The Canadian Journal of Program Evaluation Vol. 26 No. 1 Pages 49–74
ISSN 0834-1516

DEVELOPMENT OF A CLASSIFICATION SYSTEM FOR PATIENTS REFERRED TO A REHABILITATION PROGRAM FOR VISUAL IMPAIRMENT: A METHOD FOR ANALYSIS AND BUDGETARY CONTROL

Michel Coulmont
Chantale Roy
Université de Sherbrooke

Patrick Fougeyrollas
Université Laval; Institut de réadaptation en déficience physique de Québec

Abstract: Program evaluation makes assessments from various perspectives. In health care areas, evaluation generally focuses on the relationship between the care process and the clinical results. Our study is of particular interest because it adds a cost dimension to that relationship, thus introducing a method for evaluating visual impairment rehabilitation programs that integrates full operating costs. Starting from the functional level of patients on admission to a clinical program, an experimental approach was used to divide them into five homogeneous groups according to their consumption of financial resources during the care process. This method could be used in measuring and evaluating the financial performance of all rehabilitation programs and help improve budgetary control. With the added dimension of costs per client profile, it could provide a framework for other areas requiring program evaluations.

Résumé : L'évaluation de programme consiste à porter un jugement selon différents angles d'appréciation. Dans le domaine de la santé, l'évaluation porte généralement sur la relation entre le processus de soins et les résultats cliniques. L'intérêt de notre étude consiste à rajouter la dimension coût à cette relation. Ainsi cet article présente une méthode d'évaluation des programmes de réadaptation en déficience visuelle intégrant les coûts complets d'exploitation. À partir du niveau fonctionnel de la clientèle à l'entrée dans le programme clinique, une approche expérimentale a permis de regrouper la clientèle en cinq groupes homogènes en ce qui concerne la consommation des ressources financières pendant le processus de soin. Cette méthode d'évaluation pourrait être utile

Corresponding author: Michel Coulmont, DBA, Associate Professor, Faculty of Administration, Université de Sherbrooke, 2500, boul. de l'Université, Sherbrooke, QC, J1K 2R1; Michel.Coulmont@USherbrooke.ca

pour mesurer et évaluer la performance financière de tous les programmes de réadaptation et contribuer à une amélioration du suivi budgétaire. De plus, cette méthode d'évaluation, avec la prise en compte des coûts par profil de clientèle, pourrait être inspirante pour d'autres domaines nécessitant une évaluation de programme.

INTRODUCTION

Program evaluation entails the meticulous collection and analysis of information intended to assess a program, a policy, or a project. In the field of medicine and in the context of budgetary constraints, population aging, and technological advances, the issue of health-related spending and its consequences on the well-being of the population is a subject of increasing concern. According to the Bédard Committee report (Bédard et al., 2002) on the reevaluation of the budgeting method used by general and specialized hospitals in Quebec, the Ministry of Health and Social Services (MSSS; Ministère de la santé et des services sociaux du Québec) should take the financial performance of hospitals into consideration when granting development budgets. This would enable MSSS to invest in hospitals that are more likely to provide best care at low costs. Accordingly, taking costs into account becomes an important element in measuring and evaluating performance.

From this perspective, evaluating the performance of health services emphasizes the interface between the health care process and clinical results (Brook et al., 1977; Donabedian, 1985). However, to compare the performance of health services, the case mix profile must be characterized. A fair comparison of performance requires that different patient profiles be established; this prevents establishments treating patients with different profiles from being identified as similar types of establishments (Aronow, 1988; Green, Wintfeld, Sharkey, & Passman, 1990; Hornbrook & Monheit, 1985; Iezzoni, 1994; Lévesque, 2007; Young, Swinkola, & Zorn, 1982). At present, the only information used when comparing establishments is the daily hospital charge, which consists in dividing the total cost by the number of patients, regardless of the difference in resources devoted to the patients. Using such indicators (per capita, daily hospital charge, and others) to allocate resources in the health systems is increasingly recognized as inappropriate because the quantities of resources each patient uses are different, depending on the nature and severity of their health problems (Dubuc & Hébert, 2001). Establishments treating complex cases are often penalized when compared with those treating lighter

cases and, as a result, their performance is prejudiced with respect to budgetary appropriation (Dubuc & Hébert, 2001).

Many severity-based patient classification systems are available (Iezzoni, 1994) that can help provide a fair performance assessment. However, developing more detailed classification systems requires the inclusion of clinical variables that are difficult to obtain and complex to use. Criticisms of these systems will be discussed in the subsection "Critical Assessment of Existing Classification Systems."

A classification system measures performance by providing target costs or norms to various types of patient profiles in health care programs. It can be used to establish and control service-related budgets. As a proven management tool (Chandler, 1990), budgetary control can help management become more efficient and the economies that are made can improve their financial performance in a number of ways. The primary function of this type of control is to serve as a guide to financial planning operators and to establish limits for departmental excesses. It can help administrators thoroughly analyze all existing operations, and thus justify expanding, eliminating, or restricting current practices (Musselman & Hughes, 1972). To improve their control over costs and evaluate the performance of their health care establishments, most Western countries have adopted classification systems for patients such as the Diagnostic Related Groups (DRG) system.

Although these classification systems appear to be widely used throughout health care networks, the situation is different in the field of rehabilitation. Physical rehabilitation establishments do not generally have key data on the use of health care services by patients who are either hospitalized or treated in external clinics. For example, rehabilitation establishments in Quebec have key data only for the areas that include the use of services by their entire patient base. Because almost no specific data are available on the costs of the resources used by each patient, very little is included in the reports sent to the MSSS and medical databases (Durand, Lemay, Tourigny, Boutin, & Paradis, 2001). Public service employees currently have difficulty making enlightened decisions on budgetary allocations because they lack the proper tools and pertinent data to assess the clinical results and the inherent program costs in these establishments (Nicklin & Zitner, 2002).

Development of a classification system is part of a normal evaluation initiative. Such a tool will enable rehabilitation program administra-

tors to appreciate and/or evaluate the financial performance of one or more programs based on the norms and criteria of the classification system itself. This article proposes a classification system, based on Full Operating Cost (FOC), for elderly patients aged 65 and over that have been admitted to a rehabilitation program for visual impairment.

The study can make some very important contributions. From a theoretical viewpoint, given the influence of the International Classification of Impairments, Disabilities, and Handicaps model (the WHO's 1980 version), rehabilitation measurement tools have mainly been developed along capacity-incapacity lines representing a patient's biomedical component, with little attention being paid to handicap-participation. Consequently, the classification systems used in rehabilitation have mainly been developed from the same evaluation tools. In these systems, which are all based on the biomedical approach to handicap reintegration, the resources to be invested are determined by the functional state of a patient with a physical impairment without ever considering the individual's actual needs.

