The 4 Score: An Index for Predicting A Patient's Non-medical Hospital Days

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Abstract: Three hundred sixty-three patients representing two groups of consecutive medical admissions to a large city hospital were evaluated on admission to determine what factors might predict "non-medical" or social stay. Periodic follow-up determined when patients were ready for discharge and when their social stay began. A composite index, *the 4-Score*, was derived as a simple indicator of risk for subsequent social stay; it is defined as the number of positive answers to the questions: 1) Is the patient 80 years old or more? 2) Will the patient have to live somewhere new at discharge? 3) Is there any disorientation? and 4) If so, is the disorientation chronic?

Eighteen per cent of the total inpatient hospital days of this group of patients could be attributed to social stay. The 56 patients with a 4-Score of two or more on admission had on average a week each of social stay while the 307 patients with a score of less than two averaged only one social day each. (Am. J. Public Health 67:751–755, 1977)

Introduction

The continued hospitalization of patients after their medical treatments have been completed represents a misutilization of a hospital's beds and a community's resources for health care. This subsequent period of hospitalization has been defined as the social stay and refers to that segment of the total hospital stay which is directly related to discharge difficulty rather than to medical need. Misutilization has been identified by many investigators and varies greatly in different settings. Rosenfeld[1] 20 years ago observed that 42 per cent of patients in four Boston hospitals with stays of 30 days or more required no active treatment. Van dyke[2] in New York City noted that 29 per cent of all patients were hospitalized 30 days or more and that, among these, 41 per cent did not really need further hospital care. Zimmer[3] used a panel of physicians to review utilization data from Strong Memorial Hospital and found either no need or an uncertain need for general hospital care accounting for 11.9 per cent of the inpatient medical days. Becker[4] claimed that 15 per cent of New York City hospital cases are "holdover patients" who are "Medicare rejects" for whom long-term facilities are not available and a spot check of 50 New York City hospitals in 1971 found 10 per cent of the beds to be occupied by such patients. Reasons for a prolonged social stay might include delay in seeking social service assistance, difficulty in finding or financing an appropriate nursing home placement, or ambiguity in a patient's or his family's desires for placement. Given current hospital bed-day charges, a prolonged social stay represents a considerable financial burden and a severe drain on a community's health resources.

Previous studies of bed misutilization indicate that it usually occurs near the end of the period of hospitalization.[1, 3, 4] Social workers, the principle discharge planners, are often referred patients late in their hospital stay so that hospitalization is needlessly prolonged. These observations support the feeling that early case finding and discharge planning among patients at risk of a long social stay could lead to less misutilization of hospital beds.[5, 6] Berkman and Rehr attempted a preliminary controlled trial of early case finding and were able to show that among patients brought to the attention of social workers on admission, those who ultimately needed help in seeking a placement were discharged 10 days sooner.[7] They were unable to identify adequate screening parameters based on the patient's age, sex, marital status, race, or religion.

Misutilization of hospital beds might be diminished if a screening instrument were available which could identify, at the time of admission, individuals at high risk of having a prolonged social stay. In an earlier report, we presented such an index, CAAST, based on the patient's status of Continence, Ambulation, Age, Social background and Thought.[8] This index was able to discriminate between a low CAAST

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group spending 7 per cent of its inpatient time in social days from a high CAAST group with 39 per cent. Other studies[9, 10] have suggested that useful prediction is not easily achieved. Because of this, and because there were only 107 patients in our earlier study, we have repeated it with a larger series of patients, asking more questions about each patient, and undertaking a more detailed analysis of the combined results.

Setting

The New York City Hospital Center at Elmhurst offered several advantages for this study. All medical patients are admitted through the emergency room, are cared for by the house staff, and have their dispositions planned by an active social work staff. The patients depend almost exclusively on hospital-based social services for arranging their placement at discharge. During the period of the study, neither the hospital nor the recipient nursing homes were filled to capacity. A physician at any time could refer his patient needing a nursing home placement to the social worker, who would arrange an appropriate disposition.

