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Trauma

Variations in levels of care within a hospital provided to acute trauma patients

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Summary

Introduction. Caring for trauma patients is a dynamic process, and it is often necessary to move the trauma patient around the hospital to different locations. This study attempted to document the quality of observations performed on acute trauma patients as they moved through the hospital during the first 24 hours of care.

Methodology. This study was a student elective and was undertaken at Grey's Hospital, Pietermaritzburg. A third-year medical student was assigned to follow acute trauma patients throughout the hospital during the first 24 hours after admission. This single independent observer recorded the frequency with which vital signs were recorded at each geographical location in the hospital for each patient. A scoring system was devised to classify the quality of the observations that each patient received in the different departments. The observer recorded all the geographical movements each patient made during the first 24 hours after admission.

Results. Fifteen patients were recruited into this study over a 4-week period. There were 14 adult males (average age 28 years, range 18 - 56 years) and a 7-year-old girl in the cohort. There were significant differences in the quality of the observations, depending on the geographical location in the hospital. These variations and differences were consistent in certain locations and highly variable in others. Observations in the intensive care unit (ICU) and operating theatre were uniformly excellent. In the radiology suite the level of observations was universally poor. In casualty and the wards there was great variability in the level of observation. A total of 45 distinct geographical visits were made by the study cohort. Each patient made an average of 3 (range 2 - 5) visits during their first 24 hours after admission. All patients attended casualty, and there were 11 patient visits to the ward, 10 to radiology, 4 to ICU and 5 to theatre.

Conclusion. Significant variations exist in the level of observations of vital signs between different geographical locations within the hospital. This is problematic, as acute trauma patients need to be moved around the hospital as part of their routine care. If observations are not done and acted upon, subtle clinical deterioration may be overlooked and overt deterioration may be heralded by a catastrophic event.

It has become clear that clinical deterioration and sudden death in surgical patients is usually preceded by changes in the so-called vital signs.[1-4] These vital signs are easily observable and recordable physiological parameters include respiratory rate, pulse rate, blood pressure, oxygenation and mental function. Prompt recognition of alterations in vital signs may allow appropriate therapeutic interventions to be instituted.[1] This has led to a change of emphasis away from cardiopulmonary resuscitation after the event to a more pro-active philosophy of so-called 'early warning trigger and response systems'.[2,3] Acute changes in physiology should trigger an assessment by a team capable of assessing critical illness and instituting appropriate interventions. To implement such a system effectively, vital signs must be actively recorded on a continuous basis and acted upon throughout a patient's stay in hospital. Caring for trauma patients is a dynamic process involving many specialties and it is often necessary to move the trauma patient around the hospital to different locations, which makes continuous and accurate measurement of the vital signs difficult. This study attempted to document the quality of observations performed on acute trauma patients as they moved through the hospital during the first 24 hours of care.

Methodology

This study was a student elective and was undertaken at Grey's Hospital, Pietermaritzburg. Ethical approval was received from the University of Pretoria Ethics Committee and the Grey's Hospital Chief Executive Officer. A third-year medical student was assigned to follow acute trauma patients throughout the hospital during the first 24 hours after admission. The observer recorded all the geographical movements each patient made during this time. A visit to a geographical location within the hospital was recorded as a distinct patient visit. The total number of distinct patient visits and the frequency of visits to each specific location were recorded.

Patients were eligible for inclusion based on mechanism of injury and/or Revised Trauma Score (RTS). Patients who sustained

penetrating neck or torso trauma, high-velocity blunt polytrauma or direct head trauma were eligible for this study. Patients with an initial RTS of <11 were also included. Observations were divided into continuous observations (pulse and oxygen saturation) using a pulse oximeter and intermittent observations (manual blood pressure, respiratory rate, Glasgow Coma Scale and body core temperature). Urine output was not included as an essential observation for the purposes of this study. The expected and realistically achievable standard of observation for high-risk trauma patients in our centre is set out in Table I. The single independent observer documented the observations for each patient at each distinct geographical location in the hospital during the first 24 hours. In conjunction with the second author, the observations were reviewed and given a quality rating out of five levels ranging from excellent to incomplete. Points were ascribed to each level of observations, from 5 points for excellent to 1 point for incomplete. This enabled the authors to ascribe a numerical value to the quality of the observations, so allowing for comparison (Table II).