The classification system developed in the present study considers human needs from the patient's perspective. This method clearly differs from existing models as it represents a more social approach to handicap reintegration. When considered as a cost management tool for rehabilitation establishments, the development of a classification system based on a Functional Related Group (FRG) profile contributes to improving the evaluation of financial performance and the budgetary control of health care programs for patients with physical impairments. Given the few assessment tools available at this time, this classification system brings considerable added value to political decision-makers in the health field. As well, the concept of a classification system based on patient profile could be applied to other areas requiring program evaluations. For instance, in service organizations (education and others), a link between resource utilization and the specific services delivered could be established by grouping the services and the resulting costs into different categories and thus effectively measuring and evaluating financial performance.

This article is divided into four sections: (a) an overview of existing classification systems and a discussion of critical assessments; (b) research design, classification variables, and method of analysis; (c) presentation and analysis of the main findings; and (d) recommendations, discussion, and conclusion.

CLASSIFICATION SYSTEMS AND CRITICAL ASSESSEMENT

An Overview of Existing Classification Systems

The use of classification systems to assess resources or justify resource allocation has long been the cornerstone of hospital control systems (Halgand, 2000). The use of the DRG system as a conceptual design tool was a major advance in this field.

The DRG system was originally designed by a group of American researchers led by Professor R. B. Fetter of Yale University in the 1970s. Under this system, patients and the ensuing treatment costs were regrouped into a number of diagnostic categories (initially 492) according to the severity and the nature of their illnesses. Fetter's main objective (1991) was to identify the complete costs of compensation benefits on behalf of private insurers for tariff or costing purposes. However, the system also helps managers administer their health care establishments more efficiently by defining a "product" as a base for measuring and evaluation. By grouping the treatments and the resulting costs into different diagnostic categories, this management tool can establish a link between resource utilization and the specific treatments patients receive, thus allowing health care centre managers to apply some of the techniques used by commercial or industrial managers, such as flexible budgets, margin analysis, costs, and quality control (Fetter, 1991).

Known in France as *Groupe homogène de malades* (GHM), the DRG system was introduced in 1984–85 as part of a project that eventually led to the Medical Program for Information Systems (MPIS; Dubois, 1999), a hospital medical activity measurement and descriptive tool (Coca, 1998; Engel, Kletz, Moisdon, & Tonneau, 2000) that provides pertinent data per illness and/or patient, that is, the GHM (Nobre, 2000). Approximately 600 GHMs are now used for hospital admissions in medicine, surgery, and obstetrics (Nobre & Biron, 2001). Wherever they are used, the systems are ultimately linked to determine standard costs by GHM or DRG groups that serve as references for hospital establishments.

With the same objectives in mind, some researchers are attempting to reproduce this type of grouping for rehabilitation cases. However, contrary to the medical sectors—where the DRG system seems to be increasingly common and was developed on a group logarithm based on primary and secondary diagnostic variables,

along with treatment, age, type of discharge, and gender variables—groupings based on these variables do not provide convincing results in rehabilitation (Harada, Kominski, & Sofaer, 1993; Paolucci et al., 1998). A classification system in a rehabilitation environment should include the functional state of the patient with physical impairment.

In 1993, Harada et al. (1993) formulated a uniform data classification system based on FRGs. The next year, a group of researchers from the State University of New York in Buffalo refined the model to develop the first version of the Functional Independence Measure-Functional Related Group (FIM-FRG), a system seeking to group patients with physical impairments and the resulting treatment costs into a number of categories of functional independence. The first version consisted of 18 diagnostic categories forming 53 groups based on the primary diagnostic or type of incapacity, FIM motor and cognitive scores on admission, and age. The second version, FIM-FRG2, included three new categories: two were related to the type of incapacity and one to ambulatory patients. In total, the FIM-FRG2 system comprises 67 groups. For example, this classification system identifies patients who have suffered a stroke in nine groups based on the motor and cognitive functional level score on admission as rated by FIM (Keith, Granger, Hamilton, & Sherwin, 1987) and by age (Stineman, Fieldler, Granger, & Maislin, 1998).

As a rule, most of the classification systems, such as the FIM-FRG and the Australian National Sub-acute and Non-acute Patient Classification (AN-SNAP) (Eager, Gree, & Gordon, 1999), were mainly developed to categorize groups of hospitalized patients. A few systems, such as the Ambulatory Visit Groups, the Ambulatory Patient Groups, and the Ambulatory Care Groups, were more particularly designed to assess patients in external consultation and have mainly opted to classify patients by action rather than by complete treatment (Eager et al., 1999). However, the AN-SNAP also includes specific categories for external consultation based on the type of incapacity, functional independence, and recourse to a simple or multidisciplinary therapy. There are 15 rehabilitation categories, 2 of which address evaluation and 13 treatment. To date, it is the only ambulatory classification identified that has been specifically developed for rehabilitation (Eager et al., 1999).

Research on FRGs usually covers some (but not all, i.e., auditory, language and speech, motor, and visual impairments) types of physical

impairment. The classification systems mentioned above focus solely on the rehabilitation of physical motor impairment. In addition, these classifications deal mainly with rehabilitation in functional intensive care units. At present, the rehabilitation of visual impairment does not seem to be covered by any classification system.

