COMPRI—An Instrument to Detect Patients With Complex Care Needs

Results From a European Study

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The authors developed a screening instrument to detect patients in need of complex care coordination at admission to a general hospital. On the basis of a series of risk factors for care complexity, the authors constructed a short, care complexity prediction instrument (COMPRI) and assessed its qualities. The COMPRI is an easily administered screening instrument that detects patients at risk for complex care needs for whom care coordination is indicated. COMPRI's predictive power exceeds all currently available case-mix instruments.

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Health care providers have an interest in identifying patients who are using a disproportionate share of health care resources. Among the most frequently noted characteristics of these patients are having one or more chronic diseases,[1] suffering from psychiatric disturbances,[2–5] and being elderly.[6–7] Future health care delivery will be increasingly complicated because the population of these patients will continue to grow. A growing body of evidence demonstrates the effectiveness of interdisciplinary treatment and referral of these complex patients to medical and paramedical specialists.[8–11] However, effective interdisciplinary treatment and referral requires early detection of patients in need of complex care coordination and case management.

In the psychiatric literature, care complexity is only scarcely mentioned, and no standardized instruments are available to detect patients at risk of requiring complex care during a hospital stay. Screening instruments for other pa-

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tient characteristics requiring management do exist. Studies have consistently demonstrated an association between psychiatric comorbidity and health care use, and several screening instruments focusing on comorbidity have been developed.[12–15] Researchers in geriatric psychiatry, for example, have focused on age, functional status, and diminished cognitive capacity as predictors of functional decline.[15–17] Winograd et al.[7] used the concept of frailty to identify elderly patients who require complicated health care delivery. On the basis of fixed criteria, Winograd et al.[7] determined at admission the level of frailty of a group of elderly medical inpatients. The level of frailty was related to length of stay (LOS), nursing home placement after discharge, and mortality. Other researchers examined risk factors for complexity[18] and demonstrated the importance of detecting patients who required complex nursing care.[19] Bostrom[20] demonstrated that the amount of nursing care needed on the first day of a patient's admission was predictive of the total nursing care needed during the entire hospital stay. Social work research has focused on identifying patients at admission who will require social work services, such as discharge planning.[21,22] However, a standardized and integrated screening instrument for identifying patients who will require complicated medical care is still lacking.

In previous reports,[23–25] we proposed a two-phase model of measuring care complexity and related interdisciplinary health risks and needs (INTERMED). We also developed a model to measure care complexity[27] by means of 10 complexity indicators measured at the end of the hospitalization, based both on objective and on subjective data. We also identified 13 risk factors that predict increased medical needs during hospitalization.[28] These factors include physician, nurse, and patient ratings and admission data. In this study, we describe and assess the predictive reliability of our screening instrument, the COMPRI (Complexity Prediction Instrument), which is based on these risk factors. We focus on three aspects of the COMPRI: 1) the need for weighing individual items, 2) the specification of cutoff points to develop easy to score yes/no items, and 3) the generalizability of the instrument. The need for weighing individual items is based on the finding that clinical predictions had higher standardized regression weights in the regression functions.[28] Focusing on ease of use and generalizability will enhance the COMPRI's clinical usefulness because it can be scored easily without too much interpretation and it can be used in a variety of different hospitals.

METHODS

Design

This study was part of the Biomed1 Risk Factor Study,[24,26] the main goal of which was to improve detection and treatment of patients with combined medical and psychiatric problems. The study had a cohort design: patients were included in the study at their admission to the hospital and followed through their hospital stay until discharge. At admission, a physician and a nurse made a series of patient ratings about severity of illness and predictions of care complexity. During the hospital stay, an extensive structured patient interview was conducted within the first 3 days of admission 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.

Sample

Patients were admitted consecutively to one of 11 general internal medical wards from 7 European countries during 1996 and 1997. Patients were included if they were admitted directly (not through another ward or hospital) and stayed at least one night. Patients who could not be interviewed because of 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). A description of the sample is given in Table 1.

The reduction in the number of participants (1,422/2,158 = 66%) is due to patients for whom at least one of the items was scored "do not know." These items were rescored as a missing value on the COMPRI score. Table 1 shows, however, that this rescoring did not result in any major differences from the original sample.[27,28]

TABLE 1. Demographic data of the sample ($N = 1,422$)

Sex, men, n (%)	526 (37%)
Age, mean ± SD	62.1 ± 17.2
Length of stay, mean ± SD	11.3 ± 10.6
Planned admissions, n (%)	399 (28%)
Admitted from home, n (%)	934 (66%)
Discharged to home, n (%)	904 (64%)

Variables

The list of 13 risk factors, which are discussed in a previous study,[28] was linked to 10 care complexity indicators: 6 objective indicators and 4 subjective indicators.

