

Risk Factors for Complex Care Needs in General Medical Inpatients

Results From a European Study

PETER DE JONGE, PH.D., FRITS J. HUYSE, M.D., PH.D.
THOMAS HERZOG, M.D., PH.D., ANTONIO LOBO, M.D., PH.D.
JORIS P.J. SLAETS, M.D., PH.D., JOHN S. LYONS, PH.D.
BRENT C. OPMEER, PH.D., BARBARA STEIN, PH.D.
VOLKER AROLT, M.D., NANDOR BALOGH, M.D.
GRACA CARDOSO, M.D., PER FINK, M.D., PH.D., DR. MED. SC.
MARCO RIGATELLI, M.D.

The authors linked admission risk factors to a series of indicators for complex care delivery to enable detection of patients in need of care coordination at the moment of admission to the general hospital. The authors found 13 risk factors to be predictive of more than one indicator of care complexity. An admission risk screening procedure to detect patients in need of care coordination should focus on these risk factors and should include predictions made by doctors and nurses at admission and information collected from the patient and the medical chart.

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Because of the increasing number of hospital admissions of patients requiring complex care and the associated increase in the cost of their health care needs, more attention should be paid to the beneficial effects of interdisciplinary care for subgroups of patients who require complex care, including frail elderly patients,^{1–3} patients with depression or anxiety,^{4–5} or delirious patients.⁶ The beneficial effect of standard multidisciplinary treatment for all patients admitted to general internal medicine wards on average length of stay (LOS) has been demonstrated,⁷ but these effects are limited because of the lack of a valid screening method. Moreover, such interventions put a heavy strain on patients who do not necessarily need it, and on available resources.

We describe here a model for identifying the need for coordinated care for patients with complex care needs. We developed this model and propose 10 indicators for what

we call “care complexity,” the difficulty associated with managing a patient through the process of hospitaliza-

Received March 20, 2000; revised October 10, 2000; accepted October 29, 2000. From From Psychiatric C-L Service, Vrije Universiteit Hospital, Amsterdam; Department of Internal Medicine, University Hospital, Groningen, The Netherlands Hospital, Amsterdam; Department of Psychotherapy and Psychosomatic Medicine, Albert Ludwigs University, Freiburg, Germany; Psychosomatic and C-L Psychiatry Service, Hospital Clínico Universitario, Zaragoza, Spain; Department of Psychiatry, Northwestern University Medical School, Chicago, Illinois; Department of Psychiatry, University of Muenster, Muenster, Germany; Department of Medical Informatics, Institute of Cardiology, Budapest, Hungary; Department of Psychiatry, Hospital Fernando Fonseca, Amadora, Portugal; Research Unit for Functional Disorders, Psychosomatics and C-L Psychiatry, Aarhus University Hospital, Aarhus, Denmark; Department of Psychiatry, University Hospital, Modena, Italy. Address correspondence to Dr. de Jonge, Psychiatrische Consultatieve Dienst, Academisch Ziekenhuis der Vrije Universiteit, Postbus 7057, 1007 MB Amsterdam, The Netherlands. E-mail: p.dejonge@azvu.nl

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tion.⁸⁻¹⁰ Patients with high scores on our assessment of care complexity are patients whom we expect will need care coordination to prevent miscommunication between medical specialists and nurses that can result in inadequate care. In this study, an extensive list of potential risk factors for care complexity is linked to complexity indicators to identify admission risk factors for complex care needs during hospitalization. In a subsequent article, a reduced list of risk factors is used to construct a short instrument to predict care complexity at hospital admission.¹¹

METHODS

Design

This study was part of the Biomed1 Risk Factor Study,⁸ the main goal of which was to improve detection and treatment of patients with combined medical and psychiatric problems. The study has a cohort design: patients were included at their admission and followed through their hospital stay until discharge. At admission, a physician and nurse made a series of ratings about the severity of the patient's illness and predictions about care complexity. Within the first 3 days of admission, an extensive structured patient interview was conducted by a trained health care professional (i.e., a nurse, medical student, or doctor). At discharge, the physician and nurse made a series of ratings reflecting the complexity of the care the patient received. The admission nurse and the discharge nurse were the same person for only a minority of the patients in this study. The admission physician and the discharge physician were the same.