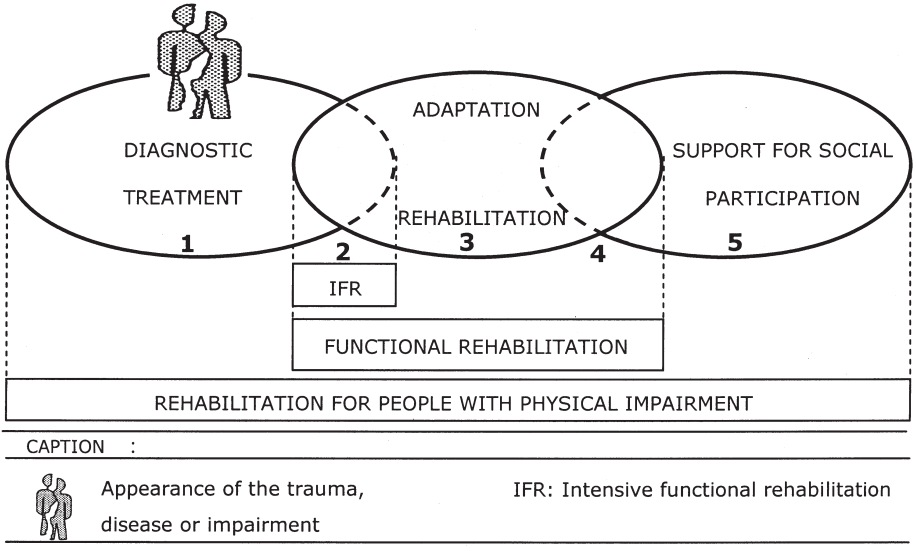
Finally, two classification systems, one from Quebec and one from France, should be discussed even though they are oriented towards residential patients and support for the elderly with loss of autonomy rather than specifically adapted to rehabilitation for physical impairment. Quebec researchers are particularly interested in a management system based on the classification of the needs of patients with a functional autonomy profile, known as ISO-SMAF (Dubuc, Hébert, Desrosiers, Buteau, & Trottier, 1999). Developed from the Functional Autonomy Measurement System (SMAF; *Système de mesure de l'autonomie fonctionnelle*) (Hébert, Carrier, & Bilodeau, 1988), the 14 ISO-SMAF profiles regroup patients with similar incapacity profiles who, overall, require similar services (ISO-Resource Groups) and who generate equivalent costs ($ISO-SMAF). ISO-SMAF profiles may also be used in all health care facilities, including home care to long-term-care establishments. This addresses the concern of the Quebec Health and Social Services system for efficiency, quality, and continuity in meeting the needs of the elderly with diminished autonomy. With ISO-SMAF profiles, the needs of individuals suffering from a loss of autonomy and the services required for each condition can be quickly identified.

Pursuing the same fundamental objectives, researchers in France have developed the ISO-RESSOURCES (National Association of Gerontology Clinics, 1994) groups. Each group represents a subgroup of patients that require the same mobilization of resources to resolve the challenge or dependence. The parameters of the ISO-RESSOURCES groups are based on the principles of the Autonomie Gérontologie Groupes Iso-Ressources (AGGIR) table (National Association of Gerontology Clinics, 1994), which is the legal tool used in France to measure the autonomy of the elderly living at home or in long-term-care facilities. Only 10 of the total 17 variables in the AGGIR table are used for the calculations of the ISO-RESSOURCES groups. The 10 discerning factors are coherence, orientation, toilet use, dressing, ability to feed oneself, waste elimination, self-transfers or displacements, internal mobility at home or at a facility, outdoor mobility, and communication at a distance. The AGGIR system classifies patients into six ISO-RESSOURCES groups.

Critical Assessment of Existing Classification Systems

Because one of the essential criteria in developing a classification system is the measurement of clinical results, critical assessments of existing classification systems are based on this measurement. In fact, in the majority of studies on the evaluation of rehabilitation services, functional independence (as measured with such tools as the FIM, SMAF, or Bartel index) has often been used as a measurement of clinical results (Desrosiers, Noreau, Rochette, Bravo, & Boutin, 2002). Patient autonomy for basic activities, such as personal care and walking, are often the desired outcomes of rehabilitation programs (Radomski, 1995; Tyson, 1995). Therefore, measuring only the results of intensive functional rehabilitation (Step 2 of the General Process in Rehabilitation of Physical Impairment presented in Figure 1) does not reflect the opinion of professionals insofar as evaluating the results of adaptability and rehabilitation that cover, for example, functional rehabilitation, development of psychosocial autonomy, school or professional learning and integration, and maintaining autonomy in various settings (Steps 3 and 4 of the General Process in Rehabilitation of Physical Impairment). The abilities to walk, wash, and get dressed are not the only essential elements in returning to

Figure 1
General Process in Rehabilitation of Physical Impairment

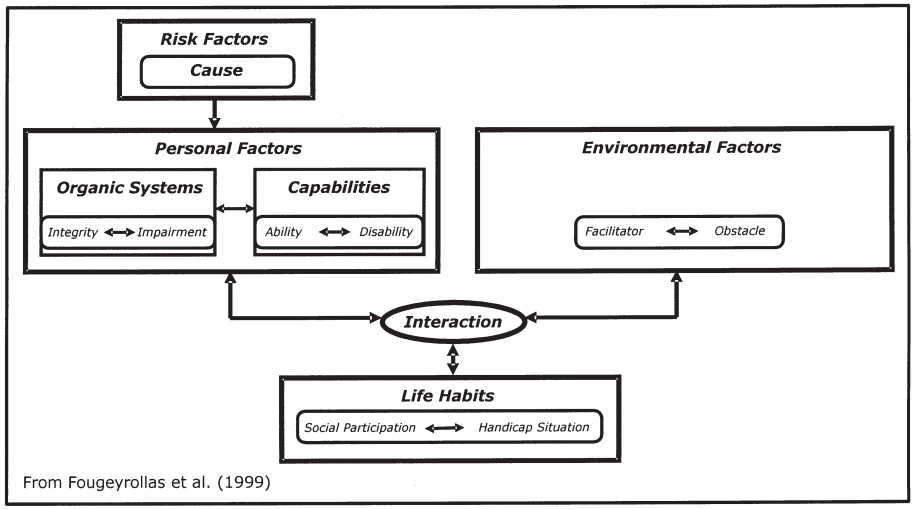


Adapted from Ministère de la Santé et des Services sociaux (1992)

a normal lifestyle (Desrosiers et al., 2002). In addition to including the recovery of certain key lifestyle essentials, the results should also include other important activities and roles normally associated with an optimal quality of life (Desrosiers et al., 2002).

Most of these clinical evaluation tools for rehabilitation are derived from conceptual models from the International Classification of Impairments, Disabilities, and Handicaps (World Health Organization [WHO], 1980) and the International Classification of Functioning Disability and Health (WHO, 2001), and are based on biomedical handicap reconstruction. This practice tends to demonstrate that the models are not well adapted to the clinical intervention methods favoured by the AERDPQ (Association of Health Care Establishments for Physical Impairment of Quebec/Association des établissements de réadaptation en déficience physique du Québec) and the MSSS. Increasing the social perspective factor in relation to skill development for patients with physical impairments leads to a very different definition of the clinical intervention model and of the tools used to evaluate clinical results. This increase is in accordance with the Disability Creation Process (DCP) model (Fougeyrollas, Cloutier, Bergeron, Côté, & St-Michel, 1999), which is an explanatory model of the causes and consequences of diseases, trauma, or other disruptions to a person's integrity or development (Figure 2).

