Are changes in vital signs, mobility, and mental status while in hospital measures of the quality of care?

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ABSTRACT

Introduction

Little is known of the changes in patients' health condition while in hospital in low-resource settings. The aim of this exploratory study is to examine dependency of patients on hospital admission and discharge in a low-resource sub-Saharan hospital.

Methods

We carried out a retrospective observational study of changes in the health condition, as reflected by their mental status, mobility and vital signs, of 5,888 consecutive patients between hospital admission and discharge.

Results

Mental status, mobility and vital signs were normal in 25% of patients on hospital admission and 30% of patients at discharge. Although very few patients with normal mental status, mobility and vital signs on admission died in hospital, the condition of 40% of them deteriorated.

Conclusion

No comparative data on changes in health condition between hospital admission and discharge have been published. Our proposed health condition categories identify changes that may matter most to patients and should be considered as a standard metric of hospital care.

KEYWORDS: Quality of care, patient-preferred outcomes, quality metrics, hospital medicine, risks of hospitalisation

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Introduction

Patients admitted to hospital with normal mental status, mobility and vital signs have a minimal risk of imminent death.[1] In a prospective multicentre study from Switzerland, Denmark and Uganda, acutely ill patients with normal vital signs and mobility had the same low in-hospital mortality, even though the resources available varied considerably between these three settings.[2] However, death is not the only healthcare outcome important to patients and preventing or delaying death is not the same as improving or fully restoring their health. Mortality rates alone, therefore, may not capture aspects of care quality that are important to patients. Although a three-tiered hierarchy for medical outcomes has been proposed, in which the top tier includes mortality and the degree of health or recovery achieved or retained,[3] the systematic measurement of outcomes other than death have not yet been widely adopted; importantly there are no standardised methods of measuring or comparing patients' clinical condition at admission and discharge.

Although several definitions of health have been proposed,[4] it has been suggested that its most important dimension is the patients' ability to perform those roles that they consider to be important.[5] Patients fear loss of independence more than death,[6] and what matters most to patients is getting better or being in good health so that they can be with family or friends and return to normal life.[7] Therefore, normal mental status and mobility are essential components of health and are maintained by constant physiological adjustments, many of which are reflected by vital sign changes. Patients with impaired mental function and mobility cannot provide for themselves and will therefore be dependent on others. This lack of independence is especially serious, and often life threatening, for poor patients in the developing world without family support.

Like any medical intervention, the benefits of hospital admission must be weighed against its risks. Hospitals expose patients to the risks of nosocomial infection, prescription error, polypharmacy, diagnostic procedures, under- and over-diagnosis, as well as the stress and danger of surgery and other invasive interventions.[8,9] Confusion and delirium are common while in hospital,[10] patients can become deconditioned by bed rest or inactivity, and after hospital discharge many patients experience generalised susceptibility to disease and increased risk of adverse events, including hospital readmission and death.[11] Hospital-acquired complications have been reported to occur in one-third of hospital admissions.[12] Although they may increase costs and hospital length of stay, it is not known how many of these complications cause acute or chronic derangement of patients' mental status, mobility, vital signs or mortality, or how many are potentially preventable versus unavoidable misadventures.

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Our tacit clinical experience has led us to believe that many patients are more dependent when discharged from hospital than they were on admission. The aim of this exploratory study was to examine the changes in patients' health condition, reflected by their mental status, mobility and vital signs, which occurred between admission and discharge from a low-resource hospital in sub-Saharan Africa.

Methods

Study design and setting

This retrospective observational non-interventional study was performed on a 46-bed medical ward at Kitovu Hospital, which has 248 beds and is located near Masaka, Uganda, 140 km from the capital city of Kampala. It is a private not-for-profit hospital, accredited by the Uganda Catholic Medical Bureau.