TABLE I. VITAL SIGNS – THESE LEVELS OF OBSERVATION FOR SERIOUSLY INJURED PATIENTS SHOULD BE PRACTICALLY ACHIEVABLE IN OUR SETTING

	Expected frequency
Pulse	**Continuous**
Oxygen saturation	**Continuous**
Respiratory rate	**30 minutes**
Manual blood pressure	**30 minutes**
Glasgow Coma Scale	**Hourly**
Temperature	**Hourly**

TABLE II. QUALITY OF OBSERVATIONS

Quality of observations	Numerical score	
Excellent	**5 points**	**Continuous pulse oximetry Manual vitals recorded every 15 - 30 minutes**
Good	**4 points**	**Pulse oximetry 70 - 80% of time in department Manual vitals recorded every 15 - 30 minutes**
Average	**3 points**	**Pulse oximetry 50 - 70% of time spent in department Manual vitals recorded every hour to 2 hours**
Poor	**2 points**	**Pulse oximetry <50% of time in department Manual vitals recorded after 2 or more hours**
Incomplete	**1 point**	**No pulse oximetry Manual vitals either partially or wholly not recorded**

Results

Fifteen patients were recruited into this study over a 4-week period. There were 14 adult males (average age 28 years, range 18 - 56 years) and a 7-year-old girl in the cohort. Of the patients 4 had been injured in a motor vehicle accident, 3 had stab wounds of the neck, 6 had penetrating torso injuries, and 1 had fallen from a height. The patient demographics and results are summarised in Table III. Five patients required operative intervention in theatre and 4 required ICU admission. Table IV shows the quality of the observations for each patient at each distinct geographical location during the first 24 hours in hospital.

There was great variability in the quality of the observations each patient received during the first 24 hours in our institution, the quality of the observations differing significantly depending on the geographical location in the hospital (Fig. 1). These variations and differences were consistent in certain locations and highly variable in others. Observations delivered in the ICU and the operating theatre were uniformly excellent. In the radiology suites the level of observations was universally poor. In casualty and the wards there was great variability in the level of observation.

A total of 45 distinct geographical patient visits were made by the study cohort. Each patient made an average of 3 (range 2 - 5) visits during their first 24 hours after admission. All patients attended casualty. There were 11 patient visits to the ward, 10 to radiology, 4 to ICU and 5 to theatre. Specific 'observation gaps' were identified by the independent observer. In 4 cases patients were left in the triage area of casualty and checked on intermittently by staff. They were not continuously monitored and vital signs were manually recorded at variable intervals. Another 'observation gap' occurred with delay in transfer of a patient from casualty to the next location of care. This was documented in 3 patients. Patients sent to radiology were transported by hospital porters unaccompanied by medical staff in 3 cases. One patient had to wait in the adjacent passage outside radiology without any observations while awaiting investigation.

Discussion

There is growing interest in a pre-emptive approach to acute clinical deterioration rather than a reactive one.[1-4] The emphasis is currently on recognising the early phase of a deterioration and implementing interventions designed to reverse the deterioration. The 'acute care team' (ACT) or 'ICU outreach' (ICUO) concepts are examples of pre-emptive approaches. The ACT or ICU outreach team consists of doctors and nurses who have been trained in critical care and are capable of recognising an acutely ill patient and initiating therapeutic interventions. Ward staff must initiate an early consultation with the ACT or ICUO team on the basis of recorded physiological changes. These changes are formalised by the creation of so-called 'early warning systems' (EWS). An EWS is a weighted clinical assessment that uses easily recorded common physiological parameters. The EWS make use of changes in these observations as criteria for initiating a consultation with the ACT or ICUO team. The EWS developed by Bellomo *et al.* is depicted in Table V.[1,5] Once consulted these teams review the patients and initiate interventions designed to prevent further deterioration. Such a system depends upon the ability to monitor patients accurately and reliably and to initiate a consultation with the ACT/ICUO team appropriately. The pre-emptive approach is also readily applicable to the management of acute trauma patients.

TABLE III. PATIENT DETAILS

Patient No.	Gender	Age (yrs)	RTS	Injury
Patient 1	**Male**	**29**	**11**	**GSW abdomen**
Patient 2	**Male**	**56**	**12**	**MVA polytrauma**
Patient 3	**Male**	**25**	**12**	**Multiple precordial stab wounds**
Patient 4	**Male**	**36**	**NA**	**Head injury following assault**
Patient 5	**Male**	**34**	**NA**	**Stab abdomen with disembowelment**
Patient 6	**Male**	**18**	**9**	**Stab chest**
Patient 7	**Male**	**25**	**12**	**GSW right chest with haemopneumothorax**
Patient 8	**Female**	**7**	**12**	**MVA with head injury**
Patient 9	**Male**	**29**	**8**	**Fell from scaffolding**
Patient 10	**Male**	**24**	**12**	**MVA bilateral fractured femurs**
Patient 11	**Male**	**37**	**12**	**Stab wound to cubital fossa**
Patient 12	**Male**	**24**	**12**	**Stab wounds to neck**
Patient 13	**Male**	**25**	**11**	**Stab wounds to neck**
Patient 14	**Male**	**19**	**NA**	**Stab wounds to neck**
Patient 15	**Male**	**16**	**11**	**MVA head injury**

RTS = Revised Trauma Score; GSW = gunshot wound; MVA = motor vehicle accident; NA = not applicable.

