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# Running a Complementary Stroke Rehabilitation and Aftercare Program: Experiences of Four European Centres

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## 1. Introduction

Stroke is one of the major public health concerns throughout the world. It is a leading cause of long-term disability (Shah, 2006), consuming a large amount of health care resources. In Western Europe, the incidence varies between 1.0 and 3.75 per 1000 habitants (Weir et al., 2001). The proportion of patients who die or are dependent at six months after stroke ranges from 20 - 41% (Brainin et al., 2000). The consequences after stroke are not only persistent neurological impairment which lead to physical, functional and psychosocial problems, but also life-time disability that requires rehabilitation to enable optimal function. There is strong evidence that specialized interdisciplinary stroke rehabilitation units are correlated with improved functional outcomes, mortality reduction, shorter lengths of hospital stay, and reduced need for long term institutionalization in moderate to severe stroke patients (Teasell et al., 2009). The benefits of specialized interdisciplinary stroke rehabilitation can be attributed to the fact that they emphasize specialized training for stroke rehabilitation inpatients, while an emphasis on working as a complementary rehab team ensures that diverse skills can be applied to deal with the complex needs of the stroke patient. Specialized interdisciplinary stroke rehabilitation units currently represent the "gold standard" in stroke rehabilitative care (Teasell et al., 2009). There are many specialized interdisciplinary stroke rehabilitation units, running throughout the European countries. Regarding the concepts of Health care provision which is composed of structures of care, processes of care, and outcomes (Donabedian, 1988), each organized stroke rehabilitation centre has its own practice ( structure of care and process of care) which will effect on its outcome and make a difference to other centres. Therefore, comparing different stroke

rehabilitation systems (multicentre study) in fields of practice and outcome from various centres between European countries allows for greater appreciation of alternative approaches and will assist in determining optimal strategies for improving outcomes and rehabilitation services (Markus, 2004).

The CERISE project (Collaborative Evaluation in Rehabilitation of Stroke across Europe) was a multicentre study that compared stroke care practices and their outcomes among 4 European centres.

## 2. Objectives

The European project CERISE (Collaborative Evaluation in Rehabilitation of Stroke across Europe) is a prospective longitudinal multicentre cohort study which mainly aims to gain insight into various clinical and organizational aspects of stroke rehabilitation and care by comparing inpatient stroke outcome, recovery patterns, process and structure of stroke rehabilitation and care during 6 months after stroke between four European countries: United Kingdom, Switzerland, Germany and Belgium.

This project consisted of 2 main components:

1. To document multidimensional clinical profile including motor, functional, emotional recovery and socioeconomic aspects of stroke patients until 6 months after stroke and to compare the results between the rehabilitation centres. This category comprised of 4 sub- studies.
  - 1.1 The Use of a Biplot in Studying Outcomes After Stroke (De Wit et al.,2009)
  - 1.2 Motor and Functional Recovery After Stroke (De Wit et al.,2007)
  - 1.3 Anxiety and depression in the first six months after stroke (De Wit et al.,2008)
  - 1.4 Effect of socioeconomic status on functional and motor recovery after stroke (Putman et al.,2007)
2. To document and compare the results between the centers in the provision of stroke services and in subject of the organizational characteristics of the different rehabilitation units. This includes consideration of following sub- studies.
  - 2.1 The use of time by stroke patients (De Wit et al.,2005)
  - 2.2 Amount of time spent by therapy ,emphasized on physiotherapy and occupational therapy (Putman et al.,2006)
  - 2.3 The content of physiotherapy & occupational therapy (De Wit et al.,2006)
  - 2.4 Admission criteria to stroke rehabilitation units (Putman et al.,2007)
  - 2.5 Variation in follow- up services after inpatient stroke rehabilitation (Putman et al.,2009)

## 3. Material and methods

### 3.1 Main study design: Longitudinal multicentre cohort study

#### 3.1.1 Settings and subjects

The CERISE project was conducted in 4 European countries. Data was collected in 6 stroke rehabilitation units (SRUs) as followed:

- The Fachklinik, Herzogenaurach, Germany (SRU-DE)
- Queen's Medical Centre and City Hospital, Nottingham, UK (analysed together, SRU-UK)
- 2 SRUs at the University Hospital Pellenberg, Belgium (analysed together, SRU-BE )
- The Rehab Clinic, Zurzach Switzerland (SRU-CH)

Each stroke rehabilitation unit has the provision of inpatient multidisciplinary care. Patients were transferred to the units from an acute setting. Between March 2002 and September 2004, all consecutive patients fitting the following inclusion criteria were recruited:

1. First-ever stroke as defined by WHO (WHO MONICA project,1988)
2. 40 to 85 years of age
3. Score on Gross Motor function of the Rivermead Motor Assessment (Lincoln & Leadbitter, 1979) (RMA-GF)  $\leq 11$  and/or a score on Leg and Trunk function (RMA-LT)  $\leq 8$  and/or a score on Arm function (RMA-AR)  $\leq 12$  on admission to the rehabilitation centre

The exclusion criteria were:

1. Other neurological impairments with permanent damage
2. Stroke-like symptoms attributable to subdural hematoma, tumor, encephalitis, or trauma
3. Pre-stroke Barthel Index (BI) (Mahoney & Barthel,1965)  $< 50$   
(To be able to distinguish between pre- existing disabilities and disabilities resulting from the stroke)
4. Admitted to the rehabilitation centre more than 6 weeks after stroke
5. No informed consent

The study was approved by the ethic committee for each centre.

### 3.1.2 Data collection

The basic documented data of all studies in the CERISE project were collected in similar pattern. These data comprised of patients' age, gender, time between stroke onset and admission assessment (TSOA), prestroke disability (assessed by Barthel Index), type of stroke & side of impairment (determined on the basis of NMR/CT and clinical examination), severity of neurological deficit (NIHSS : range 0-42), comorbidities, urinary incontinence and swallowing problems. Also the occurrence of dysarthria and dysphasia using items from the National Institutes of Health Stroke Scale and length of stay (LOS) were documented. Educational level, equivalent income, place of residence were recorded in the study as parameters of socioeconomic status on functional and motor recovery after stroke and the study of variations in follow-up services after inpatient stroke rehabilitation.

### 3.1.3 Outcome measurement and data analysis

Each of the sub-studies has different study design, outcome measurement and analysis method. All data and outcome were analyzed and corrected by reliable statistic methods which were suitable for each individual study and variations in case-mix were corrected using multiple regression analysis. They were summarized in Table 1.

