Reduced Mortality in Treating Acutely Sick, Frail Older Patients in a Geriatric Evaluation and Management Unit. A Prospective Randomized Trial

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OBJECTIVES: Documentation of treatment effects in acutely sick frail older patients in geriatric evaluation and management units (GEMUs) is scarce. The present study evaluated whether treatment in a GEMU would reduce mortality as compared to traditional treatment delivered in the Department of Internal Medicine.

DESIGN: Prospective randomized trial.

SETTING: GEMU or general medical ward

PARTICIPANTS: Acutely sick frail patients aged 75 and older who had been admitted to the Department of Internal Medicine were randomly assigned to treatment in the GEMU (n = 127) or to the general medical wards (n = 127). The following inclusion criteria were used to target frail patients: chronic disability, acute impairment of single activity of daily living, mild/moderate dementia, confusion, depression, imbalance/dizziness, falls, impaired mobility, urinary incontinence, malnutrition, polypharmacy, vision or hearing impairment, social problems, or prolonged bedrest.

INTERVENTION: In the GEMU, the treatment strategy emphasized interdisciplinary assessment of all relevant disorders, prevention of complications and iatrogenic conditions, early mobilization/rehabilitation, and comprehensive discharge planning. The control group received treatment as usual from the Department of Internal Medicine. After discharge neither group received specific follow-up.

MEASUREMENTS: Mortality and causes of death.

RESULTS: Mortality in the intervention and control groups, respectively, was 12% and 27% at 3 months (P = .004), 16% and 29% (P = .02) at 6 months, and 28% and 34% (P = .06) at 12 months. The hazard ratio was 0.39 (95% confidence interval = 0.21–0.72) at 3 months. The main cause of death was cardiovascular disease.

CONCLUSION: Treatment of acutely sick, frail, older patients in a GEMU substantially reduced mortality. **J Am Geriatr Soc 50:792–798, 2002.**

Key words: geriatrics; acute care; frail; hospital; mortality

In frail older patients, hospitalization due to acute illness is often associated with chronic functional decline, which can lead to nursing home placement or death.[1] Although this could be an inevitable consequence of the illness itself, elements of the hospital stay itself might contribute as well.[2,3] Our hospital wards are frequently overcrowded, with a high turnover of patients and short duration of stay, and there is a tendency to focus on a single diagnosis or disease. Older patients often have several comorbid diseases and thus might experience underdiagnosis, iatrogenic conditions, and functional deterioration while in the hospital.[1,3–5]

Correct diagnosis, treatment of all relevant diseases, and prevention of complications and further functional deterioration are all important and are fundamental to geriatric medicine. One way to meet the special needs of older patients in hospital is to establish geriatric evaluation and management units (GEMUs).[6]

Few randomized studies have been published on the effect of treatment in GEMUs.[7–13] These studies may be divided into two categories. First, there are studies including patients who were acutely ill, and, second, there are studies including patients in need of rehabilitation after their acute illness was stabilized.

In the first category, four studies have been published.[10–13] These controlled studies recruited patients from the emergency department, using age as the only selection criterion. No effect on survival was found.

In the second category, three studies have been published.[7–9] The study of Rubenstein et al. from a Veterans

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Affairs (VA) rehabilitation hospital showed a 50% reduction in 1-year mortality.[7] The study was criticized because less than 10% of those screened were eligible and there was doubt regarding the clinical applicability outside VA hospitals. In addition, there was discussion as to how much of the beneficial effect in the intervention group could be attributed to the GEMU as opposed to specialized follow-up in the geriatric medical outpatient clinic. In 1990, Applegate et al. reported a community-rehabilitation hospital-based study that recruited functionally impaired patients recovering from an acute medical or surgical disorder and being at risk of nursing home placement.[8] In 1995 Trentini et al. published a multicenter study of patients who had stayed in the hospital for more than 10 days and were considered at risk of losing self-sufficiency.[9] A reduction in 6-month mortality was found in both of these studies.

