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Research, Audit and Clinical Practice

How to follow the NEWS

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Abstract

Background: *it is not known how best to respond to changes in the National Early Warning Score (NEWS) after hospital admission. This report manipulates and extrapolates previously published data on the trajectories of the abbreviated early warning score (AbEWS i.e. NEWS that does not include mental status).*

Methods: *trajectories of averaged AbEWS for patients for their first 5 days in hospital and their last 5 days in hospital were combined to obtain an approximation of what happens to the average patient while in hospital.*

Results: *the trajectories of patients admitted with a low score are different from those admitted with a high score. Patients should be observed for 12 to 24 hours before their outcome can be predicted. The score of most patients who die in hospital trends upward on the second or third day after admission. Patients admitted with a score of 0-2 who raise their score to >=3 have a ten-fold increase in-hospital mortality.*

Conclusions: *the trajectories of early warning scores after admission are of prognostic importance, and escalation protocols should relate changes in the score to its initial value on admission.*

Key points

- Patient should be observed for 12 to 24 hours before their outcome can be predicted
- Failure of an early warning score to continue to fall after the third day in hospital should be of great concern.
- The escalation protocol for a patient admitted with a high score should not be the same as for a patient admitted with a low score

Introduction

The introduction of the National Early Warning Score (NEWS) into the UK and Ireland has, by and large, been welcome. Although the score has been shown to be a good predictor of outcome for most conditions such as sepsis, haemorrhage and heart disease[1] it needs to be adjusted for patients with chronic hypoxia.[2] The other area of concern is the significance of changes in the score and how best to respond to them. We have already published a report on early warning score trajectories after admission.[3] This report manipulates and extrapolates data from this paper to highlight the clinical significance of some of its findings.

Methods

All the vital signs recorded while in hospital and in-hospital mortality of 44,531 acutely ill medical patients admitted to Thunder Bay Regional Health Sciences Centre, Ontario, Canada were examined. Vital signs were abstracted from the hospital's electronic medical record system, which contains all the vital signs recorded on every patient admitted since the hospital opened in 2005. Unfortunately mental status was not reliably recorded in this database, so it was only possible to calculate an abbreviated early warning score based on NEWS that did not include level of consciousness (i.e. AbEWS). The other challenge was that the components of the AbEWS score were often not recorded at the same time. We, therefore, took an average of each of the vital signs recorded during any time interval we were interested in (usually 24 hours) and used these averages to calculate the averaged AbEWS for that time interval. Trajectories of averaged AbEWS for patients for their first 5 days in hospital and their last 5 days in hospital were then combined to obtain an approximation of what happens to the average patient while in hospital. Further details of the methods used have been published elsewhere.[3]

Results

Examination of averaged AbEWS for each individual patient revealed a chaotic picture of random fluctuations up and down with no difference in the patterns of patients who survived and of those who died. Therefore, patients were divided into three arbitrary risk groups: low risk patients had an AbEWS on admission of 0-2, medium risk 3-6 and high risk >=7. Fifty-nine per cent of all patients admitted were low risk (in-hospital mortality 1.4%), 31% were medium risk (in-hospital mortality 5.6%) and 10% were high risk (in-hospital mortality 20.3%). Low risk patients who died made up 18% of all in-hospital deaths.

During the first 48 hours in hospital any increase in AbEWS over its value at admission is associated with an increased mortality. However, a decrease in

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Table 1. The ratio of in-hospital mortality of patients who change their AbEWS score after admission compared to those whose AbEWS score remains unchanged.

AbEWS on admission	Time after admission (hours)	AbEWS Increased: AbEWS unchanged ratio (in-hospital mortality %)	Odds ratio (95% CI)	Chi-square	p
0-2	6	3.0:1.5%	2.9 (1.5 - 2.9)	18.41	0.00002
	12	2.5:1.2%	2.1 (1.6 - 2.7)	32.40	0.00001
	24	2.2:0.8%	2.8 (2.1 - 3.4)	52.53	0.00001
	48	1.9:0.9%	2.3 (1.6 - 3.2)	23.96	0.00001
3-6	6	9.5:5.6%	1.8 (1.4 - 2.3)	20.09	0.00001
	12	10.0:5.0%	2.1 (1.7 - 2.6)	55.50	0.00001
	24	10.3:5.1%	2.1 (1.7 - 2.6)	51.10	0.00001
	48	11.7:5.0%	2.5 (1.9 - 3.4)	44.00	0.00001
>=7	6	27.9:17.8%	1.8 (1.3 - 2.4)	14.23	0.0002
	12	28.8:17.8%	1.9 (1.4 - 2.4)	22.80	0.00001
	24	31.8:21.7%	1.7 (1.3 - 2.2)	13.75	0.0002
	48	39.4:32.4%	1.4 (1.0 - 1.9)	2.9	0.09
AbEWS on admission	**Time after admission (hours)**	**AbEWS Decreased: AbEWS unchanged ratio (in-hospital mortality %)**	**Odds ratio (95% CI)**	**Chi-square**	**p**
0-2	6	3.0:1.5%	2.1 (1.3 - 3.3)	9.57	0.002
	12	1.6:1.2%	1.3 (0.9 - 2.0)	2.11	0.15
	24	1.2:0.8%	1.5 (1.0 - 2.1)	3.93	0.05
	48	0.9:0.9%	1.1 (0.7 - 1.7)	0.16	0.69
3-6	6	8.1:5.6%	1.5 (1.2 - 1.9)	10.18	0.001
	12	5.2:5.0%	1.0 (0.8 - 1.3)	0.14	0.71
	24	3.9:5.1%	0.8 (0.6 - 0.9)	6.54	0.01
	48	3.3:5.0%	0.6 (0.5 - 0.9)	8.47	0.004
>=7	6	27.6:17.8%	1.8 (1.4 - 2.2)	30.03	0.0001
	12	21.6:17.8%	1.3 (1.0 - 1.6)	5.37	0.02
	24	18.5:21.7%	0.8 (0.7 - 1.0)	2.79	0.10
	48	17.1:32.4%	0.4 (0.3 - 0.6)	32.5	0.0001