Outcomes	Measurement /Assessment methods or Study design	Time of measurement/ assesement	Details/Description
<b>Motor recovery pattern</b>	RMA (Rivermead Motor Assessment) <ul style="list-style-type: none"> <li>• RMA - GF (Gross function)</li> <li>• RMA - LT (Leg/Trunk)</li> <li>• RMA- A (Arm)</li> </ul>	On admission, at discharge, 2 ,4, 6 months after stroke	The RMA-GF into 5 classes (0 -2,3-5, 6-7, 8-9, 10-13) RMA-LT into 4 classes (0 -3, 4-6, 7-9,10) RMA-A into 5 classes (0 -1, 2-5, 6-9, 10-12, 13-15)
<b>Self care and function recovery pattern</b>	Barthel Index (BI) The Nottingham Extended Activities of Dailay Living (NEADL) (Nouri & Lincoln,1978)	On admission, at discharge, 2 ,4, 6 months after stroke	BI into 5 classes (0 -20, 25-40, 45-60, 65-80, 85-100) NEADL into 6 classes (0 -2, 3-5, 6-8, 9-11, 12-16, 17-22)
<b>Emotional recovery pattern</b>	Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith,1983)	2, 4, 6 months after stroke	Measuring the symptoms of anxiety and depression, not provided by a psychiatric diagnosis The score $\geq 8$ were to be considered anxious or depressed
<b>Quality of life</b>	<ul style="list-style-type: none"> <li>• Euroqol ( EQ ) (The EuroQol Group,1990)</li> <li>• Euroqol-Health State ( EQ- HS)</li> <li>• Euroqol-Visual Analogue Scale ( EQ - VAS )</li> </ul>	2, 4, 6 months after stroke	
<b>The burden on the patients' principal caregiver</b>	Caregiver Strain Index ( CSI ) (Robinson,1983)	2, 4, 6 months after stroke	
<b>Socioeconomic</b>	<ul style="list-style-type: none"> <li>• Education level – International Standard Classification of Education ( ISCED) (OECD,1999)</li> <li>• Equivalent income : monthly household income and household composition</li> </ul>	At discharge by a structured interview	<ul style="list-style-type: none"> <li>• Education level : 2 classes Low education : ISCED classification of 0-2 High education : ISCED classification of 3 or higher</li> <li>• Income: 3 categories low, moderate ,high</li> </ul>

Table 1. Outcome measurement methods in each sub-studies.

Outcomes	Measurement /Assessment methods or Study design	Time of measurement/ assesement	Details/Description
<b>Time in therapy</b>	60 randomly selected stroke patients were observed at 10-minute intervals using behavioral mapping in each centre.	30 randomly selected days, equally distributed over the 5 weekdays to cover regular activities	Behavioral mapping was used to document patients' activity, location, and interaction
<b>Task characteristics of physiotherapists and occupational therapists</b>	Documented diary by PT and OT :Activity,number of patients,number of stroke patients, involvement of other people,location and frequency of each activity.	The therapists documented their activities in 15 min periods.	Task characteristics of physiotherapists and occupational therapists
<b>Contents of therapy</b>	Recording individual 15 PT and 15 OT sessions using a mobile camera. Five experienced PT and Five experienced OT verified that the list contained all activities ( 53 activities in 12 categories) performed when treating stroke patients.		
<b>Admission criteria to inpatient rehabilitation unit</b>	Each medical consultants do Questionnaires (To document the impact of clinical and non-clinical factors on the admission ) followed by a qualitative round of semi-structured interviews		<p>Questionnaires: 3 main categories</p> <ol style="list-style-type: none"> <li>1. Factors related to the patient: physical condition, cognition,psychological behavioral, socioeconomic conditions and patient's network.</li> <li>2. Factors related to the network between facilities</li> <li>3. Factors related to the referring hospital</li> </ol> <p>The medical consultants were asked to score the impact of each identified factor on the admission on a 4-point scale, ranging from no effect ,low effect,high effect and very high effect.</p>

Table 1. Outcome measurement methods in each sub-studies. (Continuation)



Outcomes	Measurement /Assessment methods or Study design	Time of measurement/ assesment	Details/Description
<b>Follow-up sevicess after inpatient stroke rehabilitation</b>	Structured interview patients or carers to document: <ul style="list-style-type: none"> <li>place of residences</li> <li>the services post discharge</li> </ul>	At 2,4, 6 months post- stroke	Place of residences 4 categories: living at home 1. In rehabilitation centre 2. In acute hospital 3. Institutionalized 4. ( long-term facility) The services 6 types: 1. PT 2. OT 3. nursing care 4. speech & language therapy 5. psychological therapy 6. general practitioner (GP)

Table 1. Outcome measurement methods in each sub-studies. (Continuation)

#### 4. Results

Between March 2002 and September 2004, 1297 stroke patients were admitted to the 4 centres. Of these, 765 patients were excluded due to inclusion and exclusion criteria and the remaining 532 were included in the study. Patients' characteristics and prognostic data were compared between 4 centres (Table 2.)

There were some significant data differences. Patient in the UK and Swiss centres were significantly older than those in the Belgian and German centres. In the German centre, there were significantly more male patients compared with the other centres. Patients in the UK centre have shorter time between stroke onset and admission assessment and length of stay when compared with the other centres, while length of stay was significantly longer in the Belgian Centre compared to the other centres. No significant differences were found between centres for side of impairment, type of stroke, or prestroke BI. Comparison of prognostic data between centres revealed that patients in the Swiss and German centres had significantly less severe stroke compared with the others, reflected in higher initial BI, RMA-GF, RMA-LT, and RMA-A scores. There were significantly more patients with urinary incontinence in the Belgian and UK centres. More swallowing problems in UK centre were presented, whereas dysarthria occurred significantly more in the Belgian centre and dysphagia was found more often in the Swiss centre.

According to missing data at the each period of assessment, the number of eligible patients were adjusted and analysed by each of study. The study of using a Biplot in studying outcomes after stroke and the study of motor and functional recovery after stroke showed 69 patients were lost to follow-up 6 months after stroke; 18 died, 46 refused to participate, and 5 could not be assessed (missed assessment, poor medical condition). Hence, assessments were carried out for 463 patients. For the study of anxiety and depression in the first six months after stroke, 27 patients did not complete the HADS at any time, resulting in 505 remaining patients but complete HADS data could be collected for 435 ( 86%) patients. 113 patients were excluded from the analyses in the studies of effect of socioeconomic status and on functional and motor recovery after stroke.