Figure 2
Disability Creation Process



From Fougeyrollas et al. (1999)

Ultimately, physical rehabilitation establishments seek to foster social participation for their patients with significant and persistent incapacities resulting from physical impairment (AERDPQ, 2000). Accordingly, specialized rehabilitation services seek to lessen the obstacles for patients with physical impairments through the following objectives: developing the abilities needed to recapture their life habits, compensating for residual incapacities, and reducing physical and social obstacles likely to limit their enjoyment of life. Thus, the Functional Independence Measure is incapable of reflecting the clinical results derived from services delivered by physical rehabilitation establishments. Based on the DCP conceptual plan, research from Fougeyrollas, Bergeron, and Robin (2002, 2003) has led to the development of a tool that can measure the progression of rehabilitation and could perhaps support the evaluation of clinical results for adaptability-rehabilitation. Given the planning and organization of rehabilitation services in Quebec, developing a classification system based on this measurement method seems justifiable. Using this tool, a study was conducted to design a new evaluation system that will measure and evaluate the financial performances of health care programs for physical impairment and improve budgetary control.

METHODS

Research Design

This study aims to establish a classification system, based on FOC, for patients in a rehabilitation program for visual impairment. To achieve this objective, the study used both a transversal approach (clinical data obtained at a specific moment, such as entering the clinical program) and a longitudinal approach (total costs reflecting the resource utilization per patient during the entire elapsed time of treatment). A study of prospective patients was thus carried out with 100 older adults (≥ 65 years) with visual impairment living in the community. This study took place in a specialized low vision centre in Quebec. Participants were recruited between April 2004 and February 2006 in the Chaudière-Appalaches and Quebec City regions. Each study participant was awaiting services relating to his or her impairment. In Quebec, visual impairment is defined as visual acuity lower than 20/70 or a visual field that is less than 60° in the better eye. Considering the budget and time needed to collect the clinical data, the sample size was set at 100 participants.

Classification Variables

In order to reflect the reality of the health conditions prevailing in a given community, a classification system should be based on a strong conceptual design. Therefore, in the case of elderly persons with visual impairment, this design must incorporate the handicap situations experienced by visually impaired individuals.

In a classification system, the most important variable is the clinical diagnostic or result. Based on the DCP model, clinical results were measured with the Measures of Progression in Rehabilitation (MPR; Fougeyrollas et al., 2002, 2003), a system previously developed by 27 interdisciplinary clinical teams within Quebec's rehabilitation continuum for physical impairment. The MPR system makes it possible to document social participation levels and identify the personal and environmental factors that affect the quality of social participation, which is increased by the actualization of life habits (daily activities and social roles valued by the patient in the social and cultural context to ensure survival and well-being throughout a lifetime) resulting from the interaction of personal factors (age, gender, social and cultural identity, organic systems, capabilities, etc.) and environmental factors (physical and social dimensions that determine a society's organization and context). Thus, the Functional Global Profile (FGP) measure is determined based on 24 life habits that make up the MPR. Each functional profile was given a life habit from 0 to 25 based on precise criteria derived from personal information obtained through questions and observations. A theoretical score of 600 (24 life habits x 25) relative to the FGP corresponds to a patient with no handicap or for whom no life habit is applicable. The lower the score, the higher the severity of the impairment. Appendix 1 sets out life habits, personal and environmental factors, and the measurement scales. Age, total time of services offered (elapsed time), and gender are three other variables that must be considered for classification in accordance with existing systems.

The FOC was obtained from calculations based on activity-based costing. The accounting system used the criteria included in the MSSS *Manual for Financial Management* and was designed for a management-style approach to activity groups. This method incorporates the financial charges per activity group (number of patients, number of beds, etc.) that serve as a basis for allocating financial budgetary resources by the MSSS. Among these charges, we generally distinguish three categories (Hébert et al., 1997): treatment services

(direct care provided to patients, such as professional services by educators, occupational therapists, physiotherapists, speech therapists, etc.), support services (ancillary help for treatment activities such as cleaning staff, laundry, food services, etc.), and general and administrative services (all other services that support the organization). The FOC was determined by multiplying the unit cost for each activity in the three categories by the consumption level of these activities by each patient.

The variables presented here are common for all studies on the use of resources in health care programs. Finally, to be user-friendly, a classification system should include a low number of variables in order to minimize the number of classes. For example, the FIM-FRG2 and AN-SNAP systems include three classification variables.

Method of Analysis

Group definition was performed in two stages. The first stage consisted in identifying the factors influencing the use of services through a multivariate regression. The goal was to define the relations between a dependent variable, a patient's FOC and multiple independent variables, the FGP on admission, age and gender, and total elapsed time for services offered. In order not to influence the entrance order of the variables, a stepwise regression technique was used to identify the variables that best explained the dependent variable variance. The variables with the best explanation would then be introduced in the classification procedure.

$$FOC_j = \alpha_0 + \alpha_1 FGP_{T1j} + \alpha_2 AGE_j + \alpha_3 GENDER_j + \alpha_4 TIME_j + \varepsilon_j \quad (1)$$

In which:

FOC_j = Full operating cost of patient j expressed in dollars;

FGP_{T1j} = Functional global profile at admission of patient j;

AGE_j = Age of patient j at admission for rehabilitation;

$GENDER_j$ = Gender of patient j (0 = female & 1 = male);

$TIME_j$ = Total elapsed time in which services are offered to patient j in number of days;

ε_j = Error term.

The second stage consisted in defining the groups or a classification system from the variables that seemed to have the greatest influence on the use of services. To establish this classification, decision trees were used because they are contextually sound. In fact, decision trees are the classification algorithm most commonly used in the implementation of classification systems in the health care field (Trombert-Paviot, Rodrigues, Vérin, & Gautheron, 1997). They build the partitions or steps in descending order. Starting with the initial crux or node that represents all profiles, they proceed in successive junctures until a critical stop is reached. The successive junctures in accordance with each node, choice indicator, and the partitioning of the node depending on its modalities are done by optimizing local criteria; for example, the significance of a Chi-2 in the Chi-square Automatic Interaction Detection (CHAID) (Kass, 1980). Contrary to the least-square regression algorithm, which can produce solutions with little data, the CHAID heuristic requires more data to reach the same end. Given the small size of our sampling, the regression made it possible to target relevant variables to be used in the classification procedure.