The six objective indicators were the following: 1) length of stay (LOS), 2) number of days with laboratory tests, 3) number of days with diagnostic procedures, 4) medications, 5) number of consultations by medical and paramedical specialists, and 6) number of nonstandard nurse interventions.[27] The four subjective indicators were based on a Principal Components Analysis of 14 four-point scales rated by doctors and nurses at the patient's discharge. 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). Nurse care complexity was the sum score of two items scored by the nurse: complexity of nursing care and complexity of the organization of care (potential score range = 2–8). Mental health complexity 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 scored by the doctor and three by the nurse, addressing anticipated postdischarge limitations in functional status, need for long-term medical care, and need for support after discharge (potential score range = 6–22).

Data Analysis

Pearson correlation coefficients were calculated between the sum of the 13 equally weighted items, which for this purpose were *Z*-transformed (scores subtracted by their mean score and divided by the standard deviation) and the 10 care complexity indicators. The objective care complexity indicators were all natural logarithmically transformed to obtain approximately normal distributions. In addition, two alternative scoring systems were tested: one in which the scores on the clinical prediction were doubled and one in which these scores were tripled. The correlations resulting from the three scoring systems were then compared. Cutoff points per items were studied with Pearson correlation coefficients between the sum of the items and the 10 care complexity indicators to determine if cutoff points could be specified without losing too much of the predictive value of the instrument. Stability across settings was studied by calculating for each national sample separately the correlation coefficients between the sum of the items and the 10 complexity indicators.

RESULTS

Table 2 shows the Pearson correlations between the unweighted and weighted sums of the 13 items with the 10 care complexity indicators. Square roots of the proportion-explained variances by the optimal combination of items from the regression function were added to the table to show an estimation of the loss of predictive power. Simple addition of the items caused a loss of predictive power compared to the optimal solutions found in the regression models. The loss of predictive power was not very high, however, when the clinical predictions received double weights (reduction in the correlation coefficients = 0.10, range = –0.01 to 0.17). Because the correlations with postdischarge care needs and medications became lower when the clinical predictions received a weight of 3, we chose to continue the analyses with a weight of 2 points for the clinical predictions.

Next, we investigated the tenability of cutoff points per item. First, for three items no cutoff point needed to be specified because there were only two answering categories [planned admission (yes/no), currently active malignancy (yes/no), and retired (yes/no)]. Of the remaining 11 variables, answering categories were based on clarity considerations (e.g., expectation of mental health problems: no vs. mild, moderate, or severe) or chosen so that two groups of patients were constructed with more or less equal numbers (e.g., number of medications taken the day prior to admission 0–3 vs. >3). Thus, a risk score was calculated consisting of 1 point for every positively rated score and 2 for each positively rated clinical expectation, leading to a scale theoretically from 0 to 19. Table 3 shows Pearson correlations of the risk score with the 10 complexity indicators for the total sample and each of the national samples.

With respect to the total sample, Table 3 shows that as the correlations are only slightly lower than in Table 2, so not much predictive power is lost because of the specification of cutoff points. On a national level, consistent results were found, with only 6 of 70 correlations not significantly positive. To give an indication of the potential use of the instrument, Table 4 gives the mean ± SD of the complexity indicators at different scores of the instrument. With a few exceptions, the means of the care complexity indicators steadily get higher with the risk score.

DISCUSSION

In this study, we hypothesized that the 13 risk factors for complexity we found previously could be used to construct a screening instrument that could easily be scored at a patient's admission to an internal medicine ward of a general hospital. We found that a relatively simple weighing procedure in which the six clinical predictions are given a weight of 2 can be applied to the items without losing much of the predictive power of the individual items. Similarly, recoding the items into binary (yes/no) values does not greatly reduce predictive validity. These easily calculated risk scores are related to all of the 10 care complexity indicators that we identified in the total sample and in national subsamples, with only a few exceptions.