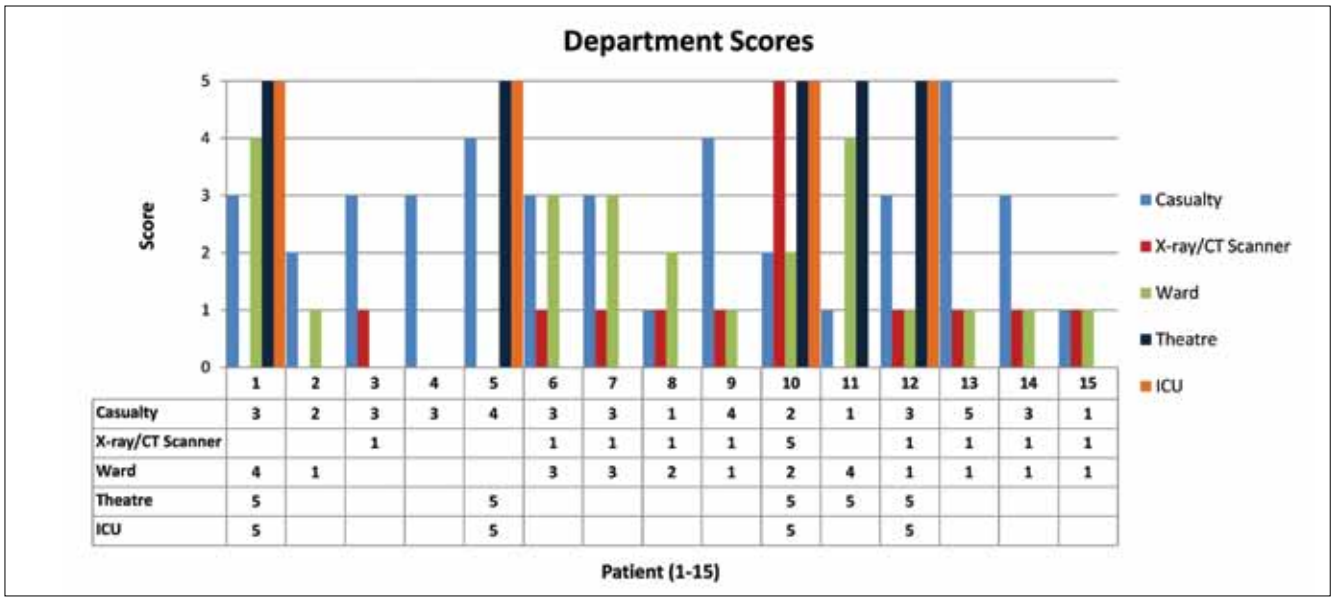

Fig. 1. Quality of observations for each patient in the five departments.

The acute care of a trauma patient is dynamic, and sudden deterioration may necessitate dramatic alterations in therapeutic plans. Ongoing continuous observation is essential if attending staff are to detect clinical changes. However, the severity and extent of an injury may not be obvious on initial survey. Accurate quantification of the extent of an injury often necessitates movement of an acute trauma patient around the hospital for specialised investigation and intervention. These movements make it difficult to perform continuous observations. It is also difficult to ensure consistency in the levels of observations performed, and our results demonstrate exactly this. There is great variability in the observations trauma patients receive during their first 24 hours in our institution. This variability results in 'information gaps' in patient observations, and there are significant periods of time during which observations are not done or not recorded. This may not necessarily be totally negative, as a skilled staff member may be able to assess a patient accurately by the so-called 'eyeball approach'. Qualitative research has shown that experienced registered nurses often visually assess patients and tend not to use formal EWS until they need to quantify a deterioration after recognising it.[6,7] The same tendency may be observed in experienced clinicians. There is little doubt that this type of qualitative assessment occurred in our cohort: patients sent to X-ray accompanied only by their friends or the hospital porter, for example, had passed the

TABLE IV. SCORES FOR EACH GEOGRAPHICAL LOCATION

Patient No.	Casualty	Radiology	Theatre	ICU	Ward
1	**3**	**-**	**5**	**5**	**4**
2	**2**	**-**	**-**	**-**	**1**
3	**3**	**1**	**-**	**-**	**-**
4	**3**	**-**	**-**	**-**	**-**
5	**4**	**-**	**5**	**5**	**-**
6	**3**	**1**	**-**	**-**	**3**
7	**3**	**1**	**-**	**-**	**3**
8	**1**	**1**	**-**	**-**	**2**
9	**4**	**1**	**-**	**-**	**1**
10	**2**	**5***	**5**	**5**	**2**
11	**1**	**-**	**5**		**4**
12	**3**	**1**	**5**	**5**	**1**
13	**5**	**1**	**-**	**-**	**1**
14	**3**	**1**	**-**	**-**	**1**
15	**1**	**1**	**-**	**-**	**1**
Average score	**2.7**	**2.5**	**5**	**5**	**2**

*Patient brought from ICU to computed tomography scanner, so level of care the same as in ICU.