Sample

Patients were admitted consecutively to general internal medical wards of 11 European hospitals in the course of 1996 and 1997. Patients were included only if they were admitted directly (not through another ward or hospital) and stayed at least one night. Patients who could not be interviewed due to the severity of their illness or because of organizational difficulties and those who did not consent were excluded. Patients who died during admission were removed from the sample (see Figure 1 of the first article in this three-part series for the patient flow chart).

Predictor Variables

Predictor variables were formulated based on existing instruments and on the consensus in our international re-

search group. In total, 117 variables were used as predictors, divisible into the following categories.

Admission Status. Admission status variables included gender, age, whether the patient had a planned or unplanned admission, where the patient was admitted from (10 dummy variables), and the admission initiative by (6 dummy variables). There are 19 variables in this category.

Subjective Clinical Predictions by Doctor and Nurse. These variables include predictions about care complexity made within 24 hours of patient admission and focus on the patient's LOS, medical complexity, nursing care complexity, organizational complexity, mental health disturbance, discharge problems, ADL limitations, long-term medical care needs, and need for support after discharge. The scores were based on 3-, 4- and 5-point ordinal scales. In total, there are 18 variables in this category.

Case Complexity/Severity of Illness Ratings. These variables include observations and clinical judgments made within the first 24 hours of admission by the medical doctor. Scores are based on dummy variables [e.g., systolic blood pressure less than 80 mmHg; whether the patient suffers from a chronic medical disease (yes/no)] and ordinal scales [e.g., Do you expect compliance? (no, minor problems, severe problems)]. There are 13 variable scores in this category.

Living/Working Situation. These variables include dummy variables on the patient's working situation (7 categories), living situation (11 categories), and whether changes have happened or are expected. There are 20 variable scores in this category.

Stress/Social Support. These ordinal variables include social relations, the expectation of visits during hospital stay, and a dummy variable describing if there has been a death of a close relative in the last year. There are 5 variable scores in this category.

ADL Functioning. ADL variables include scores on 4- and 5-point ordinal scales assessing activities of daily living, including level of walking difficulties, problems in self-care, level of help required at home (from the SF-36). There are 3 variable scores in this category.

Health Perception/Worrying. These variables include scores on 3- and 4-point ordinal scales on level of health perception (last week, last 3 months, over lifetime), pain (last week and in general), worrying, and being troubled by symptoms (from the SF-36 and Whitely-7). There are 8 variable scores in this category.

Relation With Doctors. These variables include scores on 3-, 4- and 5-point ordinal scales on the patient's attitude toward doctors, trust in doctors, and negative experiences

with doctors (from the Whately-7). There are 3 variable scores in this category.

Health Care Use. Health care use variables include the number of doctors and alternative healers, hospital admissions, and emergency room admissions in the last 3 months and mental health admissions over the patient's lifetime. Also included here are dummy variables on lifetime outpatient treatment, current mental health care use, and number of medications taken on the day before admission. There are 9 variable scores in this category.

Drug Abuse and Compliance. These variables include dummy variables on smoking, addictive medications (pain killers, tranquilizers, indigestives, sleeping pills, laxatives, antidepressants, and cough medicines), and taking more medication than prescribed. Also included here are scores on ordinal scales regarding difficulty with compliance and alcohol abuse (from the CAGE). There are 11 variable scores in this category.

Emotional State. These variables include scores on 4-point ordinal scales regarding aspects of emotional state during the last month (from the SCL-8). There are 8 variable scores in this category.