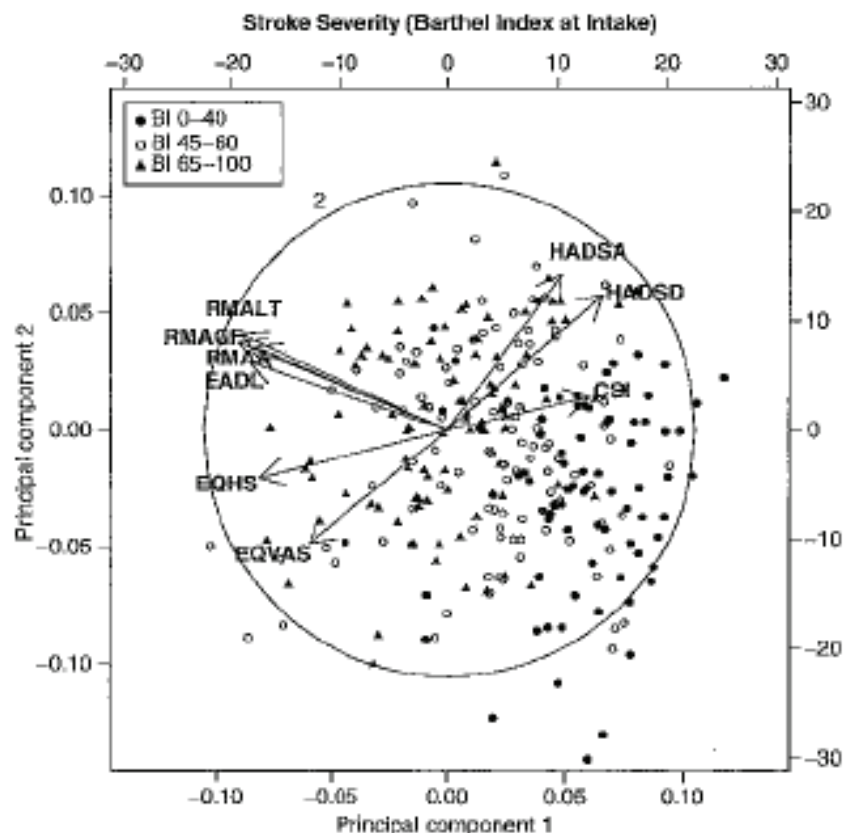
	All centre n = 532	Belgian Centre n = 127	UK Centre n = 135	Swiss Centre n = 135	German Centre n = 135	P
<b>Characteristics</b>						
Age,y : mean	69.5	67.8	72.0	71.7	66.5	<0.0001*
SD	10.3	11.2	9.5	9.6	9.8	
Men: n (%)	283 (53)	57 (45)	66 (49)	72 (53)	88 (65)	0.006†
<b>Side of impairment: n (%)</b>						
Left	285 (54)	69 (54)	81 (60)	67 (50)	68 (50)	0.28†
Right	227 (43)	51 (40)	53 (39)	62 (46)	61 (45)	
Both	20 (3)	7 (6)	1 (1)	6 (4)	6 (4)	
<b>Type of stroke : n (%)</b>						
Hemorrhage	77 (14)	24 (19)	15 (11)	24 (18)	14 (10.5)	0.33‡
Ischemic infarcts	445 (84)	101 (79.5)	117 (87)	108 (80)	119 (88)	
Unspecified	10 (2)	2 (1.5)	3 (2)	3 (2)	2 (1.5)	
<b>Prestroke Barthel : median (IQR)</b>	100 (100-100)	100 (100-100)	100 (100-100)	100 (100-100)	100 (100-100)	0.09§
<b>Urinary incontinence: n (%)</b>	149 (28)	49 (39)	27 (35)	24 (18)	29 (21)	0.0002†
<b>Swallowing problems: n (%)</b>	106 (20)	23 (18)	41 (30)	19 (14)	23 (17)	0.004†
<b>Dysarthria: n (%)</b>	223 (42)	66 (52)	46 (34)	52 (39)	59 (44)	<0.0001†
<b>Dysphasia: n (%)</b>	178 (33)	36 (28)	35 (26)	74 (55)	33 (24)	0.02†
<b>TSOA (days): median (IQR)</b>		23 (17-31.3)	12 (8-19)	19 (15-22.5)	20 (16-27)	<0.0001§
<b>LOS (days): median (IQR)</b>		66 (39.5-98)	44.5 (20-78)	52.5 (29-77)	49 (35-71)	0.0004§
<b>Initial BI: median (IQR)</b>		40 (25-60)	45 (25-80)	70 (30-90)	75 (50-90)	<0.0001§
<b>Initial RMA-GF: median (IQR)</b>		2 (1-6)	2 (1-5)	6 (1-9)	8 (4-10)	<0.0001§
<b>Initial RMA-LT: median (IQR)</b>		4 (1-7)	4 (1-7)	6 (3-9)	7 (5-9)	<0.0001§
<b>Initial RMA-A : median (IQR)</b>		2 (0-9)	3 (0-11)	7 (1-11)	7 (1-11)	0.0005§
*ANOVA, †x <sup>2</sup> , ‡exact, and §Kruskal-Wallis test with post-hoc analysis.						
IQR indicates,interquartile ranges; LOS, length of stay; TSOA, time between stroke onset and assessment on admission						
Barthel Index; (Q1- Q3) = (Quartile 1- Quartile3)						

Table 2. Comparison of Demographic and Prognostic Data Between Centres.



#### 4.1 Using a Biplot in studying outcomes after stroke (De Wit et al., 2009)

Use of a Biplot aimed to obtain a global picture of the relation between different multidimensional 6 months poststroke outcomes. This study revealed 2 clusters (Figure 1): The first cluster showed the high association between the 3 sections of the RMA (Rivermead Motor Assessment ; RMA -GF, RMA - LT, RMA- A) and the Extended Activities of Daily Living (EADL) which means that a strong association exists between motor function and dependency in activities of daily life beyond personal self care. A second cluster was formed by HADS-A, HADS-D, and EQ-VAS which showed strong association between anxiety, depression, and quality of life. The results also indicated that at 6 months after stroke, patients with BI ( Barthel Index ) < 45 had lower RMA-GF, RMA-LT, RMA-A, EQ-HS, and EQ-VAS scores but higher HADS-A and HADS-D scores compared to the others and also higher Caregiver Strain Index ( CSI ) scores when compared to the other caregivers. In contrast, the patients with initial BI score >60 had higher RMA-GF, RMA-LT, EQ-HS, and EQ-VAS scores whereas lower CSI scores and large variation of the HADS-A and HADS-D scores. This result concluded that patients with a low functional status could have higher



Abbreviations: BI, Barthel Index; CSI, Caregiver Strain Index; EQ-HS, EuroQol-Health State; EQ-VAS, EuroQol-Visual Analogue Scale; HADS-A, Hospital Anxiety and Depression Scale-Anxiety; HADS-D, Hospital Anxiety and Depression Scale-Depression; RMAGF, RMALT, and RMAA, Rivermead Motor Assessment-Gross Function, -Leg and Trunk, and -Arm.