FINDINGS

Descriptive Analysis of the Population-Based Sample

The average age on inception/admission to the program was 81.76 years (SD = 7.18 years; range between 67 and 98 years). The sample comprised 24 men and 76 women. The larger number of women in the sample may be because women constitute the larger part of the population in the age category under study (Institut de la statistique du Québec, 2011) and women with visual impairment seem to have a better chance of recovering their life habits than men. The percentage of men and women in the study was representative of the clientele receiving rehabilitation services from a specialized low vision centre in Quebec. The sample comprised 30 residents from the Chaudière-Appalaches region and 70 from the Quebec City region. It is important to note that visual impairment in the elderly is generally due to age-related ocular illnesses. In the population sample studied, 76 individuals were afflicted with macular degeneration, 9 with glaucoma, 7 with diabetic retinopathy, 6 with optical atrophy, 1 with a cataract, and 1 with a retinal detachment. According to the World Health Organization, which classifies visual impairment into two major categories of severity, 84 persons in the sample had decreased vision and 16 were considered to be blind. The average interval of the

entire elapsed time corresponding to the number of calendar days between the first and the last interventions of the sample was 238 days (SD = 126 days; range between 43 and 627 days). Although patients had the possibility of improving their social participation in relation to the 24 life habits included in the DCP model, not all of them were retained. On average, 6.19 life habits (SD = 2.94; range between 1 and 12) were retained for each patient in his or her individualized treatment plan. When a specific life habit was not part of a person's daily life or lifestyle as a matter of personal choice, it was then identified as being nonapplicable to the assessment of the impairment situation.

This is all the more important because, from a human rights and right to autonomy perspective, a life habit that is not retained by personal choice may not qualify as a handicap situation (Droit pratique, 2011). On average, the FGP score for the T1 time was 534.43 (SD = 33.15; range between 444.61 and 586.75). The FOC was calculated for the entire study group using the unitary cost of activities and the actual number of hours dedicated to the treatment of the sample. It appears that the patients' FOC was $6,074.57 (SD = $4,333.40; range between $937.09 and $21,244.06).

Results Analysis

In analyzing the results, the first step consisted in identifying the factors that influenced the intervention of services by using a multivariate regression. Table 1 presents the results of the model retained with the population sample.

Table 1
Results of the Regression Analysis; Dependent Variable: FOC (N = 100)

Model	Non-standardized Coefficients		Standardized coefficients	*t*	Sig.
	B	Standard Error	Beta		
FGP_{T1j}	-87.791	8.225	-0.691	-10.673	0.000†
AGE_j	5.315	34.913	0.009	0.152	0.879
$GENDER_j$	1,445.036	580.899	0.143	2.488	0.015*
$TIME_j$	10.113	2.148	0.295	4.708	0.000†
Constant	49,805.640	5,268.526		9.453	0.000†
$R = 0.835$; $R^2 = 0.697$; R^2 adjusted = 0.684					
$F = 54.576$ and $p = 0.000$					

†$p \leq 0.001$; *$p \leq 0.05$; (*t*-test, two-tailed).

The results of the model retained are significant and demonstrate an R^2 adjusted by 68.40%. The estimated coefficient of three variables is significant and directly associated with the FOC. First, the estimated coefficient of the FGP on admission is negative (-87.791) and thus significant ($p \leq 0.001$). It is therefore possible to predict that the FGP on admission has a significant impact on the FOC. This result translates into an increase of FOC by $87.79 per FGP level. In other words, the more the global functional level is affected (FGP_{T1j} decreased from the theoretical score of 600), the more the patient uses health care resources. Second, the estimated coefficient of the total elapsed time of services (TIMEj) is positive (10.113) and thus significant ($p \leq 0.001$). This result indicates that the total elapsed time of services offered also seems to impact on the FOC. This result can be interpreted as an increase in the operating costs of resources of $10.11 for each supplementary day that is extended to patients. Third, the estimated coefficient for the gender variable is positive (1,445.04) and thus significant ($p \leq 0.05$). It can then be predicted that gender also has a significant impact on the operating costs. This result can be interpreted as an increase in costs incurred of $1,445.04 when services are provided to males versus females. Finally, the results of the retained model demonstrate that the age of the patients does not seem to be FOC-related. The estimated coefficient associated with this variable is not significant.

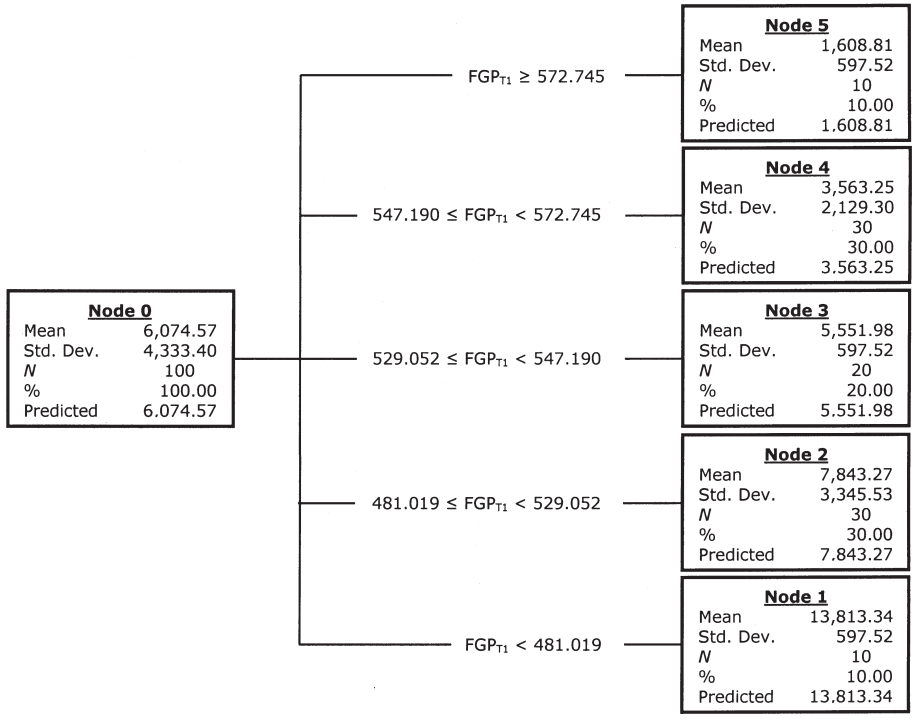
The multicollinearity between the independent variables does not seem problematic in this context. In fact, the variant inflation obtained by the collinearity diagnostic for the independent variables (FGP, age, gender, and time) is, respectively, 1.240, 1.048, 1.037, and 1.227. These values are within the prescribed threshold of [1, 10] proposed by Hair, Black, Babin, and Anderson (2010). Furthermore, the White test (1980) did not detect the presence of heteroscedasticity.

The stepwise regression technique was used to identify the variables with the greatest potential for explaining the dependent variable variance. By introducing the four variables of the original model in the stepwise regression analysis, the results demonstrate that only the variables relative to the FGP at admission (FGP_{T1j}), along with the type ($GENDER_j$) and time ($TIME_j$), were retained, and in the specific order mentioned. The variable representing patient age was not retained. Withdrawing this variable did not translate into a decrease of explicative or predictive performance. Considering these results, it should be logical that the FGP on admission is the most distinguishing or discriminating variable in the development of the classification.