In a meta-analysis of the effect of geriatric intervention published in 1993, a reduction in 6-month mortality for patients treated in GEMUs was shown (odds ratio = 0.65; 95% confidence interval (CI) = 0.46–0.91).[14] Six studies of treatment in GEMUs were included.[7,8,11,15–17] Of these, one was published as an abstract in 1990.[17] Four were rehabilitation studies,[7,8,15,16] and the only one concerning acute medical diseases showed no effect on survival, as already mentioned.[11]

No randomized studies to evaluate the treatment of older patients selected for both frailty and acute disorder have been published. When a new GEMU was established in the Department of Internal Medicine in our hospital in 1994, it was decided to conduct a prospective, randomized, controlled study to evaluate treatment of acutely sick frail older patients who had been admitted to the department. Our primary hypothesis was that in this category of patients it would be possible to reduce mortality, increase health-related quality of life, and maintain functional capacity. The effect on mortality is presented in this article.

METHODS

The University Hospital of Trondheim serves as the regional hospital for central Norway and as the local hospital for about 200,000 inhabitants in the county of South Trøndelag, Norway. The Department of Internal Medicine comprises nine different sections with a total of 190 beds. Over 90% of all admissions are emergencies. In April 1994, a nine-bed GEMU was established as a section within the Department of Internal Medicine. Six months later the present study was begun. Patients were included between October 31, 1994, and November 13, 1995.

Patient Selection and Randomization

Patients from the city of Trondheim admitted acutely to the Department of Internal Medicine were screened for enrollment in the study. To target frail patients, Winograd et al.'s targeting criteria were applied.[18] These have been proven to predict patients most at risk of nursing home placement and death.[18,19] Eligible patients had to meet at least one of the targeting criteria shown in Table 1. Briefly, they should not be in need of specific treatment offered by the section to which they were already admitted and should be suitable for transfer to the GEMU. The intention was to recruit patients aged 75 and older. A few times there were no eligible patients at this age. Being part of a very busy department, the GEMU was not allowed to keep beds free to wait for patients. Therefore, five patients between the ages of 72 and 74 were included (two in the GEMU and three in the general medical ward (MW) group). Patients with acute stroke were only included if the Stroke Unit was full. Nursing home patients and those previously fully independent and who seemed to recover quickly from the acute illness were not included, nor were patients for whom discharge was planned within 3 days. Other exclusion criteria were cancer with metastasis, other disease with expected survival less than 6 months, and known severe dementia before admission to hospital.

One experienced study nurse screened and randomized 90% of the patients in the study; during her holidays, the project leader screened and randomized the remaining 10%. Suitable patients were screened when there was a free bed in the GEMU. Eligible patients who had been recently admitted to the department were preferred over those who had been there longer. Randomization was performed after patients had given their informed consent. An independent research office used permuted block randomization with unknown and varied block size to produce allocations that were kept in sealed, serially numbered opaque envelopes. All envelopes were opened in sequence after the patients had given their consent, with at least one independent witness present. During the study period, 254 patients were recruited and randomly allocated, 127 to the GEMU and 127 to continued treatment in the MW where they were already staying. Patients allocated to the GEMU were transferred on the day of inclusion (Figure 1). Patients from eight medical sections were included, 92 (36%) from the section of cardiology.

Patient Care During the Index Stay

The staff at the GEMU consisted of one geriatrician and one (occasionally two) resident. The number of nurses was comparable with that of the other MWs, although some of these nurses also had formal training in geriatric nursing. In addition, the GEMU had two occupational therapists and one physiotherapist. During the study period, a nurse was assigned to organize the study, recruit patients, and perform assessments during the index stay and follow-up. A social worker, a dentist, and other medical specialists were consulted when necessary. The physical environment in the GEMU was comparable with that in other MWs, apart from an additional combined dining/activity-room.

In the GEMU, comprehensive assessment of all relevant illnesses and disabilities was emphasized, as was prevention of complications and iatrogenic conditions. Some standard protocols for evaluation and treatment were made at the beginning of the study; others were made during the study period. An interdisciplinary approach was employed, with close collaboration between all disciplines involved. Meetings were arranged twice a week to report assessments, set goals, discuss problems, and plan discharge. Early mobilization, with encouragement to participate in activities of daily living (ADLs) and communal meals was instituted to avoid further functional decline. When necessary, relevant rehabilitation measures were initiated in the GEMU. If further rehabilitation was indi-