Fig. 1. Biplot without CSI and with projected HADS-A and HADS-D vectors

anxiety and depression scores at 6 months after stroke, while there were large variations in anxiety and depression in patients with higher functional status. Mood disorders like anxiety and depression can occur in all stroke patients with less regard to their motor and/or functional status. EQ-HS, EQ-VAS and CSI are more related to remaining motor and functional disabilities. Patients with initial lower motor and ADL functions also have a poor prognosis for good recovery and therefore need more effort by the rehab team to avoid long term restrictions. EQ-HS and EQ-VAS at the end of the inpatient rehabilitation process seems to be additional prognostic factors for the long term perspective as it was revealed in another patient sample of the German centre (Grässel et al., 2005).

#### **4.2 Anxiety and depression in the first six months after stroke (De Wit et al., 2008)**

Prevalence of anxiety ranging between 22 -25 % and depression between 24 - 30% on HADS were found in this study. Median severity of both emotional disorders ranged between 4 and 5 at each time point. There were no significant differences between centres in the prevalence and severity of both disorders. The prevalence of both disorders remained stable between two and six months after stroke onset, but different patients were anxious/depressed at subsequent stages. This may be explained by the result which showed that about 40% of the patients with initial anxiety remained anxious up to six months, while 11% and 7% of those initially not anxious became anxious for the first time at four and six months after stroke, respectively. This pattern was similar for depression. The time course of severity of both disorders also were considered in this study. Severity of anxiety decreased between four and six months. Meanwhile severity of depression remained stable.

This study also compared severity of those who were anxious/depressed throughout the whole follow-up period to severity of those who were anxious/depressed at only two time points. The result showed that severity of both emotional disorders was significantly more severe in the group who was continuously anxious/depressed compared to those who were anxious/depressed at one or two time points. These findings from 2 studies involving in emotional disorders after stroke may indicate that anxiety was almost as common as depression in this subacute phase. Patients may become anxious and/or depressed at any time during 6 months. Those patients who remain anxious or depressed throughout the subacute period suffered from more severe emotional disorders. Thus, early screening for both emotional disorders is recommended for all stroke patients, even in those patients who had mild functional deficit. Additionally, the screening should be continued for an extended period of time after stroke.

#### **4.3 Motor and functional recovery 6 months after stroke (De Wit et al., 2007)**

The result of motor and functional recovery after stroke in 4 European centre revealed that half of the patients of all centres reached a score of at least 70% of the maximum RMA-GF score and at least 85 % of the maximum BI score at discharge. This meant that most recovery time took place during inpatient rehabilitation phase so it is important to prescribe proper therapeutic interventions to patients in this period. Among the 4 centres, the gross motor function(RMA-GF) and functional recovery using EADL were better in the Swiss and German centre than the UK centre.

On the other hand, personal self-care recovery on basic ADL functions (BI) was significantly higher in the UK compared with the German centre. The last fact may reflect the high input of

the nurses in UK with a more compensatory than functional training. The results are possibly explained by outcome findings of the other studies in the same CERISE project, time in therapy of stroke patients, use of time by physiotherapists & occupational therapists. The result of this 2 studies showed that higher percentage of time was spent in the therapeutic activities in the German and Swiss centre than in UK centre. More details of this 2 studies were reviewed on the following paragraphs. Thus, these reasonable findings led to better gross motor and NEADL recovery in these 2 centres. Despite these methodological issues, these findings are in line with the results of a meta-analysis (Kwakkel et al., 2004), indicating that more intensive rehabilitation results in better recovery. Other meta-analysis and papers reflect on the content and specificity of the rehabilitation interventions. In common we can state that more intensive and more specific (goal directed) rehabilitative treatment may improve outcome even in initially severely disabled stroke patients.

#### **4.4 Use of time by stroke patients and use of time by physiotherapists and occupational therapists (De Wit et al., 2005; Putman et al., 2006)**

Considering about the use of time by stroke patients in 4 rehabilitation centres, the results were revealed as shown in Table 3, using percentage time and Figure 2a using absolute time. The percentage of time spent in non therapeutic activities were higher (>72 % of the time) than therapeutic activities in all centres. In all 4 centres, physical and occupational therapies together accounted more than half the total therapeutic time, in which physiotherapy was comprised about 40% of therapeutic time, where as occupational therapy composed of 20-30% excepts for the United Kingdom, which spent least time on this kind of therapy, while they used more than 35 % of therapy time for nursing care. The authors of this study discussed this result that may be explained by the high availability of nurses which is in line to the previous study in UK.

The absolute time spent in therapeutic measures is shown in Figure 2a. Patients in Switzerland spent more time in therapy (2 hours and 46 minutes) compared with those in Germany (2 hours and 20 minutes), Belgium (1 hour and 59 minutes), or the United Kingdom (1 hour and 0 minutes). This showed that the United Kingdom spent the least time in therapeutic intervention, even they had highest overall time available from all professional groups, taking into account the staffing levels and number of working hours per week, but most of their time ( about 35% of therapy time) were for nursing care, instead of other professional therapeutic interventions. Moreover, higher percentage of non therapeutic time was found in the United Kingdom and Belgium centres, patient spent > 2 hours per days lying or sleeping, this was more than in Switzerland or Germany centres as shown in Figure 2b.

This study result showed that patients in the United Kingdom were significantly less likely to be in therapy than patients in the other centres. Differences in therapy time between 4 centres seemed to be related to differences in task characteristics of therapists and the organization of the rehabilitation programs. In addition, patients in the Swiss and German centres spent more time in therapy, possibly due to strictly-timed rehabilitation program and organization (consistent time tables for patients and therapists). The ward rounds and the team conferences monitoring the patients' progress and limitations and adapting the amount & content of therapeutic interventions have been more clearly structured in the German and Swiss centres. In general, more efficient use of human resources in both centres may be taken into the account.

Activity	Belgium, % (n=1200)	United Kingdom, % (n=1200)	Switzerland, % (n=1200)	Germany, % (n=1200)
Therapy time	19.8	10.1	27.7	23.4
Percentage of therapy time				
Physiotherapy	40.8	40.5	37.7	36.7
Occupational therapy	20.2	11.6	29.2	24.9
Speech therapy	5.0	1.7	5.1	1.8
Neuropsychological training	6.3	0.0	3.6	9.3
Nursing care	10.1	35.5	5.4	4.6
Medical care	0.8	2.5	5.7	5.7
Sports	1.7	0.0	0.0	0.7
Autonomous exercising	2.9	4.1	0.6	6.4
Other therapeutic activity	12.2	4.1	12.7	10.0
Nontherapy time	80.2	89.9	72.3	76.6
Percentage of non-therapy time				
Sitting	16.7	29.1	21.1	22.9
Lying/sleeping	28.3	23.8	19.9	10.7
Leisure	10.1	7.8	9.4	15.9
Communication	14.1	14.6	14.5	14.4
Transport	8.4	2.1	13.5	12.8
Dressing/hygiene	9.3	10.8	7.5	6.4
Eating	8.0	6.2	10.3	11.8
Other nontherapy	4.2	5.5	3.8	5.2

Table 3. Distribution of Activities in Percentage (%) of Observations (n=1200) Between 7 AM and 5 PM in Four Rehabilitation Centres.