Participants and data collection

From 31 July 2016 to 8 January 2021, the clinical status and vital signs on admission of every patient admitted to the hospital's medical unit were entered at the bedside using tablet computers into a clinical data management and decision support system (Rapid Electronic Assessment Data System [READS], Tapa Healthcare DAC, Dundalk, Ireland) by three dedicated nurse researchers, who worked in shifts from 9am to 5pm 7 days a week. On 17 March 2019, the system was expanded to also include the hospital's surgical ward. All patients arrived at the hospital for emergency assessment, and none arrived by appointment or electively.

READS requires that the patient's contemporaneous mental alertness, mobility and complaints are entered each time the vital signs are measured. The patient's status at discharge was also recorded in the system. Data entry into the READS system was automatically time- and date-stamped: there was no missing data as it was impossible to complete a READS assessment without entering all the data required, or to enter values that were outside a plausible range, or to close the assessment without entering the patient's condition at hospital discharge.

Vital signs were arbitrarily defined as normal if the total National Early Warning score for combined values of respiratory rate, heart rate, systolic blood pressure, temperature, oxygen saturation and inspired oxygen concentration did not exceed 2 points; only 411 (0.8%) out of 49,077 patients who fulfilled this definition of vital sign normality died within 30 days of admission to a Canadian hospital.[13] Impaired mobility on presentation was defined as lack of a stable independent gait when assessed.[14] Therefore, any patients who were unsteady on their feet, needed a walking stick or other aid to steady themselves, needed help to walk, or were bedridden were considered to have impaired mobility. A patient who was not alert and calm was considered to have altered mental status. Therefore, patients who were agitated and/or incoherent, responded only to voice or pain or were unresponsive were recorded as having an altered mental status.[15]

Statistical methods and data analysis

The variables routinely collected throughout the study period at the first and last READS assessment were analysed. No statistical analysis was done other than calculation of means and standard deviations (SDs) of continuous variables and proportions of categorical variables, using Epi-Info version 6.0 (Centre for Disease Control and Prevention, USA).

Box 1. Patient condition categories

Category 1:
Patient is alert with a stable gait and normal vital signs.
Category 2:
Patient is alert with a stable gait and abnormal vital signs.
Category 3:
Patient is alert with an unstable gait and normal vital signs.
Category 4:
Patient is alert with an unstable gait and abnormal vital signs.
Category 5:
Patient has altered mental status regardless of their vital sign changes and their mobility.

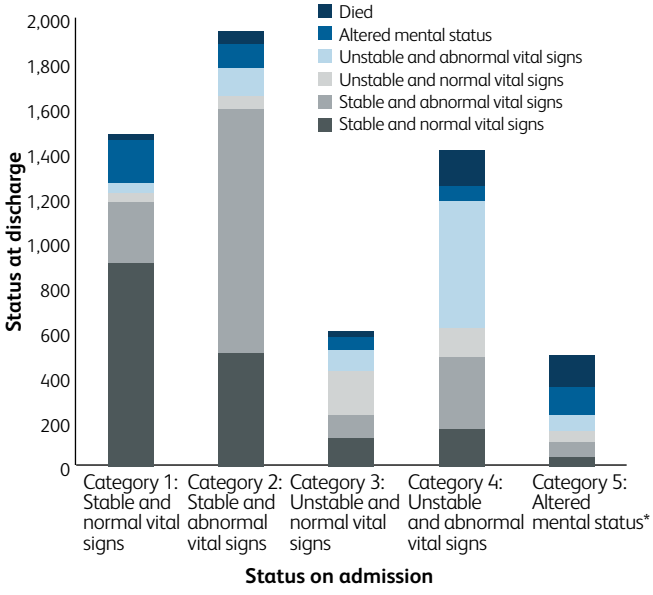

Fig 1. Clinical Category on admission (horizontal axis) compared with condition at discharge (vertical axis). [a]Category 5 patients were all those with altered mental, regardless of their mobility and vital signs. 25.2% had normal vital signs, and 7.7% normal mobility.