The second step consisted in developing a classification. A statistical analysis was conducted using AnswerTree 3.1 software. Because the objective was to produce a classification based on the FOC, the results of the regression analysis presented above were included in order to define the parameters in the decision tree. The distribution of patients into related groups was based on three discriminate variables (FGP_{T1j}, $GENDER_j$, and $TIME_j$) in function of the FOC. The classification method retained was the CHAID. The procedure consisted of a successive and automatic partitioning of the sample into hierarchical structures that minimized the residual variance for the dependent variable, that is, the costs of the resources utilized. The procedure of segmentation in two continued until there were no more significant segmentations within a margin of error higher than 5%. Figure 3 shows the decision tree for the population sample.

The results of this procedure have demonstrated that the only independent variable related to the FGP seems discriminate for this

Figure 3
Decision Tree



classification. This is coherent with those of the stepwise regression, which also showed this variable at 59.7% of the variance explained by the model. Starting with the functional global level on admission, five categories were determined. Node 1 regroups patients with an FGP inferior to 481 and costs averaging $13,813. Node 2 regroups patients with an FGP between 481 and 529 and costs averaging $7,843. Node 3 regroups patients with an FGP between 529 and 547 and costs averaging $5,552. Node 4 regroups patients with an FGP between 547 and 573 and costs averaging $3,563. Finally, Node 5 regroups patients with an FGP superior to 573 and costs averaging $1,609.

DISCUSSION AND CONCLUSION

The development of a classification system based on the Functional Related Group (FRG) can undoubtedly contribute to improving budgetary control for health care programs for physically impaired patients. The proposed classification system is based on the Measure of Progression in Rehabilitation (MPR) as part of the conceptual program of the Disability Creation Process (DCP).

From an accounting perspective, when evaluating financial performance it is logical to prioritize the analysis of budgetary spreads. In the present state and without a classification system, evaluating performance solely by analyzing the budgetary spreads of each program is an oversight of consequence, as such budget programs do not consider the severity of the case loads. When a program receives patients with more severe conditions in a given year, it would then translate into even broader budgetary spreads. As presented here, the classification system takes into consideration the severity of cases treated. In addition, it differs considerably from other systems by considering the human needs in relation to the patients' social participation. Using this classification system, administrators could increase the accuracy and fairness of their program evaluations.

At the administrative and political levels, it will be possible to integrate and assess the data stream emanating from the standardized classification system of each establishment, territory, and regional and provincial authority in order to properly plan the required human, material, and financial resources. At the same time, such a classification system should facilitate the decisional and evaluation process at all levels. This in turn will allow MSSS public servants to eventually generate more judicious reports for the development of health care policies.

Except for the ISO-SMAF classification system developed for elderly patients with a loss of autonomy, Quebec currently has no classification system of the FRG type specifically designed for the rehabilitation of physically impaired patients. Thus, in cases where the classification system developed for the research design in this study appears viable, it could serve as a model to be applied to other types of physical impairments. It would therefore provide a very useful tool for managers in health care establishments, as well as serve as a guide for government administrators required to define parameters for budgetary allocations that are precise and fair for all health care establishments involved in the rehabilitation of physically impaired patients. Specifically, recent developments regarding the deployment of SIPAD software (an information system designed by the MSSS for patients with a physical impairment, in which the data from administrative and clinical activities are collated) suggest that a large quantity of data will be available that will enable us to significantly refine the proposed classification system and extend it to all physical impairments.

The DCP does not apply only to individuals with serious visual, auditory, language, or motor impairments. In other words, it is not limited to a "disability" as we spontaneously conceive of it. Among other purposes, it has been used to analyze the situation of individuals who have difficulty communicating in the workplace, the elderly experiencing diminished autonomy, and persons with mental health problems. Its scope is continually expanding, and a number of intervention environments in Quebec use it as a general reference framework to guide their practices (Gauthier, Boisvert, & Cardinal, 2005). We are convinced that the classification model developed according to DCP measures, proposed here in relation to visual impairment, could be a very useful tool for measuring and evaluating financial performance in the broader areas of rehabilitation, mental health, and others, not only in Quebec, but also in the rest of Canada and on the international scene.

The classification system set out in the results analysis section presents a new viewpoint in the sense that the appropriate treatment and the resulting resources to be invested are defined by the requirement to respond to the patient's social needs rather than simply the patient's physical impairment. This approach corresponds to the program advocated by physical rehabilitation establishments. In effect, the government budget allocation method is presently based on historical data, whereas health care establishments for the rehabilita-

tion of physical impairments find it more realistic for the allocation to be based on the needs of patients with physical impairments.

In addition, such a classification system should simultaneously meet the needs of patients, health care providers, administrators, public servants, and political leaders. Therefore, at the clinical level, the identification of the resources required to improve the patient's FGP is accomplished by consensus between the patient and the health care team, which together define the most appropriate intervention plans in order to provide the most appropriate services responding to the specific needs of the patient with a physical impairmentFinally, as in all studies with inherent limits, it is important to mention the main element regarding the sample size. Despite the fact that the sample respects certain norms regarding the size of the type of analysis performed, the number of observations was relatively small, mainly to facilitate the development of a classification system based on the CHAID method. A much larger sample would be needed to refine and increase the viability of the proposed system. Nevertheless, this exploratory study should encourage us to conduct a much more expansive study that would include all categories of physical impairments and a greater number of observations to validate the classification system by dividing sample sizes. One part of the sample would be used to construct the classification system and the other part to validate the results. The SIPAD software can be a real opportunity to solve the problem of sample size.

In conclusion, this evaluation model, which has been developed according to a classification system that takes the financial dimension into account, could be applied to other areas. Therefore, insofar as certain measurable variables impact on the consumption of financial resources, a classification based on client profile could be used for all programs and public services in which clients consume resources in a nonhomogeneous fashion. Health is not the only sector in which budget constraints are a fact of life and where any new method for evaluating programs is significant.

ACKNOWLEDGEMENTS

The authors thank everyone involved in this project, especially those who are part of the rehabilitation program for the visually impaired aged 65 and over at the Institut de réadaptation en déficience physique de Québec.

REFERENCES

Aronow, D. B. (1988). Severity-of-illness measurement: Applications in quality assurance and utilization review. *Medical Care Review, 45*(2), 339–366.

Association des établissements de réadaptation en déficience physique du Québec. (2000). *Rôles des établissements de réadaptation en déficience physique*. Montréal: Association des établissements de réadaptation en déficience physique du Québec.