the score during the first 6 to 12 hours in hospital was associated with increased rather than reduced in-hospital mortality (Table 1). Therefore, it is not until 24 to 48 hours after admission that a reduced score can be confidently associated with a lower mortality.

Trends in averaged AbEWS for patients for their first 5 days in hospital and their last 5 days in hospital were combined to obtain an approximation of what happens to the average patient in each risk group while in hospital (Figures 1-3). During the first 48 hours in hospital the averaged AbEWS went up for low risk patients and down for high risk patients. High risk patients who survived had a longer length of stay than low risk survivors, while low risk patients who died had a longer length of stay than high risk patients who died.

High risk patients – AbEWS on admissions >=7 (Figure 1)

Forty-four per cent of all in-hospital deaths are in high risk patients. On average all of these patients improve after admission and after two days survivors have an AbEWS of 5.4 (Standard Deviation (SD) 1.2) and non-survivors with a score of 6.8 (SD 2.3). The AbEWS of patients who die in hospital then increases, death occurring three days later at a score of 7.9 (SD 2.4) (i.e. lower than their score of 9.3 (SD 2.2) on admission). In contrast, the AbEWS of survivors steadily falls to 4.0 +/- 2.4 when discharged after 8.3 (SD 6.2) days in hospital.

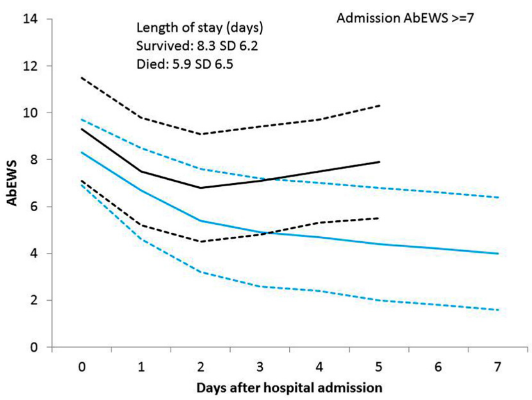

Figure 1. Approximate trends in averaged AbEWS from admission to discharge for "high risk" patients admitted with an AbEWS >=7. Black lines: patients who died in hospital; Blue lines: survivors; Solid lines: mean AbEWS; Dotted lines: standard deviation.

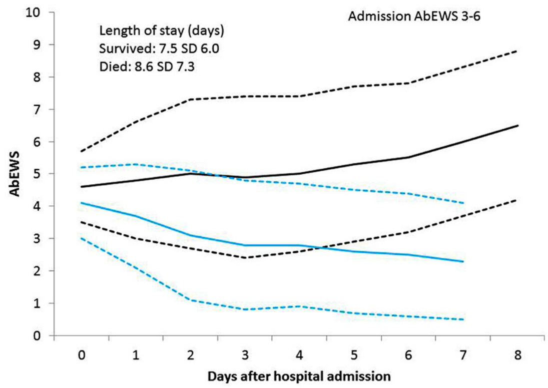

Figure 2. Approximate trends in averaged AbEWS from admission to discharge for "medium risk" patients admitted with an AbEWS 3-6. Black lines: patients who died in hospital; Blue lines: survivors; Solid lines: mean AbEWS; Dotted lines: standard deviation.

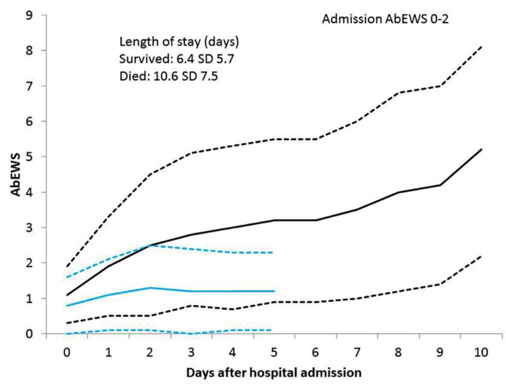

Figure 3. Approximate trends in averaged AbEWS from admission to discharge for "low risk" patients admitted with an AbEWS 0-2. Black lines: patients who died in hospital; Blue lines: survivors; Solid lines: mean AbEWS; Dotted lines: standard deviation.