Ethics

Ethical approval of the study was obtained from the Scientific Ethics Committee Kitovu Hospital. The study conforms to the principles outlined in the Declaration of Helsinki.[16] The study is reported in accordance with the STROBE statement.[17]

Results

During the study period, 5,888 patients with a mean age of 48.5 (SD 23.1) years were admitted to the hospital for a mean length of stay of 4.5 (SD 3.8 days); while in hospital 346 (5.9%) died. On admission, 5,408 (91.8%) patients were alert, 3,446 (58.5%) had a stable gait and 2,192 (37.2%) had normal vital signs.

The clinical condition of patients on admission was defined by five arbitrary categories according to mental status, gait stability and vital sign derangement on admission (Box 1). Of the 480 patients who were category 5 on admission, 359 (74.8%) had abnormal vital signs and all had an unstable gait apart from 37 of the 120 patients who were agitated.

Table 1. Clinical condition category on admission according to patient demographics, condition at discharge and change in condition between admission and discharge

	Condition on admission					
	Category 1 Stable and normal vital signs	**Category 2** Stable and abnormal vital signs	**Category 3** Unstable and normal vital signs	**Category 4** Unstable and abnormal vital signs	**Category 5** Altered mental status	**Total**
Patient number	1,479 (25.1%)	1,930 (32.8%)	592 (10.1%)	1,407 (23.9%)	480 (8.2%)	5,888 (100.0%)
Age (years)	41.7 SD 20.4	43.2 SD 21.2	57.1 SD 22.5	56.3 SD 23.7	57.2 SD 23.9	48.5 SD 23.1
Length of hospital stay (days)	3.9 SD 3.8	4.4 SD 3.5	4.7 SD 3.4	5.0 SD 3.8	5.4 SD 4.2	4.5 SD 3.8
Male gender	759 (51.3%)	855 (44.3%)	283 (47.8%)	637 (45.3%)	220 (45.8%)	2754 (46.8%)
Surgical patient	238 (16.1%)	250 (13.0%)	103 (17.4%)	160 (11.4%)	51 (10.6%)	802 (13.6%)
Condition on discharge						
Stable normal vital signs	**914 (61.8%)**	505 (26.2%)	131 (22.1%)	165 (11.7%)	43 (9.0%)	1758 (29.9%)
Stable abnormal vital signs	269 (18.2%)	**1088 (56.4%)**	93 (15.7%)	316 (22.5%)	58 (12.1%)	1824 (31.0%)
Unstable normal vital signs	44 (3.0%)	61 (3.2%)	**204 (34.5%)**	139 (9.9%)	54 (11.3%)	502 (8.5%)
Unstable abnormal vital signs	33 (2.2%)	124 (6.4%)	88 (14.9%)	**562 (39.9%)**	70 (14.6%)	877 (14.9%)
Altered mental status	214 (14.5%)	112 (5.8%)	65 (11.0%)	67 (4.8%)	**123 (25.6%)**	581 (9.9%)
Died in hospital	5 (0.3%)	40 (2.1%)	11 (1.9%)	158 (11.2%)	132 (27.5%)	346 (5.9%)
Condition category change at discharge						
Decreased (ie improved)	0 (0.0%)	505 (26.2%)	224 (37.8%)	620 (44.1%)	225 (46.9%)	1574 (26.7%)
No change	914 (61.8%)	1088 (56.4%)	204 (34.5%)	562 (39.9%)	123 (25.6%)	2891 (49.1%)
Increased (ie worse)	560 (37.9%)	297 (15.4%)	153 (25.8%)	67 (4.8%)	0 (0.0%)	1077 (18.3%)
Died in hospital	5 (0.3%)	40 (2.1%)	11 (1.9%)	158 (11.2%)	132 (27.5%)	346 (5.9%)