Bédard, D., Bastien, R., Brown, B., Chicoine, J. P., Laroche, M., & Rouleau, R. (2002). *La budgétisation et la performance financière des centres hospitaliers*. Comité sur la réévaluation du mode de budgétisation des centres hospitaliers de soins généraux et spécialisés. Québec: Gouvernement du Québec, MSSS.

Brook, R. H., Davies-Avery, A., Greenfield, S., Harris, L. J., Lelah, T., Solomon, N. E., & Ware, J. E. (1977). Assessing the quality of medical care using outcome measures: an overview of the methods. *Medical Care*, supplement *15*(9), 1–165.

Chandler, A. (1990). Scale and scope: The dynamics of industrial capitalism. Cambridge, MA: Belknap Press.

Coca, E. (1998). *L'ISA et le PMSI: comment mieux gérer les établissements hospitaliers.* Paris, France: Berger-Levrault.

Desrosiers, J., Noreau, L., Rochette, A., Bravo, G., & Boutin, C. (2002). Predictors of handicap situations following post-stroke rehabilitation. *Disability & Rehabilitation, 24*, 774–785.

Donabedian, A. (1985). *The methods and findings of quality assessment and monitoring: An illustrated analysis*. Ann Arbor, MI: Health Administration Press.

Droit pratique. (2011). *Les droits des personnes handicapées*. Retrieved from http://www.droit.pratique.fr/dossiers-actualite/155124-les-droits-des-personnes-handicapees.html#

Dubois, J. (1999). Le PMSI : principes fondamentaux. In *Le PMSI : bilan, actualité et perspectives après 15 ans d'évolution*, première partie, lettre des systèmes d'information médicalisés, August, 3 (supplement), 5–9.

Dubuc, N., & Hébert, R. (2001, November). Les profils ISO-SMAF: un système de gestion clinico-administratif pour la planification des services de longue durée dans un système de soins intégrés. *Actes du Colloque PRISMA*, Drummondville, QC.

Dubuc, N., Hébert, R., Desrosiers, J., Buteau, M., & Trottier, L. (1999). Système de classification basé sur le profil d'autonomie fonctionnelle. In R. Hébert & K. Kouri (Eds.), *Autonomie et vieillissement* (pp. 255–272). St-Hyacinthe, PQ: EDISEM.

Durand, P. J., Lemay, A., Tourigny, A., Boutin, L., & Paradis, M. (2001). *Développement et implantation d'un système de prix de revient des soins et des services à domicile dans le cadre du projet de démonstration d'un réseau intégré des services dans les Bois-Francs avec une coordination des services par gestion de cas. Fonds d'adaptation des services de santé et addenda sur les coûts privés à domicile* (working paper). Beauport, QC: Unité de recherche en gériatrie de l'Université Laval.

Eager, K., Gree, J., & Gordon, R. (1999). *A national classification system and payment model for private rehabilitation services* (working paper). Wollongong, Australia: University of Wollongong, Center for Health Services Development.

Engel, F., Kletz, F., Moisdon, J. C., & Tonneau, D. (2000). *La démarche gestionnaire à l'hôpital : le PMSI*. Paris: Seli-Arslan.

Fetter, R. B. (1991). DRG: Understanding Hospital Performance. *Interfaces, 21*(1), 6–26.

Fougeyrollas, P., Bergeron, H., & Robin, J. P. (2002). *Les mesures de progression en réadaptation* (working paper). Québec: Institut de réadaptation en déficience physique de Québec.

Fougeyrollas, P., Bergeron, H., & Robin, J. P. (2003). Développement d'un cadre de classement des résultats de la réadaptation pour documenter la progression des clientèles. *Canadian Journal of Program Evaluation, 18*(2), 139–164.

Fougeyrollas, P., Cloutier, R., Bergeron, H., Côté, J., & St-Michel, G. (1999). *The Quebec classification: Disability creation process*. Quebec: International Network on the Disability Creation Process/Canadian Society for the International Classification of Impairments, Disabilities, and Handicaps.

Gauthier, S., Boisvert, R., & Cardinal, V. (2005). Réflexion sur l'utilisation du cadre conceptuel « Processus de production du handicap » dans l'analyse des facteurs de vulnérabilité et de protection à la violence conjugale. *International Journal of Victimology, 3*(3), 1–18.

Green, J., Wintfeld, N., Sharkey, P., & Passman, L. J. (1990). The importance of severity of illness in assessing hospital mortality. *Journal of the American Medical Association, 263*(2), 241–246.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis* (7th ed.). Upper Saddle River, NJ: Prentice Hall.

Halgand, N. (2000). Calcul des coûts et contrôle budgétaire de l'hôpital : éléments d'analyse comparée du nouveau cadre comptable. *Proceedings of the XXIe Congrès de l'Association Francophone de Comptabilité*, 18–19 mai, Angers.

Harada, N., Kominski, G., & Sofaer, S. (1993). Development of a resource-based classification scheme for rehabilitation. *Inquiry, 30*, 50–63.

Hébert, R., Carrier, R., & Bilodeau, A. (1988). The Functional Autonomy Measurement System (SMAF): Description and validation of an instrument for the measurement of handicaps. *Age Ageing, 17*, 293–302.

Hébert, R., Dubuc, N., Buteau, M., Roy, C., Desrosiers, J., Bravo, J., … St-Hilaire, C. (1997). *Services requis par les personnes âgées en perte d'autonomie*. Québec: Gouvernement du Québec.

Hornbrook, M., & Monheit, A. C. (1985). The contribution of case-mix severity to the hospital cost-output relation. *Inquiry, 22*, 259–271.

Iezzoni, L. (1994). *Risk adjustment for measuring health care outcomes*. Ann Arbor, MI: Health Administration Press.

Institut de la statistique du Québec. (2011). *Population selon le groupe d'âge et le sexe, 1996–2009*. Retrieved from http://www.stat.gouv.qc.ca/donstat/societe/ anals_difrn_sex/hmi_ads.htm#donnees

Kass, G. V. (1980). An exploratory technique for investigating large quantities of categorical data. *Applied Statistics, 29*(2), 119–127.

Keith, R. A., Granger, C. V., Hamilton, B. B., & Sherwin, F. S. (1987). The Functional Independence Measure: A new tool for rehabilitation. *Advances in Clinical Rehabilitation, 1*, 6–18.

Lévesque, G. (2007). *Mode d'allocation des ressources financières 2006–2007 aux hôpitaux du Québec pour les patients hospitalisés et en chirurgie d'un jour par le Ministère de la Santé et des Services sociaux*. Québec: Gouvernement du Québec, Ministère de la Santé et des Services sociaux, Direction de la recherche.