Outcome Variables

The 10 indicators of care complexity were divided into 6 objective and 4 subjective indicators: 1) LOS, 2) days with laboratory tests, 3) days with diagnostic tests, 4) medications, 5) medical and paramedical consultations, 6) non-standard nursing interventions, 7) medical complexity, 8) nursing complexity, 9) postdischarge care needs, and 10) mental health problems. All indicators are thought to address both the duration and complexity of care.

The first five objective indicators were scored by means of the hospital information system and the medical chart. LOS is the discharge date minus the admission date. The number of days on which there were diagnostic tests involved all tests that were not conducted on the admission ward. Both this variable and the number of days on which there were laboratory tests were preferred to the actual number of tests because of local and individual policy differences. Moreover, it was assumed that the number of days of diagnostic testing was an indicator of diagnostic complexity. The number of prescribed medications included psychopharmaceuticals. The total number of medical and paramedical consultations documented in the medical chart was summed up over the total hospital stay. For the number of nonstandard nursing interventions, the following 13 items were scored daily by the nurse whether or

not they were applicable that day: more than standard monitoring, neurological monitoring, intravenous lines, nasal tube feeding, total parenteral nutrition, nasal oxygen, drains, airway cleaning, special care for scars and wounds, artificial respiration, hemofiltration, patient fully bedridden, and patient fully ADL dependent.

The subjective indicators were all scored at the patient's discharge by means of seven items with four-point answering categories (no, mild, moderate, severe; scored 1–4) rated by both the doctor and nurse. A Principal Components Analysis (PCA) conducted to form scales, resulted in a four-factor solution.⁸ The factors were interpreted as medical care complexity, nursing care complexity, mental health disturbance, and postdischarge care needs. For all scales, Cronbach's alpha's were calculated to assess their internal consistency. Medical care complexity consisted of two items rated by the doctor: level of complexity of the medical care received by the patient and level of organizational difficulty (Cronbach's $\alpha = 0.83$). Nursing care complexity consisted of two items rated by the nurse: level of complexity of the nursing care received by the patient and level of organizational difficulty (Cronbach's $\alpha = 0.86$). Mental health disturbance was scored by two items rated by the doctor and two by the nurse. These items addressed the mental health problems experienced during hospital stay and the level of discharge problems (Cronbach's $\alpha = 0.63$). Level of anticipated postdischarge problems was scored by three items rated by the doctor and three by the nurse. These items addressed anticipated postdischarge care needs, expected ADL functioning, and expected need of support (Cronbach's $\alpha = 0.80$). So, in total four subjective scales were used as outcomes in addition to the six objective criteria: medical complexity, nursing complexity, postdischarge care needs, and mental health problems. Medical complexity was the sum score on two items scored by the doctor: complexity of medical care and complexity of the organization of care (potential score range = 2–8). Nursing care complexity was the sum score of two items scored by the nurse: complexity of the nursing care and complexity of the organization of care (potential score range = 2–8). Mental health problems was the sum score of four items: two scored by the doctor and two by the nurse, both addressing the extent to which there was a mental health disturbance and discharge problems (potential score range = 4–16). Postdischarge care complexity was the sum score of six items, three to the doctors and three to the nurse, addressing anticipated postdischarge limitations in functional status, need for long-term medical

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care, and need for support after discharge (potential score range = 6–22).

Because all objective indicators had skewed distributions, natural logarithmic transformations were conducted for the prediction analyses. This resulted in approximately normal distributions for all outcome measures, which was necessary to do the analyses. The subjective complexity scales all had approximately normal distributions.

Data Analysis

Multiple linear regression analysis without interaction terms was conducted to select a small set of variables most relevant for the prediction.¹² Scores were excluded beforehand where variance was small or where there were many missing data. “Do not know” as an answer was treated as missing data. The number of initial variables is in acceptable proportion to the number of patients (117:2,158 = 1:18). Two potential weaknesses of the regression analysis were anticipated and dealt with in the analysis strategy. First, the large number of initial items could lead to many patients with a missing value on at least one variable. Second, the anticipated reduction of items in the final regression model might result in an unstable solution.