We believe that a screening instrument based on these findings, which we call "COMPRI" (COMplexity PRediction Instrument, Figure 1), will be useful both in clinical and research work. Possible clinical applications include standardizing the screening procedure for the admission to a specialty ward, such as a psychiatric or geriatric ward within a general hospital, and standardizing the indication for multidimensional assessment of health care needs, such as within the INTERMED and the related referrals to consultation services and interdisciplinary care coordination. In addition to general internal medicine wards, where the instrument was developed, neurological or surgical departments might also find this instrument useful, where a relatively high proportion of psychiatric comorbidity is seen. Risk screening for care complexity could also be extended to ambulatory care, although some items would have to be adjusted and additional items considered. This instrument could also be developed for planning purposes, leading to a more efficient use of hospital beds and nursing capacity. For example, hospital admission procedures could make distinctions between short- and long-term stay

TABLE 2. Pearson correlations of three risk scores and the optimal combination of items with 10 complexity indicators

	Optimal Combination of Items*	Sum of Unweighted Items	Sum of Weighted Items (Clinical Predictions 2)*	Sum of Weighted Items (Clinical Predictions 3)*
Length of stay**	0.62	0.44	0.49	0.5
Medical complexity	0.52	0.44	0.48	0.49
Nurse complexity	0.54	0.51	0.53	0.52
Postdischarge care needs	0.63	0.52	0.5	0.48
Mental health problems	0.55	0.41	0.44	0.45
Days with diagnostic tests**	0.51	0.26	0.34	0.36
Days with laboratory tests**	0.51	0.35	0.38	0.38
Medications**	0.51	0.41	0.39	0.37
Consultations**	0.52	0.35	0.42	0.44
Additional nurse care interventions**	0.44	0.44	0.45	0.45

*The correlation is based on the regression functions reported in de Jonge et al.[27] with fixed regression weights in the validation sample. ** Based on natural logarithmic transformations in order to achieve approximately normal distributions.

TABLE 3. Correlations between the risk scores and the complexity indicators for the total sample and the national samples

	Spain**	Italy**	Hungary**	Netherlands**	Portugal**	Germany**	Denmark**	Total**
LOS*	0.57	0.36	0.45	0.55	0.52	0.40	0.38	0.47
Medical complexity	0.55	0.36	0.45	0.38	0.38	0.34	0.20	0.46
Nurse complexity	0.56	0.51	0.63	0.24	0.37	0.38	0.29	0.49
Postdischarge care needs	0.44	0.51	0.56	0.33	0.61	0.43	0.46	0.47
Mental health problems	0.57	0.33	0.59	0.25	0.04***	0.26	0.24	0.40
Days with diagnostic tests*	0.42	0.10***	0.09***	0.35	0.42	0.29	0.21	0.35
Days with laboratory tests*	0.43	0.31	0.07***	0.43	0.25***	0.33	0.29	0.35
Medications*	0.30	0.38	0.22	0.54	0.57	0.41	0.36	0.38
Consultations*	0.30	0.21	0.38	0.41	0.00***	0.19	0.27	0.40
Additional nurse care interventions*	0.32	0.45	0.29	0.30	0.55	0.41	0.16	0.44

*Based on natural logarithmic transformations in order to achieve approximately normal distributions. ** For a description of the samples see de Jonge.[26] The national samples had the following numbers of complete cases (Spain: 146; Italy: 256; Hungary: 343; Netherlands: 93; Portugal: 48; Germany: 366; Denmark: 170; Total: 1,422. *** Not significant $\alpha = 0.05$

