set for patients with neurological conditions in the acute hospital. *Disabil Rehabil* 2005; 27: 367–373.
- Stoll T, Brach M, Huber EO, Scheuringer M, Schwarzkopf SR, Konstanjsek N, et al. ICF Core Set for patients with musculoskeletal conditions in the acute hospital. *Disabil Rehabil* 2005; 27: 381–387.
- BaHammam A. Sleep in acute care units. *Sleep Breath* 2006; 10: 6–15.
- Drouot X, Cabello B, d’Ortho MP, Brochard L. Sleep in the intensive care unit. *Sleep Med Rev* 2008; 12: 391–403.
- Aksamit TR. Thromboembolism occurrence and diagnosis in the medical intensive care unit. *Semin Thromb Hemost* 2001; 27: 47–57.
- Muscudere JG, Heyland DK, Cook D. Venous thromboembolism in critical illness in a community intensive care unit. *J Crit Care* 2007; 22: 285–289.
- Herridge MS. Mobile, awake and critically ill. *CMAJ* 2008; 178: 725–726.
- Sachdev PS, Brodaty H, Valenzuela MJ, Lorentz L, Looi JC, Berman K, et al. Clinical determinants of dementia and mild cognitive impairment following ischaemic stroke: the Sydney Stroke Study. *Dement Geriatr Cogn Disord* 2006; 21: 275–283.
- Serrano S, Domingo J, Rodriguez-Garcia E, Castro MD, del Ser T. Frequency of cognitive impairment without dementia in patients with stroke: a two-year follow-up study. *Stroke* 2007; 38: 105–110.
- Hajat C, Dundas R, Stewart JA, Lawrence E, Rudd AG, Howard R, et al. Cerebrovascular risk factors and stroke subtypes: differences between ethnic groups. *Stroke* 2001; 32: 37–42.
- Kissela BM, Khoury J, Kleindorfer D, Woo D, Schneider A, Alwell K, et al. Epidemiology of ischemic stroke in patients with diabetes: the greater Cincinnati/Northern Kentucky Stroke Study. *Diabetes Care* 2005; 28: 355–359.
- Moroz A, Bogen RA, Bryant PR, Geis CC, O’Neill BJ. Stroke and neurodegenerative disorders. 2. Stroke: comorbidities and complications. *Arch Phys Med Rehabil* 2004; 85 Suppl 1: S11–S14.
- Megherbi S-EMD, Milan CP, Minier DMD, Couvreur GMD, Osseby G-VMD, Tilling KP, et al. Association Between Diabetes and Stroke Subtype on Survival and Functional Outcome 3 Months After Stroke: Data From the European BIOMED Stroke Project. *Stroke* 2003; 34: 688–694.
- Vuagnat H, Chantraine A. Shoulder pain in hemiplegia revisited: contribution of functional electrical stimulation and other therapies. *J Rehabil Med* 2003; 35: 49–54; quiz 6.
- Piotrowicz R, Wolszakiewicz J. Cardiac rehabilitation following myocardial infarction. *Cardiol J* 2008; 15: 481–487.
- Rees K, Bennett P, West R, Davey SG, Ebrahim S. Psychological interventions for coronary heart disease. *Cochrane Database Syst Rev* 2004 (2): CD002902.
- Holmes JD, House AO. Psychiatric illness in hip fracture. *Age Ageing* 2000; 29: 537–546.
- Yea-Ing Lotus S, Huey-Shinn C, Huei-Chin T, Min-Chi C, Chi-Chuan W, Wen-Che T. Older people with hip fracture: depression in the postoperative first year. *J Adv Nurs* 2009; 65: 2514–2522.