Table 1. Baseline Characteristics

Characteristic	GEMU (n = 127)	MW (n = 127)
Age, mean ± standard deviation	81.8 ± 4.8	82.4 ± 5.2
Female, n (%)	81 (64)	84 (66)
Widowed/living alone, n (%)	93 (73)	85 (67)
Residence at time of inclusion, n (%)		
Private home	115 (91)	110 (87)
Sheltered housing	12 (9)	17 (13)
Days in hospital before inclusion, median (interquartile range)	2 (1–5)	3 (1–6)
Previous diagnosis,* n (%)		
Heart disease	46 (36)	58 (46)
Infectious disease	30 (24)	21 (17)
Gastrointestinal disorder	27 (21)	22 (17)
Cerebrovascular disease	24 (19)	17 (13)
Endocrine disease	20 (16)	16 (13)
Airway disease	18 (14)	9 (7)
Cancer	15 (12)	12 (9)
Other	41 (32)	44 (35)
Targeting criteria, n (%)		
Acute impairment of single ADL	111 (87)	109 (86)
Imbalance, dizziness	110 (87)	108 (85)
Impaired mobility	54 (43)	59 (47)
Chronic disability	52 (41)	58 (46)
Weight loss	31 (24)	20 (16)
Falls during the last 3 months	30 (24)	32 (25)
Confusion	24 (19)	31 (24)
Vision or hearing impairment	22 (17)	28 (22)
Depression	21 (17)	24 (19)
Malnutrition	15 (12)	13 (10)
Mild or moderate dementia	14 (11)	18 (14)
Urinary incontinence	12 (9)	11 (9)
Social or family problems	10 (8)	7 (6)
Polypharmacy (≥5 drugs per day)	5 (4)	5 (4)
Prolonged bedrest	3 (2)	3 (2)
Number of targeting criteria per patient, median (interquartile range)	4 (3–5)	4 (3–5)

Note: None of the differences were statistically significant.
*Diagnoses at earlier admissions to the University Hospital of Trondheim.
GEMU = geriatric evaluation and management unit; MW = general medical ward; ADL = activity of daily living.

cated, patients were referred to specialist rehabilitation facilities (see Table 2).

Enrolled patients assigned to the MW were treated according to the general routines for the Department of Internal Medicine. Residents and specialists in internal medicine and different subspecialties (e.g., cardiology, pulmonary diseases, nephrology) were responsible for the care provided. Physiotherapy and occupational therapy were normally given when prescribed by the doctor, with each occupational therapist and physiotherapist serving several wards.

Patient Care During Follow-Up

The healthcare system in Norway is public. General practitioners (GPs) and home care nurses, in cooperation with occupational therapists and physiotherapists, are responsible for care in the community healthcare system. Care may be provided in patients' homes or in nursing homes.

In the GEMU, meetings were arranged to discuss necessary arrangements after discharge; patients, their family members, and representatives from the home services and the staff of the GEMU were invited. If necessary, an occupational therapist visited the patient at home to assess the need for adjustments. In the MW, home care nurses were telephoned to discuss arrangements after discharge if the hospital staff found it necessary.

After patients were discharged from the hospital, the GPs were responsible for the medical treatment of the patients in both groups.

Sources of Data

Information on baseline data was collected before randomization. Sociodemographic characteristics were obtained through interviews of patients and caregivers. Information about diagnoses and duration of stay was obtained from the University Hospital of Trondheim, which serves as the local hospital for all patients in the study. Information about the targeting criteria was collected through interviews of the patients, their caregivers, and nurses in the ward where the patients were admitted. Date and cause of death were recorded from death certificates. Sudden death

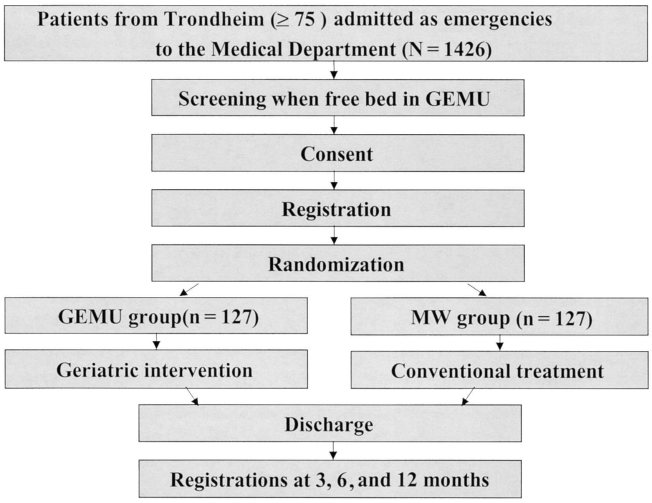

Figure 1. Flow of the study. GEMU = geriatric evaluation and management unit; MW = general medical ward.

from unknown cause was classified as cardiac death (three GEMU and four MW patients).