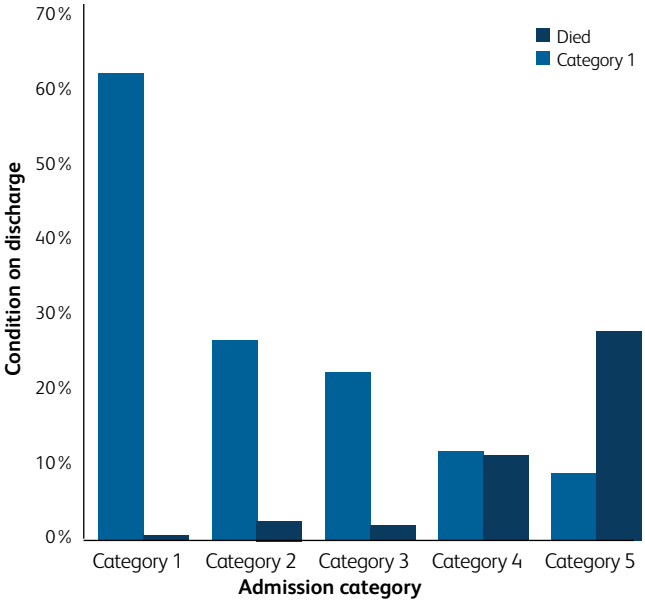

Fig 2. Percent of patients who died in hospital or were category 1 at discharge (ie alert with a stable independent gait and normal vital signs) according to the category on admission.

The differences in the demographics on admission between each category, the category at discharge, and changes in categories while in hospital are shown in Table 1 and illustrated in Figs 1 and 2. Length of stay in hospital and in-hospital mortality increased as the patients' admission category increased (Table 1). By discharge 346 (6%) patients had died; admission category status was unchanged in 2,891 (49%), decreased (ie improved) in 1,574 (27%), and increased (ie worsened) in 1,077 (18%) of patients.

Although in-hospital mortality increased as the admission category increased, it remained relatively low in alert patients unless they were both unstable with abnormal vital signs (ie category 4 patients, of whom 11.2% died); mortality more than doubled if mental status was altered on admission (ie patients were in category 5), regardless of mobility or vital sign changes (Fig 2).

The lower the category on admission, the more likely patients were to be in the lowest category (ie category 1) at discharge (Fig 2). However, of the 1,479 patients who were category 1 on admission only 914 (61.8%) were still category 1 at discharge: 269 (18.2%) had developed abnormal vital signs, 77 (5.2%) an unstable gait with or without vital sign derangement, and 214 (14.5%) altered mental status (Table 1).

Discussion

Main findings

This study confirms that mental status, mobility and vital signs on admission are strongly associated with in-hospital mortality. However, mental status, mobility and vital signs were normal in 25% of patients on hospital admission and only 30% of patients at discharge. Although very few patients with normal admission mental status, mobility and vital signs (ie Category 1) died in hospital, the condition of 40% of them deteriorated during hospitalisation. It is unclear to what extent these changes in clinical condition while in hospital reflect natural disease progression, the quality of care delivered or other factors.

Limitations

As far as we know this is the only study that has examined changes in patients' health condition, as judged by mental status, mobility and vital signs, while in hospital. The study could not look at the effect of in-hospital care and did not have the granularity to identify other admission characteristics that might influence outcomes, such as the patients' underlying diagnoses. The assessment of mental status did not distinguish between acute conditions such as delirium and chronic conditions such as dementia. The study was performed in a single low-resource centre, and patients who died within minutes of arrival at the hospital were not included. As no follow-up was possible after discharge, the number of patients who may have improved, deteriorated or died shortly after discharge is unknown. For some patients, such as those who were post-operative, improvement after discharge would have been a justifiable expectation.

Interpretation

Although no formal statistical analysis of the data was performed, the raw data speak for themselves. This study's most worrying finding was that, even though their in-hospital mortality was low, the condition of 40% of patients who were Category 1 on admission was worse at hospital discharge. We do not know if these changes resulted from the natural course of the patients' illness or the care they received. We estimate that during the study period 50,000 category 1 patients attended the hospital's emergency department, and only 3% were admitted. The decision to admit some category 1 patients may have been because of concern that their condition was likely to get worse and their subsequent deterioration was correctly anticipated. However, for other patients their deterioration could have been iatrogenic and may not have occurred if they had not been admitted. For example, the deranged mental status acquired by many patients may have been because of the hospital's stressful environment, sleep deprivation, inappropriate sedation, pain or medication.