Ministère de la Santé et des Services sociaux. (1992). *Programme-cadre pour les personnes ayant une déficience physique*. Québec: Gouvernement du Québec.

Musselman, V. A., & Hughes, E. H. (1972). *Introduction to modern business: Analysis and interpretation* (6th rev. ed.). Englewood Cliffs, NJ: Prentice-Hall.

National Association of Gerontology Clinics. (1994). AGGIR. Guide pratique pour la codification des variables. Principaux profils des groupes isoressources. *Revue de Gériatrie, 19*, 249–259.

Nicklin, W., & Zitner, D. (2002). Healthcare: navigating without a compass. Poor data, poor healthcare? Who knows? *Healthcare Management Forum, 15*(3), 42–45.

Nobre, T. (2000). Quels tableaux de bord de pilotage pour l'hôpital ? *Proceedings of the XXIe Congrès de l'Association Francophone de Comptabilité*, 18–19 mai, Anger.

Nobre, T., & Biron, N. (2001). Application de la méthode ABC au calcul des coûts par pathologie: le cas de la chirurgie infantile. *Proceedings of the XXIIe Congrès de l'Association Francophone de Comptabilité*, 17–19 mai, Metz.

Paolucci, S., Traballesi, M., Emberti Gialloreti, L., Prastesi, L., Lubich, S., Salvia, A., … Caltagirone, C. (1998). Post-stroke rehabilitation: An economic or medical priority? Current issues and prospects in light of new legislative regulations. *Italian Journal of Neurological Sciences, 19*(1), 25–31.

Radomski, M. V. (1995). There is more to life than putting on your pants. *American Journal of Occupational Therapy, 49*(6), 487–490.

Stineman, M. G., Fieldler, R. C., Granger, C. V., & Maislin, G. (1998). Functional task benchmarks for stroke rehabilitation. *Archives of Physical Medicine and Rehabilitation, 79*, 497–504.

Trombert-Paviot, B., Rodrigues, J. M., Vérin, I., & Gautheron, V. (1997). Développement d'un système de classification de type case mix pour les soins de suite et de réadaptation et évaluation de la qualité des soins. In P. Degoulet & M. Fieschi (Eds.), *Informatique et santé* (Vol. 9, pp. 53–63). Paris: Springer-Verlag France.

Tyson, S. F. (1995). Stroke rehabilitation. What is the point? *Physiotherapy, 81*(8), 430–432.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Economica, 48*(4), 817–838.

World Health Organization. (1980). *The international classification of impairments, disabilities, and handicaps*. Geneva: Author.

World Health Organization. (2001). *International classification of functioning, disability and health*. Geneva: Author.

Young, W. W., Swinkola, R. B., & Zorn, D. M. (1982). The measurement of hospital case mix. *Medical Care, 20*(5), 501–512.

Michel Coulmont, DBA, is associate accounting professor at Sherbrooke University. He has written several articles and made numerous presentations at academic conferences. His research interests focus on cost management in health and social services and on sustainability disclosures.

Chantale Roy, CA, D.Sc.Gestion, is full professor of management accounting at Sherbrooke University. Her research interests include cost and performance measurement in health and social establishments and sustainable development. She has written a number of academic publications.

Patrick Fougeyrollas, Ph.D., is a social anthropologist and Scientific Support Director at the University Institute of Rehabilitation of Quebec City, and Adjunct Professor in the Departments of Rehabilitation and Anthropology at Laval University. He is also a researcher at the Rehabilitation and Social Integration Interdisciplinary Research Center.

Appendix 1
Disability Creation Process - Life habits, personal factors and environmental factors

List of Items Relating to Dimensional "Life Habits"

1. Diet
2. Food Preparation
3. Meals
4. Hygiene
5. Health Care
6. Mental Fitness
7. Physical Fitness
8. Dressing
9. Short Distance Mobility
10. Transports
11. Oral and Body Communication
12. Written Communication
13. Telecommunication
14. Signs
15. Lodging
16. Home Maintenance
17. Affective Relationships
18. Social Relationships
19. Family Responsibility
20. Financial Responsibility
21. Community Life
22. Recreation
23. Education
24. Employment

The Accomplishment Scale of Life Habits

Level of Accomplishment

6. No Difficulty
5. With Minor Difficulty
4. With Moderate Difficulty
3. With Major Difficulty
2. Accomplished by a Proxy
1. Not Accomplished

Type of Assistance

4. No Assistance
3. Assistive Device or Adaptation or Human Assistance
2. Occasional Human Assistance + Assistive Device or Adaptation
1. Steady Human Assistance + Assistive Device or Adaptation

List of Items Relating to Dimensional "Personal Factors"

1. Intellectual Capabilities
   - Attention and Concentration
   - Amnesia
   - Thought
2. Language Capabilities
   - Speech
   - Understanding Oral Language
   - Understanding Sign Language
   - Understanding Written Language
   - Lip-Reading
   - Oral Language Expression
   - Sign Language Expression
   - Written Language Expression
   - Pragmatic
3. Behavior Capabilities
   - Volition
   - Affective
   - Behavior
4. Touch
5. Interceptive Functions
6. Hearing
   - Auditory Perception
   - Auditory Discrimination
   - Auditory Identification
   - Sound Localization
   - Sensations Associated with Auditory and Dressing Functions
7. Vision
   - Detail Vision
   - Spatial and Movement Vision
   - Ocular Motor Control
   - Visual Perception
8. Motor Activity Capabilities
   - Voluntary Body Part Movements
   - Postural Development and Control
   - Equilibrium
   - Coordination
   - Deglutition
   - Manual Activities
   - Walking
9. Tolerance and Resistance Capabilities

Measurement Scale of Personal Factors

Severe Disability

4. Limitless Ability
3. Slightly Limited Ability
2. Significant Limited Ability
1. Incapable

Type of Assistance

3 No Assistance
2. Human or Technological Assistance
1. Human and Technological Assistance

List of Items Relating to Dimensional "Environmental Factors"

1. Family Structures
2. Social Network
3. Residential Buildings
4. Financial Security
5. Pre-school and Academic Instruction
6. Workplace
7. Physical, Household, and Psychosocial Support
8. Transportation Services
9. Technology
10. Urban Development
11. Climate

Measurement Scale of Environmental Factors

Appreciation of the Accomplishment of a Person's Life Habits

3. Facilitator (+)
2. No Influence
1. Obstacle (-)

Obstacle or Facilitator Assessment Scales

3. Minor
2. Moderate
1. Major