Sample Size and Statistical Analysis

An estimate of possible effect size was based upon literature review. Donaldson et al. conducted a study of mortality in relation to age and functional capacity and, in patients in acute and geriatric beds, found 1-year mortality of about 40% among those who had considerably reduced ADL scores and about 30% among those who had moderately reduced ADL scores.[20] In Rubenstein et al.'s study, a 50% reduction of 1-year mortality was achieved.[7] Based on these studies, the sample size required for our study was estimated.[21] If mortality was 30% in the MW, to detect a 50% reduction to 15% in the GEMU, with $\alpha = .05$ and power 80%, 113 patients would be required in each group. For an estimated mortality reduction from 40% to 20%, the sample size would be smaller. Thus it was decided to recruit at least 113 patients in each group over a 1-year period.

The Mann Whitney U-test was used for comparison of age, duration of hospital stay, and causes of death, because these data were not normally distributed. The chi-square test was used for comparison of gender, residence, marital status, previous diagnoses, and inclusion criteria. Kaplan Meier plots were used for the survival curves. The Breslow test was used for survival analysis during the first 12 months because of the special interest in early survival, and Fisher's Exact test was used for survival at 3 and 6 months. After checking the proportional hazards, Cox's proportional hazards model was used for analysis of hazard ratio (HR) and to adjust for covariates. A P-value $< .05$ was used as indication of statistical significance. For statistical analysis, SPSS version 10.0 for Windows was employed (SPSS Inc., Chicago, IL).

Ethics

Participation in the trial was voluntary and according to the Helsinki Declaration. Written informed consent was obtained from all patients except those who were not able to write, where an oral consent was accepted. If the patient was cognitively impaired, relatives also gave their written consent. The Regional Ethical Committee approved the protocol.

RESULTS

During the study period, there were 1,426 emergency admissions of patients aged 75 and older from the community of Trondheim. Two hundred fifty-four of these (18%) were allocated to the study. Five patients refused to participate.

The GEMU and MW groups were comparable with respect to all demographic and clinical characteristics at baseline (Table 1), as is to be expected if randomization was effective. Median duration of stay before inclusion in the study was 1 day longer in the MW group, $P = .09$. Duration of stay in hospital after inclusion was 15 days (interquartile range 11–26) in the GEMU versus 7 days (interquartile range 3–14) in the MW, $P < .001$. Median total

Table 2. Main Differences in Staff and Patient Approach

GEMU	General Medical Ward
Staff	
Some nurses with formal training in geriatric nursing*	Same number of nurses per bed as the GEMU†
One physician per 5 beds	One physician per 5–10 beds†
Two occupational therapists*	Part-time (50%) occupational therapist serving about 180 beds
One physiotherapist*	Five physiotherapists serving about 180 beds
Treatment	
Interdisciplinary assessment	Assessment mainly by doctors and nurses
All relevant disorders evaluated	Diseases precipitating the emergency admission were mainly treated
Prevention of iatrogenic conditions and complications	
Early mobilization and rehabilitation	
Early discharge planning in close collaboration with caregivers and home services	
Visit in patient's home if necessary	

*Also performing study-related assessments in both groups during index stay and follow-up.
†Number varied in different wards.
GEMU = geriatric evaluation and management unit.

length of stay for patients allocated to the GEMU was 19 days (interquartile range 13–30) and for those allocated to the MW 13 days (interquartile range 7–18), $P < .001$.

At discharge, 38% of the GEMU patients and 7% of the MW patients had psychiatric diagnoses (mainly dementia, depression, and delirium), $P < .001$. There were no statistically significant differences in distribution of the other diagnoses (Table 3). Patients in the GEMU group had a median of three diagnoses at discharge; in the MW group, the median was two, $P < .001$.