TABLE 4. Mean complexity indicators at different COMPRI Scores

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Patients, *n*	30	99	136	134	135	137	136	132	113	105	90	43	53	37	18	12	9	3	—
LOS	4.6±4.0	5.7±4.2	6.6±5.4	7.9±7.8	8.0±5.6	10.0±7.0	10.3±7.3	13.8±12.7	15.1±10.6	15.4±10.6	16.2±12.2	16.2±9.7	18.9±21.1	14.2±7.7	14.4±10.4	17.4±5.8	18.8±7.4	11.7±0.6	—
Days with laboratory tests	2.5±2.3	2.6±1.7	3.2±2.3	3.8±3.4	4.1±3.2	4.2±3.3	4.6±3.6	6.0±6.7	6.8±6.1	5.8±6.0	7.0±6.2	8.4±6.0	7.4±8.3	6.4±4.2	4.8±3.8	10.3±5.5	8.7±7.4	3.7±4.7	—
Days with diagnostic tests	2.5±1.7	2.5±2.1	2.9±2.5	2.6±2.7	3.7±2.7	3.4±2.3	4.2±3.4	5.0±3.5	4.9±4.9	4.9±4.9	5.5±4.2	5.5±4.4	5.2±4.4	5.4±4.4	4.1±3.9	8.8±4.9	6.4±5.2	6.7±0.6	—
Medications	3.7±3.9	3.9±2.8	5.8±4.2	6.8±3.3	7.2±7.3	7.2±4.0	8.4±5.2	10.0±5.5	8.5±4.7	8.5±4.7	10.4±6.2	11.3±8.0	11.1±6.3	11.5±11.7	8.5±7.0	13.6±5.2	10.0±3.7	8.0±2.0	—
Consultations	1.9±2.8	1.6±2.9	1.4±2.5	2.0±3.4	1.8±3.0	3.7±4.3	4.4±5.4	5.2±6.2	5.9±10.5	5.9±10.5	6.6±6.3	5.7±5.1	6.7±6.6	6.4±6.2	4.1±3.6	9.4±7.6	6.0±6.10	15.3±1.2	—
Additional nurse care	3.2±10.7	4.7±7.7	4.4±6.7	6.4±11.6	6.4±9.9	8.7±11.8	10.9±12.7	14.1±17.5	18.1±22.0	17.5±18.0	19.4±18.4	30.1±33.3	26.6±33.1	23.1±19.6	25.1±23.7	54.1±30.6	35.1±48.1	20.7±18.5	—
Medical complexity	2.7±1.1	2.7±1.3	2.6±1.1	2.9±1.4	3.0±1.3	3.4±1.5	3.4±1.5	3.8±1.7	4.2±1.7	4.3±1.8	4.6±1.6	4.7±1.8	4.7±1.7	4.9±1.4	4.9±1.8	6.0±1.2	6.1±1.5	5.3±3.1	—
Nurse complexity	2.5±1.1	2.5±1.1	2.7±1.2	2.7±1.1	3.0±1.4	3.0±1.2	3.1±1.4	3.6±1.7	3.9±1.5	3.6±1.6	4.7±1.5	4.7±1.5	4.6±1.7	4.9±1.8	5.3±1.5	6.0±1.3	6.1±1.8	6.7±0.6	—
Mental health problems	4.8±1.6	4.9±1.4	4.9±1.7	4.5±1.1	5.2±2.1	5.1±1.8	5.5±2.3	5.7±2.3	6.1±2.3	5.7±2.1	7.2±2.9	6.8±2.6	6.9±2.5	7.3±2.2	9.5±3.4	9.8±3.1	10.0±3.4	10.7±2.5	—
Post-discharge care	11.1±3.3	10.8±2.6	11.3±3.0	11.7±2.7	12.4±2.9	12.3±3.0	12.7±3.0	13.3±3.5	14.3±2.5	14.1±3.9	15.2±3.9	15.1±3.6	15.8±3.3	15.2±3.6	18.0±2.9	18.2±2.7	19.0±2.5	18.3±3.6	—

Note: Values are means ± SD unless otherwise noted.

wards or discharge units to which patients are referred based on their COMPRI scores. One possible research application of the COMPRI is to identify complex patient groups that could benefit from interventions aimed at reducing care complexity through integrated longitudinal coordinated care, including case management. As mentioned, specific cutoff points would then have to be formulated, depending on local circumstances such as case mix, available manpower, and the nature of the intervention.

Whether used in clinical or research work, after assessment with the COMPRI, care needs assessment should follow to plan interdisciplinary integrated treatment for patients with complex care needs, such as by means of the INTERMED.[29–35]

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FIGURE 1. Complexity Prediction Instrument (COMPRI)

Predictions Made by the Doctor

Do you expect this patient to have a hospital stay of 2 weeks or more?	Yes	No
Do you think the organization of care during hospital stay will be complex?	Yes	No
Do you expect that this patient's mental health will be disturbed during this hospital stay?	Yes	No

Predictions Made by the Nurse

Do you expect this patient to have a hospital stay of 2 weeks or more?	Yes	No
Do you think the organization of care during hospital stay will be complex?	Yes	No
Do you think this patient will be limited in activities of daily living after discharge?	Yes	No

Additional Questions

Is this an unplanned admission?	Yes	No
Is the patient retired?	Yes	No
Is the patient known to have a currently active malignancy?	Yes	No
Did the patient		
have walking difficulties during the last 3 months?	Yes	No
have a negative health perception during the last week?	Yes	No
have more than 6 doctor visits during the last three months?	Yes	No
take more than three different kinds of medications the day prior to admission?	Yes	No

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