Methods

Two hundred and fifty-six consecutive admissions to the medical service at the City Hospital Center at Elmhurst were used for the present study. Their ward physicians were questioned within 48 hours of admission by two high school hospital volunteers who recorded the patient's demographic characteristics, chief complaint, admitting diagnoses, and other data on an introductory questionnaire. Emphasis was placed on questions which we felt would relate to the difficulty of discharge and be simple and straightforward to assess by the house staff. This included the patients' form of hospital payment, mental status, ability to ambulate and to perform routine activities of daily living, and planned placement at discharge.

Definitions

A *change in mental status* was defined as any disorientation of time, place, or person or inability to perform simple intellectual tasks, as long as it was of more than two days duration. A *chronic* change in mental status meant the presence of a significant organic mental syndrome for more than one month with an inability to engage in a meaningful conversation or to be alert to time and place. *Ambulation* was scored according to the patients' best potential prior to admission (full ambulatory, ambulatory with assistance only, and non-ambulatory). *Activities of daily living* (ADL) including grooming, feeding and bathroom care were graded according to the patient's ability to function alone, with some help or with complete assistance. The need for a *change of residence on discharge* was assessed at the time of admission by asking the family and, if mentally competent, the patient, whether the patient must seek a new residence at discharge. If the patient was planning to return home, a subjective assessment of the presence or absence of home support was also made.

The house staff members were queried twice a week to determine the patients' progress by two different observers (RG, DB) who were blinded from the registration data on the patient. The responsible house officer was asked to state when he considered his patient medically fit for discharge from the medical floor. Subsequent in-hospital days were recorded as social stay and any factors which might be responsible for the delay in discharge were noted.

Inter-observer bias in recording information on the initial questionnaire and in the follow-up data was tested and found to be negligible. Patients who died during their hospital stay were considered to have had no social stay.

Results

The 256 patients enrolled in this second study were 51 per cent male and had a mean age of 60 years. There were 33 hospital deaths and 2,963 total hospital days. Forty-four patients had some social stay, accumulating among them a total of 602 social days. "Social days" thus constituted 20 per cent of all hospital days. There were no significant differences in either length of stay or social days recorded among the four medical wards or the 12 physician teams.

Five variables were evaluated as predictors of social stay: age, activities of daily living, change of residence, mental status, and ambulatory status (Figure 1). "Form of payment" was not evaluated because in 85 per cent of our cases, the doctors were unfamiliar with this information. Ambulation, as in the first study, failed to demonstrate a step-wise relationship with social days. The predictive ability of the "activities of daily living" information could be explained away by the large degree of correlation with age, change of residence, and mental status. A new index to predict social stay, the 4-Score, was derived by simplifying the significant results from Figure 1 (see Figure 2). This index is scored as the number of positive responses to the following questions referred to later as elements of the 4-Score index: 1) Is the patient 80 years old or more? 2) Will the patient live somewhere new upon discharge? 3) Is the patient in any way disoriented? 4) If so, is this disorientation chronic?

When all the elements of the 4-Score index are included in a multiple regression model for predicting the number of social days, the best predictive model gives each of the elements of the index approximately equal weight. Further multiple regression analysis using social days scored from 0–3 corresponding to 0, 1–6, 7–13, and 14 or more social days respectively, confirmed that the 4-Score was of considerable help (correlation coefficient = 0.46, $P < .001$) in predicting the duration of social stay. No other weighted combination of these four elements was significantly better than the 4-Score. Examination of the predictive capacity of all other factors we measured (activities of daily living, ambulation, ethnicity, sex) failed to significantly improve our ability to predict the length of social stay beyond the simple 4-Score. Because the simplified 4-Score is based on information which is also available from the original study of 107 patients, those data have also been included in subsequent tabulations in the present paper.