To reduce the impact of these problems, an iterative procedure for the selection of items was followed. The stepwise procedure for including and dropping items was used according to the standard procedure in SPSS: a forward selection procedure with the possibility of excluding variables at each stage (version 7.5; inclusion when the significance of the standardized regression weight < 0.05 and exclusion when the significance of the standardized regression weight > 0.10). When no more items with significant regression weights can be added to the model the procedure is terminated. All models were cross-validated; the regression model was developed on a random half of the sample and tested with fixed regression weights on the other half. Standardized residuals were plotted against the fitted values (predicted outcome) to detect model violations such as the presence of outliers and heteroscedasticity.¹³

This regression analysis procedure was repeated for all 10 outcome measures. Regression functions were then compared, and a selection of predicting variables that were present in more than one function was made. Variables were excluded if their contribution in the regression functions was explained by national differences. The definitive list of predictive variables was used to predict the 10 out-

come variables in one-half of the sample, which was again validated with fixed regression weights in the other half.

RESULTS

Table 1 gives a description of the sample. At an international level, some considerable differences can be seen. First, Denmark shows a considerably lower average LOS of patients compared to the other samples. Examination of the national Danish hospital data¹⁴ shows that this is in agreement with national data and not the result of a biased patient selection procedure. Second, there is a great deal of variation in the proportion of unplanned admissions. The most pertinent difference is between the patients in the Portuguese sample, who virtually all had unplanned admissions, and the Hungarian sample in which only 9% of admissions were unplanned.

By means of analysis of variance, we sought to determine if substantial univariate differences on the 10 variables existed between the countries. In terms of proportions of explained variances due to national differences, the most substantial differences are found on 5 variables: consultations (39%), diagnostic tests (37%), nursing care interventions (23%), laboratory tests (18%), and doctors' impressions of complexity of organization (16%). In all these instances, the patients in the German sample had the highest average scores and the Danish the lowest.

Table 2 shows that all indicators could be predicted with 5–9 variables from the list of initial items. The regression functions were generally relatively stable, as indicated by minor differences between the explained variance in the development sample and the validation sample. The proportions of explained variance were relatively high, ranging from 24% to 50% in the validation sample.

As a considerable overlap among the regression functions occurred, a preliminary list of predictive items could be formulated consisting of 39 variables. Of these items, 14 were present in more than one function.

To assess whether the contribution the predictor variables made can be explained by national differences, regression models were fit on the 10 complexity indicators with the addition of six dummy variables to model cross-national differences. In this procedure the variable “do you worry about aspects of your life other than your disease” no longer significantly contributed to the prediction of all outcome measures. The inclusion of this variable was induced by relatively high scores on this variable in the Hungarian sample, where relatively high complexity scores were also found. Therefore this variable was excluded

from the list. The remaining 13 variables are presented in Table 3.

There are four ratings by the doctor, three by the nurse, four ratings scored during the patient interview, and two variables scored from the medical chart. All variables had positive regression weights, indicating a relation with the outcome measure in the anticipated direction. Table 4

shows the prediction of the 10 outcome measures by means of the reduced set of 13 predictor variables.

From Table 4 it can be seen that the percentages of explained variance of the 10 complexity indicators range from 19 to 39, slightly lower than the optimal predictions. The number of variables needed in the predictions varies from 3 to 8 items. All variables are present in at least two