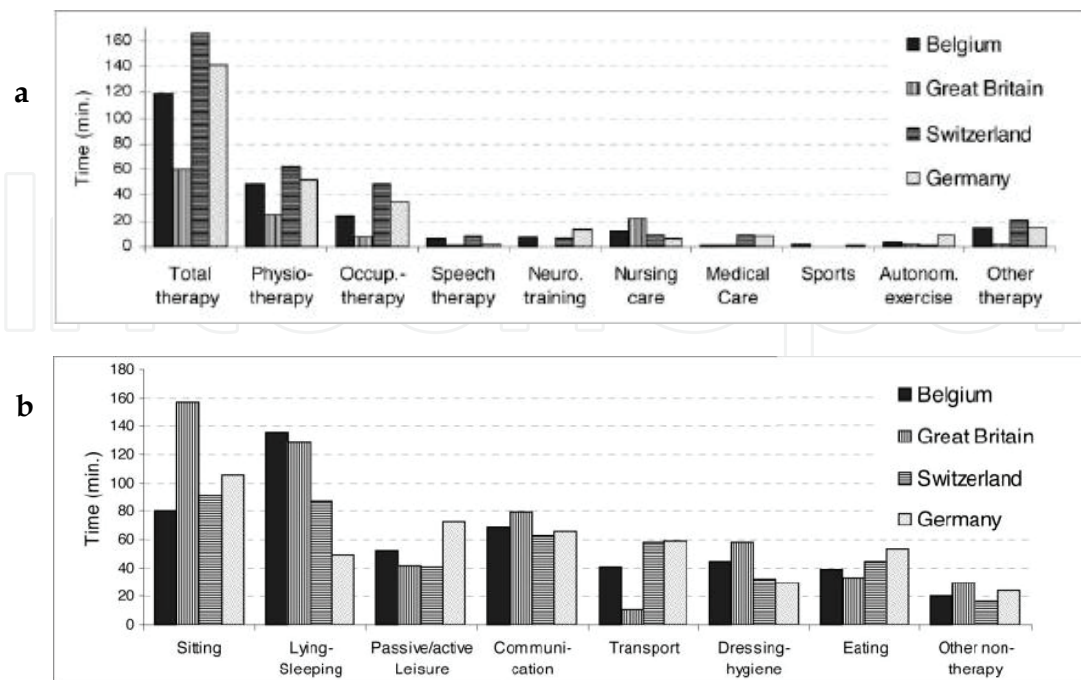


Fig. 2. Absolute time spent in therapeutic activities (a), nontherapeutic activities (b).



### Use of time by physiotherapist (PT) and occupational therapist (OT)

This study focused on 2 professions, physiotherapists and occupational therapists, who accounted for highest proportion of therapy services in in-patient stroke rehabilitation. The aim of this study was to compare the time allocated to therapeutic activities (TA) and non-therapeutic activities of this 2 professions. Therapeutic activities defined all professional interventions when PT's and OT's were in personal contact with the patients (e.g. single and group therapy). Non-therapeutic activities of PT's and OT's were divided into patient linked co-ordination (e.g. patient administration, organizing technical aids, counseling care givers), unit linked co-ordination (e.g. team conferences, staff organization) and others. Table 4 showed the result of this study that the highest percentage of time spent in therapeutic activities was found in German centre (PT= 66.1 %;OT= 63.3%). The lowest was in the United Kingdom centre (PT= 45.9 %;OT = 32.9%). This was in corresponding to the finding that more than half for both PT and OT in the United Kingdom were used in non-therapeutic activities such as administration work (PT= 54.1%;OT=67.1%) This led to less time therapy for patient.

	SRU-GB		SRU-CH		SRU-DE		SRU-BE	
	PT n = 2476	OT n = 1284	PT n = 3883	OT n = 2033	PT n = 4548	OT n = 2157	PT n = 2545	OT n = 1495
<i>Therapeutic activities, %</i>	45.9	32.9	53.7	45.2	66.1	63.3	61.7	50.2
mobility training	34.6	9.4	26.7	14.6	36.1	31.3	36.9	13.0
ADL-training	8.0	19.5	14.6	22.1	15.0	18.4	20.2	23.5
neuropsychological training	0.1	1.2	1.8	6.9	4.6	8.4	0.4	12.8
other training	3.2	2.6	10.8	1.6	10.4	5.1	4.2	0.7
<i>Non-therapeutic activities, %</i>	54.1	67.1	46.3	54.8	33.9	36.7	38.2	49.8
patient linked co-ordination	23.1	32.6	14.0	24.5	16.7	12.9	9.7	13.1
unit linked co-ordination	14.6	22.3	14.9	13.8	10.0	15.8	13.4	15.7
other	16.4	12.3	17.4	16.6	7.2	8.0	15.1	21.0

Table 4. Percent (%) of activities of PT and OT in the four stroke rehabilitation centers

### 4.5 Contents of therapy: Physical Therapy (PT) & Occupational Therapy (OT) (De Wit et al., 2006)

Contents of therapy were categorized into 12 groups : (1) mobilization,(2) selective movements,(3) exercises and balance in lying,(4) exercises and balance in sitting,(5) exercises and balance in standing,(6) sensory,perceptual training and cognition,(7) transfers,(8) ambulatory,(9) personal activities of daily living (ADL),(10) domestic ADL, (11) leisure and work- related activities,(12) miscellaneous techniques. The comparison between the content of PT and OT sessions revealed a different emphasis of each profession in 8 of the 12 categories. PT sessions significantly more often were composed of ambulatory exercises, transfers, exercises and balance in standing and lying, whereas ADL, sensory, perceptual training, cognition, domestic and leisure activities occurred significantly more in the OT sessions. No statistically significant differences were found for selective movement, mobilization, and exercises and balance in sitting. The category of miscellaneous contained too few observations for statistical analysis. This result revealed that PT and OT are distinct professions with clear demarcation of roles. When comparing the contents of PT and OT between 4 centres, there were only 2 from 12 categories that showed significant differences between the centres which were ambulatory exercises and selective movements. Ambulation exercises occurred more in the United Kingdom and Belgian centres than in the German and Swiss centres. Selective

movements occurred less for both PT and OT sessions in the United Kingdom compared with the Swiss centre and the German centre, respectively.