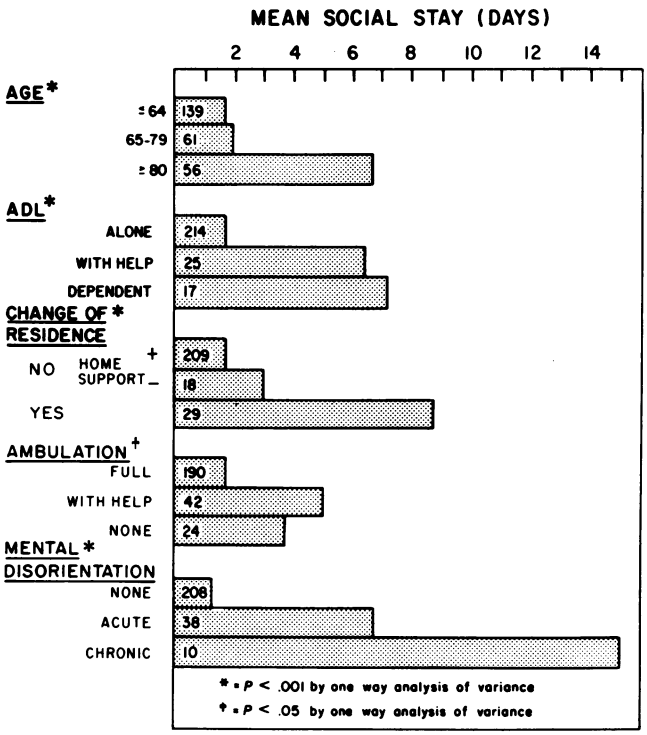

FIGURE 1—Ability of All Parameters to Predict Social Stay.

The 4-Score is strongly associated with social stay (Table 1). Patients with a low 4-Score less frequently experienced a social stay, and when they did that social stay was usually of shorter duration. The index is also associated with mortality and total hospital stay (Table 2). The prolonged hospital stay of patients with a high 4-Score is due to their extended social stay rather than to any difference in their need for medical attention. Although 18 per cent of the total hospital days in this study were for non-medical reasons, patients with a high 4-Score spent 54 per cent of their inpatient time in social stay.

How well does the 4-Score identify the medical patient at high risk of having a prolonged social stay? Choosing a score of two or more would correctly identify 36 per cent (26/72) of all patients who have some social stay (sensitivity) while correctly rejecting 90 per cent (261/291) of all patients who have none (specificity). A 4-Score of one or more would be 61 per cent (44/72) sensitive and 71 per cent (206/291) specific (Table 1). A patient who on admission recorded a score of two or more would have a 46 per cent (26/56) chance of having some social stay. The average social stay among these 26 was 17 days.

Discussion

The misutilization of hospital beds for social stay is an expensive drain on a community's financial and health resources. The large proportion of time spent for social stay in this study should provide an incentive to investigate similar situations in other hospital settings. Moreover, the development of a simple and effective screening instrument, the 4-Score, and a means of estimating an undesirable outcome, i.e. social stay, allows for experimentation with a number of interventions to diminish the extent of this misutilization of hospital beds in the future.

In this study, the impact of prolonged social stay is most simply expressed in terms of an estimated cost of $200 per day for a municipal hospital bed in New York City. While this may not reflect the true value of the care received, it indicates the economic order of magnitude of the misutilization problem. While the sensitivity and specificity of the 4-Score remain to be improved, the 56 patients with a score of two or more on admission had on average about a week of social stay, at a cost of $1400 each, while the 307 patients with a 4-Score of less than two had on average only one day of social stay.

The determination of social stay like other measures of misutilization requires that a medical judgment be rendered regarding the appropriateness of the patient remaining in an acute hospital setting. This judgment is tempered by the doctor's feeling for the patient and his illness, and the demand made for hospital beds. In this study, the resident physician was asked to determine when his patient was medically fit for discharge from the acute medical floor. This was an individual decision tempered by the acceptable practice in a university-affiliated city hospital in which the medical wards were never fully occupied and which had no private attending staff in medicine. The goal of the study was not known to the house staff and the question regarding time of discharge was asked in association with other information on the progress of the patient's workup. We would expect some reasonable variation between physicians and their determination of social stay, but analysis of this variation revealed no differences between doctors which were significant. A systematic bias for