TABLE 1. Descriptive statistics of the sample

	Denmark (<i>n</i> = 277)	Germany (<i>n</i> = 511)	Hungary (<i>n</i> = 520)	Italy (<i>n</i> = 363)	Netherlands (<i>n</i> = 136)	Portugal (<i>n</i> = 117)	Spain (<i>n</i> = 234)	Total (<i>n</i> = 2,158)
Demographic								
Age	58.9 ± 16.4	60.9 ± 16.5	64.7 ± 14.3	64.3 ± 17.7	58.8 ± 20.3	55.4 ± 20.0	64.7 ± 17.0	61.8 ± 17.4
Men, %	46	43	50	48	48	51	52	48
Unplanned admissions %	83	74	9	77	60	98	67	61
Complexity Indicators								
Mean length of stay	6.6 ± 7.2	13.0 ± 11.0	11.2 ± 6.5	12.4 ± 11.4	11.2 ± 10.3	12.7 ± 16.2	12.6 ± 10.7	11.5 ± 10.2
Mean days with laboratory tests	1.0 ± 1.4	5.9 ± 4.9	5.2 ± 3.0	2.9 ± 2.2	2.6 ± 2.7	2.7 ± 2.2	3.4 ± 3.0	3.9 ± 3.6
Mean days with diagnostic tests	3.5 ± 4.0	8.2 ± 7.0	3.4 ± 2.8	5.8 ± 5.4	5.3 ± 8.4	4.1 ± 2.9	3.6 ± 3.2	5.2 ± 5.1
Mean number of medications	5.8 ± 4.3	9.9 ± 6.1	7.3 ± 4.3	6.5 ± 5.8	8.1 ± 5.3	7.2 ± 4.5	7.6 ± 6.8	7.7 ± 5.7
Mean number of consultations	0.4 ± 1.0	8.3 ± 7.8	3.9 ± 4.1	1.1 ± 1.4	1.2 ± 2.2	1.5 ± 0.7	1.5 ± 2.2	3.4 ± 5.2
Mean number of nurse interventions	2.8 ± 4.4	25.5 ± 27.3	6.0 ± 8.0	10.0 ± 17.2	13.8 ± 20.4	13.8 ± 16.3	16.1 ± 19.0	12.9 ± 19.7
Medical care complexity	2.7 ± 1.1	4.6 ± 1.7	3.4 ± 1.5	3.4 ± 1.8	3.0 ± 1.5	3.8 ± 1.5	3.6 ± 1.6	3.6 ± 1.7
Nurse care complexity	2.9 ± 1.4	4.3 ± 1.6	2.9 ± 1.4	3.5 ± 1.9	3.6 ± 1.8	3.5 ± 1.6	3.3 ± 1.6	3.5 ± 1.6
Mental health disturbance	5.3 ± 1.9	6.6 ± 2.9	5.5 ± 2.1	5.4 ± 2.3	5.3 ± 2.0	5.8 ± 2.4	5.6 ± 2.1	5.7 ± 2.4
Postdischarge care needs	11.8 ± 3.2	13.2 ± 3.3	13.2 ± 3.4	13.8 ± 4.1	11.7 ± 3.5	14.0 ± 3.0	15.0 ± 3.5	13.3 ± 3.6

Note: Values are means ± SD unless noted otherwise.

TABLE 2. Optimal prediction of the 10 complexity indicators

	Number of Predictive Items	Explained Variance, % (Development Sample, <i>n</i> = 1,090)	Explained Variance (Validation Sample, <i>n</i> = 1,068)
Objective indicators			
Length of stay	5	43	39
Days with laboratory tests	9	35	29
Days with diagnostic tests	8	34	28
Number of medications	9	35	27
Number of consultations	8	36	28
Number of nurse interventions	9	29	24
Subjective indicators			
Medical care complexity	5	36	28
Nurse care complexity	8	32	31
Mental health disturbance	7	41	41
Postdischarge care needs	7	56	50

Note: Values for Items are the number of predictive items from the initial list of 117 possible risk factors.

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functions. All regression weights are positive, indicating a relation in the anticipated direction.

DISCUSSION

In this large, multicenter European study, risk factors for a series of indicators for hospital-based care complexity were identified. A list of 117 possibly predictive variables was reduced to 13 variables that can be used as risk factors for the 10 indicators for care complexity. This vast reduction of items was accompanied by only a relatively small loss of predictive power. With the remaining variables 19% to 39% of variance of the outcome variables was predicted. In addition, the findings were relatively stable as shown in the validation analyses.