#### **4.6 Effect of socioeconomic status on functional and motor recovery after stroke (Putman et al., 2007)**

Socioeconomic status (SCS) should be considered as one essential part for holistic stroke approach. Previous study (Jakovljevic et al., 2001) also showed impact of socioeconomic status on morbidity and mortality. In one part of the CERISE project, the study aimed to explore the impact of education and equivalent income on motor and functional recovery between the period in the stroke rehabilitation unit and the period after discharge. The patient's educational level was converted to the International Standard Classification of Education (ISCED) (OECD,1999) for valid comparison between countries. Equivalent income was based on the monthly household income and household composition, and calculated according to the modified Organization for Economic Cooperation and Development (OECD) scale. The Barthel index (BI) and the Rivermead Motor Assessment (RMA) were used for functional outcome measurement performed on admission, at discharge and at 6 months after stroke. There was significantly higher urinary incontinence in the low education group. The high income group had consistently higher BI outcome score compared with other subgroups at all three assessment points. This was similar to the RMA -GF which was significantly higher in both the high education and high income groups. When comparing between the SES groups, BI and RMA scores, the results revealed that patients with a low educational level were less likely to improve on the functional status (BI) and the RMA of the arm section, while no significant effect of equivalent income on motor and functional recovery during inpatient rehabilitation period were found. After discharge until 6 months after stroke, neither equivalent income nor education had a significant effect on the functional recovery (BI) but patients with a low equivalent income were less likely to improve further on motor function, represented by RMA (RMA- GF, RMA-Leg and trunk, RMA-arm) compared with the high income group. This may conclude that education level was a determinant of recovery during inpatient rehabilitation, while after discharge, equivalent income was the main impact of additional recovery.

#### **4.7 Admission criteria to inpatient stroke rehabilitation units among the 4 European stroke rehabilitation centres (Putman et al., 2007)**

Previous literature (Langhorne & Duncan,2001) reviewed that post-acute rehabilitation is an essential part of the recovery process. There was no clear evidence when it would be suitable to transfer patients to post-acute stroke rehabilitation units. Even though there is limited evidence that early admission to stroke rehabilitation directly results in improved functional outcomes, stroke patients should be admitted to stroke rehabilitation units as soon as they are medically stable (Teasell et al.,2009).

According to the difference in the organization and financing of healthcare systems across Europe, this might have an impact on admission policies and the selection of patients for post-acute inpatient rehabilitation. This study focuses on comparing the admission procedures in 6 SRUs across 4 European countries reflecting the impact of clinical and non-clinical factors in the decision making process on admission. The finding of clinical and non-



clinical factors for admission were not quite explicit and were evaluated differently between the European rehabilitation units. The factors related to the patients were identified as followed; in the SRU-UK, diagnosis of stroke was the only criterion for admission, in the Belgian, German and Swiss units, pre-morbid conditions were taken into account in admission decisions. For example, patient in SRU-DE with pre-morbid disability who required support were more or less automatically transferred to geriatric rehabilitation or nursing care. Presence of pre-morbid cognitive disability or depression reduced the likelihood of being admitted in all SRUs excepts SRU-UK. Severe behavioral problems after stroke also are considered in both SRU-UK and SRU-BE. Admission to SRU-CH was delayed if the patient showed rehabilitation potential but did not yet have the stamina required for intensive rehabilitation. Also the availability of home support was a decisive factor in the decision to admit a patient in SRU-CH. Highly motivated patients or their relatives sometimes influenced to be admitted in SRU-DE. Patient's socioeconomic status did not really influence any on a decision to admit a patient. Patient's network was concerned by the medical consultants in SRU-CH.

Factors related to the network between facilities showed that the affiliations between the SRU and other healthcare settings were highly important for the admission to SRU-BE,SRU-CH and SRU-DE. In SRU-CH, the medical consultants who worked at the acute stroke units also were responsible for referral process to other SRU. In SRU-DE, the medical consultants was not involved in the selection of stroke patients because the association of different legal (by social laws) or private cost bearers (health or personal insurances) with the rehabilitation centre was appraised as having a very high effect on the admission policy. External stakeholders decided, based on the referral letters from the medical consultants in the acute unit, whether the patient was suitable for further rehabilitation in SRU-DE.

This study concluded that clinical characteristics of stroke patients were significantly different between European rehabilitation units admitted. Decision - making process on admission was effected not only by clinical factors, but also by non-clinical factors which seemed to determine whether and where patients are referred to inpatient stroke rehabilitation services.

#### **4.8 Discharge program & follow up services after inpatient stroke rehabilitation (Grassel et al., 2005, 2006; Putman et al., 2009)**

An effective stroke rehabilitation program must also involve comprehensive discharge planning and give recommendations for the post discharge rehabilitation phase which follow - up services are needed and should be prescribed or ordered. Several studies on different models for discharging and follow-up for stroke patients have been performed with varying effect, and there is still no consensus concerning care of stroke patients after discharge (Holmqvist et al., 1998; Anderson et al., 2000; Ytterberg et al.,2000). "Early supported discharge" is one of the settings studied in other countries.

In CERISE study,the majority of the patients were still in the rehabilitation centre ( 50-70%) at 2 months after stroke. But at 4 months, the majority of patients were at home,with the lowest percentage for SRU-BE (55%) and the highest for SRU-DE ( 75%). At 6 months, 66 -76 % of the patients were at home. The patients in SRU-BE and SRU-UK had significantly lower scores on all motor and functional assessments compared with the other 2 centres as shown

in the previous studies in this project. Patients from SRU-BE also had the lowest score of the quality of life (using EuroQuoL VAS).

The data above showed that the majority of the patients in each rehabilitation centre were discharged to their home at 4 months after stroke. However, the decision making for discharge planning such as suitable time to discharge may depend on a number of variable factors including stroke severity, family support, progression in rehabilitation, availability of outpatient resources, incentives to discharge, and discharge guidelines or policies in each unit. Like for the admission also non-clinical, mainly health care system related factors had partially great impact on the discharge.

For examples, Kalra and Walker (2009) noted that in the United Kingdom, the rehabilitation goals of professionals often do not reflect the patients' priorities, which can lead to unnecessarily prolonged rehabilitation stays. Putman and De Wit (2009) noted that in Germany distinct phases for rehabilitation have been developed so that patients receive the targeted therapy that they need, with the BI being used as help to determine which phase is right for which patient.