Clinical relevance

Hospitals are complex organisations and the 'black box' approach used in computing and engineering, which only considers a system's inputs and outputs, might provide a simple, practical model by which to assess their performance.[18] From the patients' perspective the inputs and outputs that matter are their health conditions on admission and discharge, and whether they have been changed for the better. Excluding conditions such as end-of-life care, a primary objective of hospital care should be to make patients better; mortality is not the only measurable outcome and understanding why seemingly independent and physiologically stable patients deteriorate following admission should be a priority metric by which hospital performance is judged.

Is there a place for mandatory assessments performed on all patients entering and leaving a hospital? Before discharge from hospital, should there be a formal list of assessments that must be checked off? What should the list be, who should do it, and who should be accountable for it? Further refinement of our proposed clinical condition categories is warranted. Vital sign values that have the lowest association with death may not be those that best predict changes in health condition. There may be better assessments of mental status, such as the months backwards test for inattention, which may detect acute delirium earlier.[19] Mobility might be more objectively and accurately measured by devices that record gait speed[20] and analyse movement patterns.[21] Age, nutritional status and procedures performed may also have to be considered, and more detailed information may be required to identify chronic conditions that are unlikely to improve, such as dementia and stroke.

Benchmarking or comparing the quality of care between hospital is difficult because patient populations vary according to age, diagnoses, comorbidities, illness acuity and severity, as well as the intensity, cost, and quality of care. As this study was performed in a low-resource setting, comparison of its results with other settings should be made with caution. Many patients may have been discharged from the hospital too soon because they could not afford further treatment, whereas in other settings patients may remain in hospital for extended periods while alternative care is being arranged, or futile further investigations and treatments are performed.

Unfortunately, we could find no other comparable data on health condition categories on admission and discharge or their relevant changes. Although our proposed condition categories are simple, and require little time and skill to record, finding this information on admission and discharge is impossible in most current hospital record systems. Without this information it is difficult to see how any hospital can demonstrate it benefits the patients it treats, or that the quality of its care is improving over time. Much of the huge amount of data collected by electronic medical records are not correct, complete, or current and, therefore, of questionable value.[22] Moreover, manipulation of this data by complex predictive algorithms is unlikely to trump the value and validity of directly measured changes in vital signs, mobility, and mental status.[23]

As with any in-hospital death, a change for the worse in a patient's mental status, mobility or vital signs needs to be explained. Our proposed condition categories merely identify outcomes that matter to patients; once identified it may be possible to determine their cause and how to modify or prevent them. The care and skill sets required by category 1 and category 5 patients will differ considerably and need to be defined. Paradoxically, the quality of care a hospital provides may be better determined by the outcomes of low-category rather than high-category patients; as the risk of in-hospital mortality for low category patients is so small, changes in their clinical condition may be a better quality of care measure.

This study should be repeated in high-resource settings. If its findings are reproduced, further studies should explore the reasons why patients admitted in lower categories deteriorate and whether these declines can be prevented or reversed. Ultimately, this metric could be part of the quality improvement agenda, prompting institutions to 'drill down' and identify why patients deteriorate, especially mentally alert emergency patients who enter the hospital independently mobile and with little or no vital sign derangement.

Conclusion

During hospitalisation in a low-resource setting, the clinical condition, as judged by mental status, mobility and vital signs, was unchanged in half of all patients, improved in a quarter, and the remaining patients either became worse or died. Comparative studies between hospitals in different settings are required to determine if these changes in clinical condition are unavoidable or preventable by improved care. ■

Conflicts of interest

JK is a major shareholder, director and chief medical officer of Tapa Healthcare DAC. The other authors have no conflict of interest to declare.

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