Among the risk factors, six are based on predictions by doctors and nurses made close to the time of a patient's admission. These predictions probably reflect complex combinations of a range of clinically relevant variables instead of relying on a single patient characteristic. Inclusion of these predictions is in accordance with reported findings.^{10,15} In contrast to Kelleher, we observed that predictions made at a patient's admission can be powerful predictions of a series of complexity indicators, among them LOS. The selected predictions are equally distributed among the doctors and nurses, supporting the view that they may have different and complementary views of the patient's care complexity. The remaining seven variables together address the patient's admission status and recent history of functioning. Four of these scores were obtained during the patient interview: 1) how the patient rated his/her health during the week before admission, 2) to what

extent the patient had walking difficulties, 3) how many pills were taken the day before admission, and 4) how many doctors were seen during the 3 months prior to admission. Two scores were taken from the medical status: whether the admission was planned and whether the patient was retired. One score was rated at admission by the doctor: whether a currently active malignancy was suspected.

In the literature much attention is given to chronically ill patients because they have high and complex care needs and an increased risk of multipathology, including psychiatric comorbidity.¹⁶ Chronically ill patients are likely to be those having seen many doctors in the 3 months prior to their admission and those taking multiple medications prior to admission. The first variable has been found to be a risk factor for repeated hospital admissions in elderly patients.¹⁷ The latter variable has been found to be a risk factor for complexity¹⁸ and an indicator for chronicity.¹⁹ Among the patients with high health care use may also be patients with somatization disorder. In particular, the number of doctors seen in the last 3 months before admission could be seen as an indicator of "doctor-shopping." This subgroup of patients is often highly distressed,²⁰ and a large degree of attention is needed to clarify diagnostic problems and/or treatment. An important benefit for early detection lies in fact that a relatively simple intervention could greatly reduce health care use.²¹ Another subgroup of patients that may be identified with the risk factor list is frail elderly patients. It is frequently mentioned that elderly patients are at risk for functional decline, chronic multipathology, and reduced cognitive skills and that age is an important risk factor for complications in care and excessive care use.^{22,23} In this study retired patients and patients with walking dif-

TABLE 3. Risk factors for the 10 complexity indicators

Risk Factors	Answering Categories
Doctor's Ratings	
Expected LOS	A few days, A week, Two weeks, Three weeks, A month, More
Expected organizational complexity	No, Maybe, Most probably, For sure
Expected mental health problems	No, Mild, Moderate, Severe
Suspected currently active malignancy	No, Yes
Nurse's Ratings	
Expected LOS	A few days, A week, Two weeks, Three weeks, A month, More
Expected organizational complexity	No, Maybe, Most probably, For sure
Expected ADL limitation by nurse	No, Mild, Moderate, Severe
Patient's Ratings	
Walking difficulties	No, Walking aids needed, Supervision needed, Support needed, Fully incapable
Health during week before admission	Excellent, Good, Fair, Poor
Doctors seen last 3 months before admission	Count
Types of medications taken day prior to admission	Count
Admission Data	
Admission type	Planned, Unplanned
Retired	No, Yes