Besides the consideration of suitable time to discharge, the effective discharge planning program was also an essential part. This program aimed to prepare the patients to live with proper care and minimize problems occurring at home. Family caregivers of stroke patients also play a major role in this phase. Some studies revealed that family caregivers of stroke patients were to suffer from increased emotional distress (Dennis et al.,1998) and required support from professionals, both as regards caring itself and also in helping them to cope with emotional and psychological problems (Dennis et al.,1998; Wyller et al.,2003).

The intensified transitional concept was an example that concerned and emphasized on the effective discharge planning program and post discharge phase for stroke patients. This concept was developed by the Rehabilitation Clinic Herzogenaurach, Germany which is one of the stroke rehabilitation units in this CERISE project. This concept consisted of a standard transitional program with an additional therapeutic weekend care at home, individual training course and telephone counselling 3 months after discharge for the family caregivers in order to minimize the problems at home, decrease physical and emotional stress of family caregivers (mostly the spouse). This concept was also studied by comparing with the standard transitional program in aspects of effect on the functional status of stroke patients and the physical and emotional burden of their caregivers at 2 time periods (6 months and about 2 and a half years after discharge) (Grässel et al.,2005,2006). The result revealed that the intensified transitional program had no effect either on the functional status of the stroke patients or the health status of the care givers at 6 months after discharge but this intensified program led to earlier visits of family physicians & therapists and more uptake of outpatient services. Additionally,significantly fewer patients in this intensified transitional program were institutionalized or had died, comparing to the standard transitional group at two and a half years after discharge. This concluded that the effect of an intensified transition program can occur and persist over a long term period.

Follow-up services can be an effective mean to alleviate the functional disabilities of stroke at home (Andersen et al., 2002). Indicators or determining factors which patients receive follow-up services remain uncertain. Patient's needs and functional abilities at discharge seem to be logical factors. However, Asplund et al. (2003) found that healthcare routines

rather than the patient's condition were the major determinants of the extent to which resources were used. Therefore, differences in discharge policies especially involving in proportions of patients receiving services after discharge may influence follow - up comparisons in outcome between centres.

In Europe, wide variations are observed in healthcare provision after stroke (McKevitt et al.,2000; Wolfe et al.2004). This leads to great variations in follow-up services after inpatient stroke between the 4 European centres which were founded in the CERISE study. This study revealed that the Belgian patients were most likely to receive physiotherapy (53 -82%) but least likely to receive occupational therapy (9-11%) . German patients were least likely to receive nursing care (2-4%) and the UK patients were least likely to receive medical care from general practitioners (family doctors) (43- 61%) but most likely to receive OT (16-27 %) compared with the other patient groups. (Figure 3.) The follow-up services for stroke patients in UK is more focused on so called " stroke nurses" who did not exist as a profession of health care system in the other countries. In other countries, all the medical services must be prescribed by the family doctors who must be contacted. Low frequencies in both speech and language therapy and psychological therapy were found in all countries and could not be analysed further.

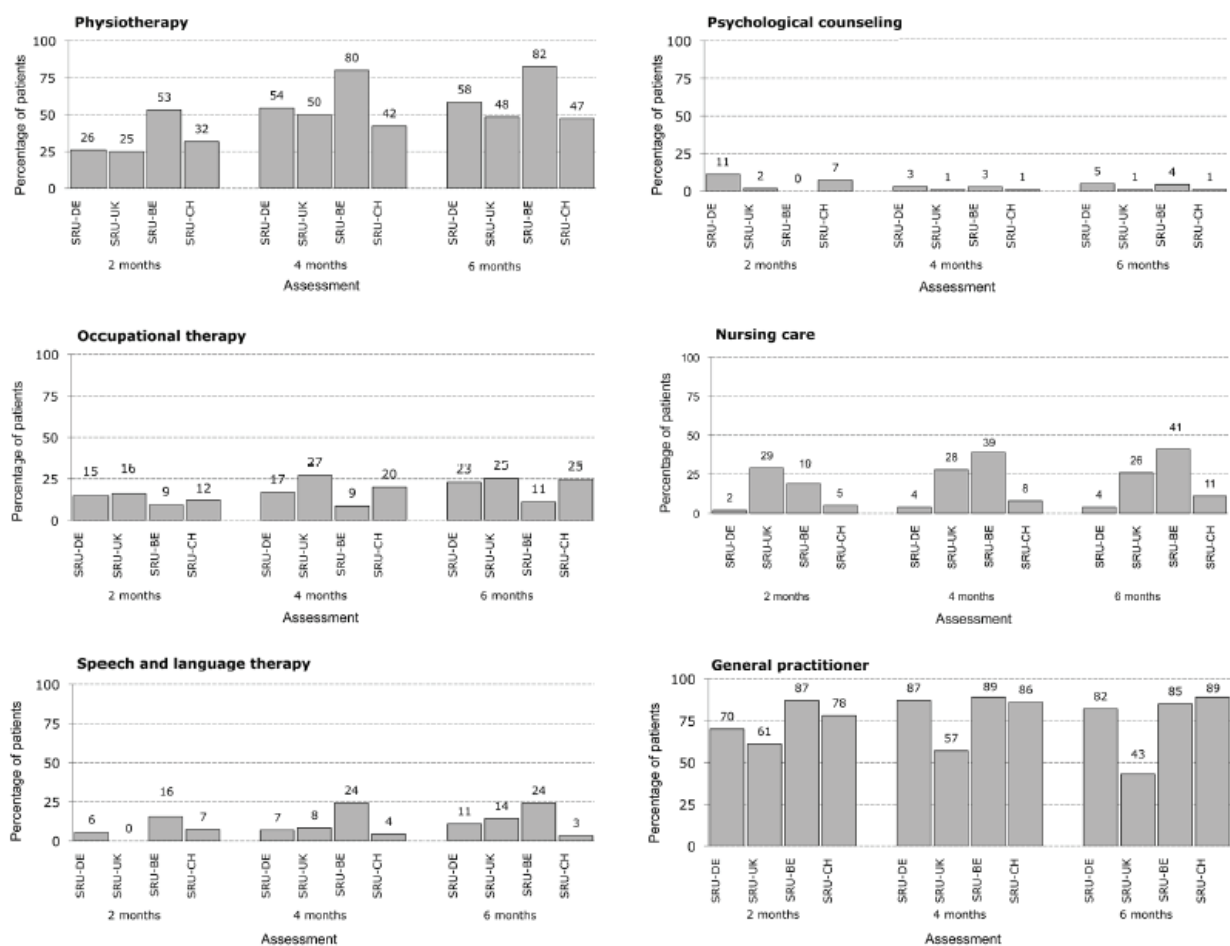


Fig. 3. Percentage of patients at home receiving services at 2, 4 and 6 months post-stroke onset. SRU-DE: German stroke rehabilitation unit; SRU-UK: United Kingdom stroke rehabilitation unit; SRU-BE: Belgian stroke rehabilitation unit; SRU-CH: Swiss stroke rehabilitation unit.