Medium risk patients – AbEWS on admission 3-6 (Figure 2)

Immediately after admission the AbEWS of medium risk patient starts to falls in survivors and to increase in non-survivors. After an initial increase over 24 to 48 hours the AbEWS of patients who die stabilizes, but starts to rise again after three days in hospital. In contrast most survivors have an AbEWS <5 by their third day in hospital. Most non-survivors have an AbEWS of 6.5 (SD 2.3) on the day they die, whereas survivors are usually discharged 7.5 (SD 6.0) days after admission with an AbEWS of 2.3 (SD 1.8).

Low risk patients – AbEWS on admission 0-2 (Figure 3)

Although low risk patients tend to increase their AbEWS after admission, only 10% of these patients ever increase their AbEWS >=3. However, half of the patients who die have an AbEWS >=3 by their third day in hospital. Patients who increase their AbEWS to >=3 have a mortality rate of 15% and are, therefore, the "high risk low risk" patients. Survivors are discharged 6.4 (SD 5.7) days after admission with an AbEWS 1.2 (SD 1.1), whereas non-survivors die 10.6 (SD 7.5) days after admission with an AbEWS of 5.2 (SD 3.0). Only 44 of the 369 (12%) of the low risk patients who died never increased their AbEWS above 2 - these patients were 77.3 (SD 11.5) years of age, died 7.7 (SD 6.4) days after admission and the causes of death were heart attack or stroke (15), gastrointestinal and liver illness (7), cancer (5), infection (5), delirium or dementia (3) and miscellaneous (9); only one patient died from a respiratory condition (i.e. pneumonia) and two from a cardiac arrest.

Discussion

These results raise three interesting questions. How long should a patient be observed before their outcome can be predicted? Does something special happen on the second or third day after admission? Why do patients die with normal vital signs?

How long should a patient be observed before their outcome can be predicted?

The paradoxical finding that patients who decreased their averaged score over the first few hours in hospital have higher in-hospital mortality may be explained by the fact that initial treatment such as a fluid challenge or placing the patient on 100% oxygen may promptly change one or two vital signs, yet may be of no sustained benefit. Whatever the explanation, it is clear that patients must be observed for at least 12-24 hours before their response to treatment can be properly evaluated and that any "improvement" that occurs before this time may be illusory. This finding supports the concept of acute medical units that carefully assess and promptly treat patients, and then monitors their response in order to determine the appropriate level of care to which they should be then transferred.

Does something special happen on the second or third day after admission?

By 48 hours after admission the AbEWS of survivors, regardless of their initial score, starts to steadily decline. In contrast, although the AbEWS of non-survivors may stabilize for a while, it then starts to rise again around second to third days after admission. As junior doctors we often remarked that our sick patients might rally temporarily after an acute episode. Confusion in the elderly, for example, would often clear and the patient would enjoy a lucid period for a day or two only to start to deteriorate again. Patients admitted to hospital following myocardial infarction would often suffer an arrest or die from cardiogenic shock three days after admission.[4] It seemed to us as if many of these patients were a "house of cards", and destined to lurch from one medical disaster to another. Every day would bring a different problem – yesterday it was heart failure, today pneumonia, tomorrow renal failure or a pulmonary embolus or a stroke. Our findings suggest there may some validity in these observations, and it certainly seems prudent to keep a careful eye on patients with NEWS/AbEWS that stops declining or starts to climb upwards again 2 or 3 days after admission.

Why do patients die with normal vital signs?

Of patients who died nearly 5% had a score below 3 on the day they died, and 60% of these patients also had a low score when they were admitted to hospital. Indeed, 12% of low risk patients who died never increased their AbEWS above 2 and only two of these patients died of a sudden cardiac arrest. It could be argued that the abnormal vital signs that constitute an increased AbEWS simply reflect the normal body's attempts at trying to stay alive. If this is correct, one might assume that patients who die with a low or "normal" AbEWS are those who are too sick, frail or weak to mount the body's normal vital sign response to life threatening illness. It might also explain why high risk patients tend to have a lower AbEWS on the day they die than on their day of admission.

Implications for Escalation Protocols and clinical practice

If these findings are confirmed by others they have implications for the current national escalation protocols.[5] The possibility that scores may transiently fluctuate up and down and that initial values may be of poor prognostic value must be considered. On the other hand failure of the AbEWS to fall and/or any increase and/or an AbEWS > 5 after the third day in hospital should be of great concern. Furthermore, the relative change in the score may be more important than its absolute value. For example, a high risk patient with a score of 4 may be ready for discharge, whereas a low risk patient with the same score may be in great danger. Therefore, to have the same escalation protocol for a patient admitted with a high score as a patient admitted with a low score makes no sense. Finally, the optimal method of evaluating a "low risk" patient who deteriorates should be determined and no longer delegated to a junior doctor without any clear direction as to what is supposed to be done. These "high risk low risk" patients make up around 6% of hospital admissions and are the ones most likely to end up as "failure to rescue" tragedies widely publicised in the media.

Competing Interests

The authors declare no competing interests.

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