TABLE 4. Regression weights and explained variance for all regression functions

	Length of stay	Laboratory Tests	Diagnostic Tests	Medications	Nurse Interventions	Consultations	Medical Care Complexity	Nurse Care Complexity	Mental Health Disturbance	Postdischarge Care Needs
Doctor's Ratings										
Expected LOS	0.34 (0.40)	0.14 (0.21)	0.15 (0.21)	0.10 (0.14)	0.14 (0.10)	0.20 (0.20)	0.31 (0.18)			0.47 (0.13)
Expected organizational complexity		0.09 (0.13)	0.16 (0.21)		0.17 (0.12)	0.22 (0.21)	0.63 (0.35)	0.30 (0.17)		
Expected mental health problems								0.25 (0.13)	10.24 (0.42)	
Nurse's Ratings										
Expected LOS	0.25 (0.31)	0.18 (0.26)	18 (0.26)	0.09 (0.14)	0.24 (0.19)	12 (0.13)	31 (0.18)			
Expected organizational complexity					0.20 (0.13)	0.24 (0.21)	0.41 (0.21)	0.50 (0.27)	0.72 (0.26)	0.44 (0.11)
Expected ADL limitation by nurse					0.21 (0.14)			0.33 (0.18)		10.42 (0.35)
Patient's Ratings										
Walking difficulties										0.39 (0.09)
Health during week before admission	0.07 (0.08)			0.08 (0.11)				0.14 (0.07)		0.39 (0.09)
Doctors seen last 3 months before admission		0.01 (0.08)		0.01 (0.10)			0.01 (0.06)			
Types of medications taken day prior to admission	0.02 (0.06)		0.02 (0.08)	0.08 (0.38)						0.22 (0.18)
Suspected currently active malignancy				0.23 (0.12)	0.42 (0.10)		0.41 (0.07)	0.48 (0.09)		30.01 (0.26)
Admission Data										
Admission type		0.31 (0.24)		0.18 (0.14)	0.45 (0.17)			0.39 (0.12)	0.43 (0.09)	
Retired					0.20 (0.08)					
Explained variance, % (development sample, $n = 1090$)	42	28	23	30	29	26	34	26	27	42
Explained variance (validation sample, $n = 1068$)	38	25	22	25	20	19	26	20	26	39

Note: Values in brackets are standardized coefficients.

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difficulties were found to have higher complexity scores, similar to other studies.^{17,24} Hickam and colleagues reported an underestimation of the impact of functional status on the risk of nursing home placement by the clinicians, which may be a reason for the inclusion of walking difficulties in this study. Several studies found functional limitations to be related to health care use.^{26,27} Covinsky et al.²⁶ therefore argued that prognostic and case-mix adjustment methods may be improved if they include measures of functional status. The patient's subjective health perception is also frequently discussed in the literature. This variable may complement the objective indicators for severity of illness and the clinical views on the patient's health status. Subjective poor health rating is related to chronic disease and especially to having multiple conditions.²⁸ As an outcome measure, patient-rated health is used in the SF-36.^{29,30} This variable is also found to be a risk factor for repeated hospital admission in elderly patients.¹⁷ In future, it may be worthwhile to expand this single-item concept to a more elaborate multidimensional health status assessment.³¹ Although the inclusion of malignancy and unplanned admission are somewhat more difficult to interpret because of large cross-national differences on these variables, a few conclusions about their results can be made. First, in contrast to unplanned admissions, there are many patients with planned admissions who can no longer stay at home because of their somatic illness and/or their psychological or social constellation. In addition, the acuity of the problems of unplanned admissions require a fast diagnostic process involving many tests; whereas in planned admissions the reason for admission has already been determined. With respect to patients suffering from an active malignancy, the reason for their admission to a general internal ward may be a severe complication to their condition, resulting in complex care needs during their hospital stay.

A limitation of this study regarding the use of subjective ratings of care complexity by the physicians and nurses should be mentioned. For the nurses, only seldom did the same nurse perform both the discharge ratings and the complexity of care predictions; however, for the doctors, the admitting physician was also generally the discharging physician. However, because the same person made both the original care prediction as well as the discharge rating, the discharge rating may have been biased by this. But since the predictive power of the physicians' ratings was only slightly higher than that of the nurses' ratings, if there was a bias, it was very small.

It is important to know the admission risk factors for care complexity. These risk factors enable the formulation of an admission risk screening procedure for patients admitted to general internal medicine so that a standardized admission procedure to special kinds of wards, such as a psychiatric or geriatric ward within the general hospital, can be established. In addition, standardized referral procedures to consultation services can be developed based on these risk factors. Although the effectiveness of many interventions directed at care for complex patients has been proved, care for complex patients is still often based on ad hoc decisions and underestimates the clinical problem. For research purposes, admission risk screening may prove important for patient selection in intervention studies. Our study shows the relevant foci of attention in developing an admission risk screening instrument, the most important being the predictions made by doctors and nurses at a patient's admission.¹¹

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