TABLE 1—Social Stay by 4-Score Groups

		SOCIAL DAYS									
		0		1-6 days		7-13 days		14+ days		Total	
		N	%	N	%	N	%	N	%	N	%
4-Score	0	206	88	16	7	10	4	2	1	234	100
	1	55	76	8	11	4	5	6	8	73	100
	2	22	64	4	11	4	11	5	14	35	100
	3/4	8	38	5	24	1	5	7	33	21	100
Total		291	80	33	9	19	5	20	6	363	100

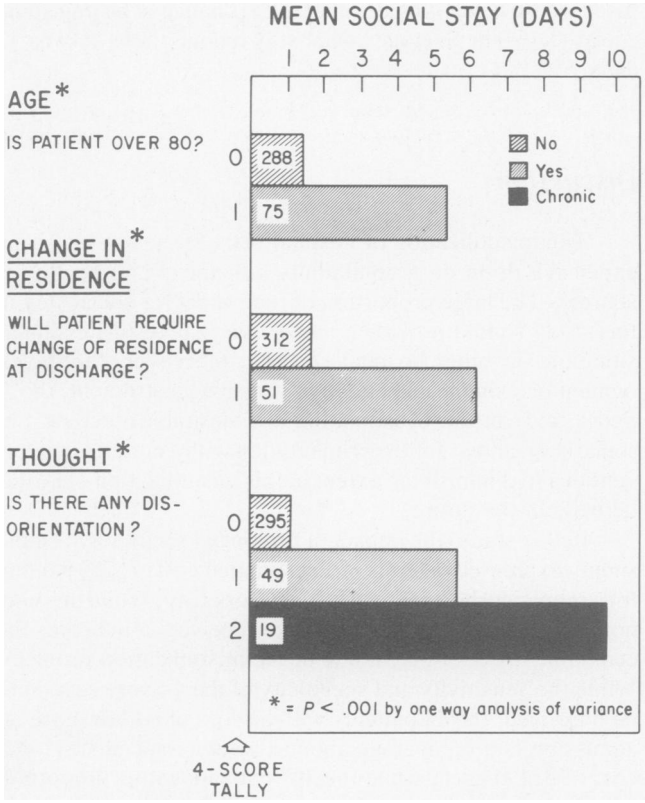

FIGURE 2—Ability of Individual 4-Score Parameters to Predict Social Stay.

underreporting social days would magnify the extent of the problem. Slight overreporting might have occurred but our data were consistent with other values reported in the literature. We did identify an unexpected confounding factor between our original series of 107 patients entering the hospital in August and the second series of 256 patients entering in May. House staff changes routinely occur in late June, and an "end-of-the-year effect" was observed whereby patients who were not discharged by mid-June were left on the wards to have their discharge planned by the new team of physicians. Social days in the initial study of 107 patients represented 14 per cent of total hospital days of patients entering the hospital in August, while in the second series which entered in May, the comparable figure was 20 per cent.

The 4-Score is an effective index in the setting studied. It is simple enough so that unskilled volunteers can identify high risk patients in an emergency room and could then alert and involve the social worker in earlier discharge planning without the doctor's belated approval in the pre-discharge period. The predictive value of the 4-Score may be no better than the clinical judgment of a social worker or clinician attuned to the problem of prolonged social stays. The problem of non-medical hospitalization will vary between hospitals and between different services so that the elements of a predictive index will need to be modified accordingly. Nonetheless, the approach illustrated in the present study is straightforward and the ability to submit early intervention to controlled trial remains to be tested.

Implicit in the notion of social stay is the feeling that medical care must be partitioned between an acute medical ward and intermediate care and non-medical facilities. The relative ease of securing a hospital bed in New York City when compared to alternate facilities and arrangements has been outlined by Cantor and Meyer.[4] Often the hospital becomes the expensive holding area for the nursing home or the home care program. At other times, delay in securing financial support for extended care facilities prolongs in-hospital stay. To counteract these situations, Goldberg and Holloway have suggested that the process of hospital utilization review take into account whether a patient needs an acute care hospital or a nursing home rather than merely his length of stay.[11] They feel that the critical question should be: "Do the type, number, and/or intensity of the combination of physician, skilled nursing, and ancillary services being received by this patient require a continued hospital location?"