The probability of receiving services at home correlated only in part with clinical characteristic of patients. According to statistic analysis in this study, patients under 70 years, patients with initial swallowing problems or low score on the RMA-A were more likely to receive PT programs. Age under 70 years, being male and low RMA-A score were factors significantly associated with a higher likelihood of receiving OT programs.

In this study, the results showed that age of patient and motor function ( RMA-A) may influence any follow-up services provided especially in PT and OT programs 6 months after discharge. This findings were comparable to the results from the other study by U.Hoess, et al. (2008). They also investigated factors that may effect the frequency of prescription and performance of the follow -up services, predominantly PT, at 6 months and even in long term period (2 and a half years) after discharge. They found that younger stroke patients, who had more physical but less mental impairment were most likely to receive more therapies. Additionally, in the period of 6 months after discharge, stroke patients who visited the outpatient clinic more frequently, were more likely to get multiple medication and physical therapy prescriptions.

However, non-clinical factors such as cost bearing regulations in the national health care systems, also influence the variations in follow-up services after discharge from inpatient stroke rehabilitation. As follow-up services can reduce the long-term dependency after stroke, variation of patients receiving services after discharge may influence follow-up comparisons in outcome between centres. Thus, services provided after discharge from inpatient rehabilitation should be better documented to facilitate a more precise comparison on the effectiveness of rehabilitation programs and aftercare.

Despite to the results which showed that physical therapy and occupational therapy remained the common therapy services that stroke patients received after discharge in outpatient settings, in the present, there are unclear standards or guidelines for the prescription of these two therapies in follow up services.

A summarizing review of the literature on these two therapy programs ( PT and OT), their contents, prescription criteria and effects on stroke patients in outpatient service setting was recently performed in Germany (Steib & Schupp,2011). The results showed that the physical therapy programs such as progressive strength training, endurance training, gait training were effective to improve physical performance, resulting in benefits on gait, mobility and ADL. Also, occupational therapy showed an improved performance in activities of daily living (ADL / EADL), increase of participation & leisure activities and reducing risk of "poor outcome" (deterioration of condition of patients, progression of disability, death). Frequency and duration of the therapy in outpatient service usually took two to three times a week for 4 - 12 weeks, respectively. The duration of each treatment varied from 20 minutes to two hours.

## 5. Conclusion

The European project CERISE was a longitudinal multicentre and multiprofessional collaboration that studied multidimensional aspects of stroke rehabilitation. Comparison between European stroke rehabilitation centres in field of structure of care and process of care should provide insight into the aspects of stroke rehabilitation that are crucial for



patients' outcome and also provide important information to improve efficiency of stroke rehabilitation programs and organization. Although differences in service provision and patient selection in each centre limit direct comparisons of outcome measures, this can be considered as an advantage to show the real situation in existing settings. However, some limitations of this project need to be addressed. Only a limited sample of each centre was included, even the centres were very experienced in stroke rehabilitation with a good reputation, but they cannot be representative for the different countries. Therefore, the variations found in this study cannot be attributed entirely to differences in national healthcare services, but may also reflect differences in local healthcare structure and policies. Study designs that need to collect data from observations by blind participants may not reflect a real situation. Data from interviews may not be a real data due to participants' conditions such as memory or behavioral status.

From all our experiences revealed by the studies cited above we can conclude that:

Stroke patients should be referred to a comprehensive rehabilitation program. The admission should be mainly guided by medical reasons and by personal and environmental context factors according to the ICF. Financial aspects of cost bearers should not interfere with the admission to such stroke rehab programs. The stroke rehabilitation units should be strictly organized and managed, that the therapists can spend the majority of their working time in direct therapeutic interactions with the patients. The therapeutic activities must be emphasized against every tendency for more bureaucracy. Physiotherapists (PT's) and occupational therapists (OT's) are responsible for the main therapeutic input ,but both professions have to clarify their different approaches and responsibilities for training in ADL, mobility, EADL, vocational and leisure activities. On the other side they must repeatedly discuss and adapt their therapeutic interventions which are to be based on neurobiological scientific research and modified by the patients' psychosocial context in at least weekly team conferences along with the patients' recovery process. Most patients have much more time available during the day in any inpatient rehabilitation program, which could be filled with additional therapy supporting activities and exercises, supervised and guided by PT's and OT's. A new role of therapists should include this task to give every patients recommendations for such self administered therapeutic activities and exercises. Such recommendations are also very important for the phase after inpatient or outpatient rehabilitation setting (aftercare and long term rehabilitation). Mood disorders like anxiety and depression often develop after stroke and negatively influence the long term outcome. Therefore, screening for such comorbidity, and if any suspicion can be derived, definite diagnosis and treatment should be performed.

The structures and performance of further rehabilitation services and treatment should be improved in every country and their health care systems. Socioeconomic parameters should not any longer impact on the long term outcome and quality of life (QoL) after stroke as we had seen in our studies. This fact is in contrast to the human rights of disabled people.

Many research studies until now in the field of stroke rehabilitation largely focus on acute or subacute stroke rehabilitation phase and single specific interventions. In the present, studies in a long term stroke care are less evident,despite the fact that the need to gain more knowledge on this aspect is increased. Further studies on long term stroke care are needed

based on holistic aspects and multicentre setting to prevent further impairment, disability and improve quality of life.

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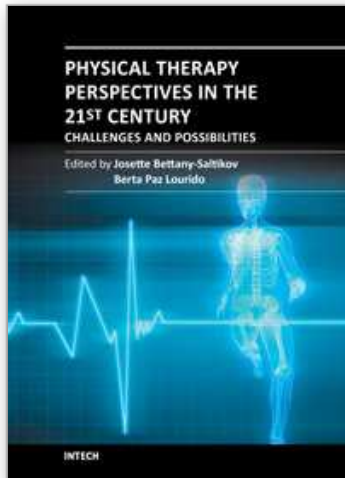
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## **Physical Therapy Perspectives in the 21st Century - Challenges and Possibilities**

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This book contains new information on physical therapy research and clinical approaches that are being undertaken into numerous medical conditions; biomechanical and musculoskeletal conditions as well as the effects of psychological factors, body awareness and relaxation techniques; specific and specialist exercises for the treatment of scoliosis and spinal deformities in infants and adolescents; new thermal agents are being introduced and different types of physical therapy interventions are being introduced for the elderly both in the home and clinical setting. Additionally research into physical therapy interventions for patients with respiratory, cardiovascular disorders and stroke is being undertaken and new concepts of wheelchair design are being implemented.

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