Mortality was reduced in the GEMU group during the first year of follow-up compared with the MW group (Figure 2). At 3 months, mortality was 12% in the GEMU group and 27% in the MW group, $P = .004$, at 6 months it was 16% and 29%, $P = .02$, and at 12 months it was 28% and 34%, $P = .06$. The reduction in mortality was greatest during the initial 3-month period (HR = 0.39, 95% CI = 0.21–0.72). Adjustment for age, history of heart disease, duration of stay in hospital before inclusion in the study, number of targeting criteria, and gender in a Cox proportional hazards model did not have any effect on HR during the first 3 months.

For both groups, there was a bend in the survival curve after about 2 months, with high initial mortality after the acute illness that caused hospital admission and lower mortality when the patient's condition stabilized. The curves came together at 18 months. After 2 years, approximately 50% of the patients were dead in both groups.

Heart disease was the major cause of death in both groups at both 3 and 12 months (Table 4). By 12 months, deaths from infections (mainly pneumonia) were more frequent in the GEMU group, $P = .04$.

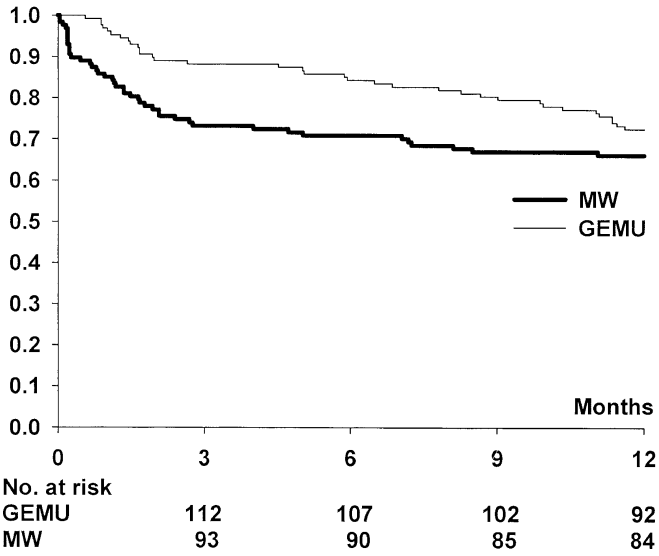

Figure 2. Cumulative survival among patients treated in the geriatric evaluation and management unit (GEMU) and the general medical wards (MW). $P = .004$ at 3 months, .02 at 6 months, and .06 during the first 12 months.

DISCUSSION

In this study, patients treated in the GEMU had a considerable reduction in early mortality compared with those treated in the MW. After 12 months, there was still a trend for better survival in the GEMU group. The main cause of death at 3 and 12 months was cardiac disease in both groups. By 12 months, more patients were dead from infections in the GEMU than in the MW group.

The early mortality reduction is most probably related to competence in the assessment and treatment of geriatric patients with acute disorders and the organizational structure of the GEMU (see Table 2). The treatment program in the GEMU had a systematic approach toward older patients, who often had complex medical problems and alteration of characteristic disease symptoms.[6,22] All relevant disorders and disabilities were assessed, not only those precipitating the hospital admission. This strategy may explain why patients in the GEMU group received more psychiatric diagnoses at discharge than did the MW patients. Intensified medical treatment with optimal drug prescription and focus on side effects is known to be important.[4] The combination of acute medical treatment and acute rehabilitation probably helped prevent complications and reduce the immobility and functional decline frequently seen in hospitalized older persons. It may also be important that there had been no educational influences on geriatric medicine in the hospital before the GEMU was established (6 months before the study started). As with

Table 3. Diagnosis at Discharge from Index Stay

Diagnosis	GEMU (n = 127)	MW (n = 127)
Heart disease, n (%)	72 (57)	69 (54)
Infectious disease, n (%)	20 (16)	25 (20)
Gastrointestinal disease, n (%)	22 (17)	15 (12)
Cerebrovascular disease, n (%)	38 (30)	28 (22)
Endocrine disease, n (%)	24 (19)	21 (17)
Airway disease, n (%)	17 (13)	12 (9)
Cancer, n (%)	12 (9)	10 (8)
Psychiatric disorder,* n (%)	48 (38)	9 (7)
Other, n (%)	51 (40)	68 (54)

*$P < .001$; none of the other differences were statistically significant.
GEMU = geriatric evaluation and management unit; MW = general medical ward.