The 4-Score is a simpler and slightly more accurate predictor of social stay than our previous CASST index. It remains to be tested in different hospital settings. Practical application in a routine situation could help determine whether earlier social service referral following identification of high risk patients using our 4-Score will appreciably decrease unnecessary hospital stay. Likewise, a more detailed analysis of the reasons for a prolonged social stay might further our understanding of this costly problem.

REFERENCES

1. Rosenfeld, L. S., Goldmann, F. and Naprio, L. A. Reasons for prolonged hospital stay. J Chronic Dis 6:141–152, 1957.
2. Van Dyke, F., Brown, V. and Thom, A. "Long Stay" Hospital Care. The Department of Hospitals of the City of New York, 1963.

TABLE 2—Summary Report

		N	Death* Rate (%)	Mean Hospital Stay*	Mean Social Stay*	Mean Medical Stay	Percent of Time in Social Stay*
4-Score	0	234	3.8	10.8	0.8	10.0	7.3
	1	73	21.9	13.3	2.9	10.4	22.1
	2	35	31.4	13.4	4.9	8.5	36.2
	3/4	21	38.1	20.6	11.4	9.2	55.4
	Total	363	12.1	12.1	2.2	9.9	18.4

*$p < 0.001$ for trend.

3. Zimmer, J. G. Length of stay and hospital bed misutilization. Med Care 12:453–462, 1974.
4. Cantor, M. and Mayer, M. The Health Crises of Older New Yorkers; Facts for Action. New York City Office for the Aging 4:45–46, 1972.
5. Berkman, B. G. and Rehr, H. The "sick-role" cycle and the timing of social work intervention. Soc Ser Rev 46:567–580, 1972a.
6. Berkman, B. G. and Rehr, H. Social needs of the hospitalized elderly: A classification. Soc Work 17:80–88, 1972b.
7. Berkman, B. G. and Rehr, H. Early social service case finding for hospitalized patients: An experiment. Soc Ser Rev 47:256–265, 1973.
8. Glass, R. I. and Weiner, M. S. Seeking a social disposition for the medical patient: CAAST, A simple and objective clinical index. Med Care 14:637–641, 1976.
9. Berkman, B. G. and Rehr, H. The search for early indicators of social service need among elderly hospital patients. J Am Geriatr Soc 22:416–421, 1974.
10. Posner, Jr. and Lin, H. W. Effects of age on length of hospital stay in a low-income population. Med Care 13:855–875, 1975.
11. Goldberg, G. D. and Holloway, D. C. Emphasizing "level of care" over "length of stay" in hospital utilization review. Med Care 13:474–485, 1975.

Ill Fares the Land to Hast'ning Ills a Prey*

Our 200th anniversary was a memorable year,
It would be unbelievable, if one hadn't been here;
The celebrations have all ended and yet,
There were unhappy incidents we should not forget;
The continuous threats of developing cancer
Had people as jittery as a high-wire dancer;
The American Legion was badly shaken
By a mystery disease—many lives were taken;
Government experts ran off the line
Predicting epidemics of influenza of swine;
The public, God bless 'em, took the vaccine
Until cases of paralysis appeared on the scene;
Our water and air were a continual threat
From oil, ketone, asbestos, and even carbon tet;
Older people were not safe from strokes or occlusion
Low fat diets with jogging added to the confusion;
Television ads were lurid and disgustingly crass
With loose dentures, insomnia, constipation, and gas;
Present dangers to health cause distressful unease
But new perils threaten such as Lassa fever and Marburg disease;
May our third century bring a growth of real wealth
Unassociated, one hopes, by more menaces to health!

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*Oliver Goldsmith, "The Deserted Village"