Table 4. Causes of Death 3 and 12 Months After Inclusion

	3 Months		12 Months	
	GEMU	MW	GEMU	MW
Cause of Death	n (%)			
Heart disease	6 (40)	18 (53)	14 (40)	23 (54)
Infectious disease*	5 (33)	4 (12)	12 (34)	6 (14)
Cerebrovascular disease	0 (0)	4 (12)	1 (3)	5 (12)
Cancer	1 (7)	5 (15)	3 (9)	6 (14)
Other	3 (20)	3 (9)	5 (14)	3 (7)
Total	15 (100)	34 (100)	35 (100)	43 (100)

*$P = .04$ at 12 months; none of the other differences were statistically significant.
GEMU = geriatric evaluation and management unit; MW = general medical ward.

the studies of Landefeld et al., Asplund et al., and Counsell et al.[10,12,13] our study was conducted in an acute/subacute context, but, in contrast to them, we selected patients who were frail and expected to benefit the most from treatment in the GEMU.

Sample size estimation was based on the studies of Rubenstein et al. and Donaldson et al.,[7,20] with an expected 1-year mortality of 30% in the MW group and a reduction to 15% in the GEMU group. We found a comparable significant reduction in mortality at 3 and 6 months, but not at 12 months. However, Rubenstein et al.'s study was conducted in a rehabilitation setting with highly selected patients with stable medical disease, much longer duration of stay, and specialized follow-up in the outpatient geriatric clinic after discharge. In contrast, intervention in our study was concentrated in the acute/subacute stage of disease. Although patients in this study were likely to be in need of specialized geriatric assessment after discharge, no specific follow-up was offered, except for study-related registrations in both groups at 3, 6, and 12 months that were similar in both groups. Outpatient studies of geriatric patients considered at risk for hospitalization or recently discharged from the hospital have shown a positive effect of comprehensive geriatric assessment on various outcomes,[23,24] and some have even shown reduced mortality.[25] It is therefore likely that future high-risk patients should be offered specialized follow-up after discharge from hospital.

An shortcoming of certain other studies has been that selection criteria made their results applicable only to a minority of patients.[7] During the study period, 18% of all admitted patients aged 75 and older from the community of Trondheim were recruited to the present study. The limited number of beds in the GEMU restricted the number of patients recruited. From internal registrations at the Medical Department we estimate that about 30% of patients aged 75 and older are in need of treatment at the GEMU. This estimate is based mainly upon the inclusion criteria in this study and is comparable with the findings of Reuben et al.[26] Thus, the results of this study should be applicable to a considerable proportion of older patients treated in other internal medicine departments.

Regarding causes of death, it is noteworthy that more GEMU patients than MW patients died from infections at 12 months. One possible explanation for this is that those surviving their cardiac disease because of better treatment died from infections (mainly pneumonia) instead. Causes of death were registered from death certificates, which might be an unreliable and inaccurate source of information.[27] Only a small minority of the deceased underwent an autopsy. However, identical assessments were made for the two groups, and any errors should have distributed equally.

The present study was not designed to calculate the costs of the treatment. In contrast to other studies of units for acute care for older patients that have shown reduced or similar duration of stay for patients in the intervention group,[10–13] median duration of stay in the present study was 6 days longer among the GEMU patients. This was due to transfer of patients from other wards, comprehensive diagnostic evaluation, and the intervention offered. In addition, the extra staff in the GEMU was one physiotherapist and two occupational therapists, as part of the interdisciplinary team. The additional resources spent must be contrasted with the huge reduction in short-term mortality, which indicates that treatment of acutely sick frail older patients in MWs is insufficient. It may be that professional acute geriatric care inevitably costs more than suboptimal care. However, it will still be important to improve the efficacy of our GEMU in the future.

This study is one of the first to show that treatment of acutely sick frail older patients in a GEMU considerably reduces mortality. The strength of our study is that we have applied clearly defined inclusion criteria, focusing on acutely ill patients and selecting those who were expected to benefit the most from treatment in a GEMU. Although local differences in hospitalized older patients will make targeting of patients difficult, this study should be repeated in other settings. If the results are confirmed, hospitals should change their routines for assessment and treatment of this category of patients accordingly.

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