TABLE V. EARLY WARNING SYSTEM DEVISED BY BELLOMO *ET AL*.[5]

Staff member is worried about the patient

Acute changes in heart rate to <40 or >130 beats/min

Acute change in systolic blood pressure to <90 mmhg

Acute change in respiratory rate to <8 or >30 breaths/min

Acute change in pulse oximetry saturation to <90%

Despite oxygen administration

Acute change in conscious state

Acute change in urine output to <50 ml in 4 h

'eyeball test' of the staff in casualty. Although this type of assessment may be reliable, it depends on individual experience and as such is not reproducible. This is especially a problem when staff providing care are heterogeneous in terms of experience. Formal EWS are designed to generate both reliable and reproducible observations.[3,6-8]

The gaps in our observations imply that subtle acute signs may go unnoticed until a catastrophic deterioration occurs. These variations in observations correlate with changes in geographical location within the hospital.[3] However, in specific locations there is a fairly consistent quality of observations. In the ICU and theatre the quality of the observations was consistently excellent, and in radiology the quality of the observations was consistently poor. The single exception to this in radiology was a patient brought from the ICU for a computed tomography scan and accompanied by ICU staff with full electronic monitoring. The operating theatre and ICU are designed to undertake close monitoring of patients at all times. In the operating theatre an anaesthetist is present with the patient during the entire procedure. After the procedure the patient is nursed in the recovery room, where there is dedicated nursing staff and ongoing non-invasive monitoring of blood pressure, pulse and oxygen saturation. Once in the ICU again each individual patient is cared for by a dedicated nurse and has continuous invasive and non-invasive monitoring. This level of care, however, is very expensive and is a limited resource. There were 4 ICU visits (8%) and 5 visits to theatre (11%) in this small cohort. The most infrequently visited locations have the best observations. It is unlikely that this level of care can be reproduced throughout the entire hospital.

Radiology is a weak point in the care of the trauma patient. This is especially important in view of the frequency (22%) of distinct visits to the radiology suite. Radiological imaging is an essential aspect of trauma care, but radiology departments have the most poorly developed infrastructure for ongoing monitoring of acutely injured patients. The radiology suite has limited capacity to deal with acute changes in condition. The primary responsibility of radiology is to produce and interpret diagnostic images, and to perform specific imaging-guided diagnostic and therapeutic procedures. Radiologists and radiographers are not trained to provide emergency care or resuscitation. Continuous monitoring and evaluation of acute patients remains the responsibility of the managing clinicians. Generally radiology has no nursing staff to provide monitoring after hours, and monitoring facilities during normal working hours are limited. This has long been recognised as a problem, and most trauma courses emphasise the dangers of sending acutely ill patients to radiology suites where observations are difficult to perform. Acute deterioration in these locations may well go unnoticed.

Within specific locations such as casualty and the ward great variations in the level of care exist. Casualty is a location where close monitoring is essential and should be achievable. It is the receiving area for acutely ill patients and as such should be staffed and equipped to deal with these patients. Variability in the levels of observation in casualty is cause for concern. The situation in the general wards is also highly variable. The general wards are busy and often under-staffed. The paucity of senior professional nursing staff results in inadequate supervision of junior staff.

Developing a pre-emptive approach requires a change in mentality among all categories of staff. Geographical parochialism needs to be challenged and reversed. It makes little sense to be able to perform high-level observations in particular areas with relatively low visitation rates but to accept large information deficits in other geographical areas with much higher visitation rates within the same institution. Acute care of trauma patients is ongoing and dynamic. Deterioration may occur suddenly and radically change the therapeutic plan for the patient. Without ongoing observation, deterioration is not recognised early and therapeutic interventions that may have been able to prevent further deterioration will not be implemented in time. Dealing with the problem of variability in the quality of observations requires a multi-faceted strategy. Ongoing educational efforts that emphasise the importance and significance of routine observations are essential. The development of formal mechanical

lock-out-type systems that prevent the inappropriate movement of potentially seriously injured patients is another approach. The introduction of formal tick sheets in the form of a sticker that must be completed and stuck onto the patient's file would force staff to formally classify patients according to both physiology and mechanism of injury, before moving the patient. It is also essential that we begin to develop high-care facilities in our public hospitals where patients who do not require intensive care or mechanical ventilation can remain for 12 - 48 hours until they are fit to be moved to the general wards. In the high-care area there should be adequate nursing staff to provide ongoing monitoring and to intervene as required. Ensuring that enough functioning non-invasive monitors are available in wards and casualty receiving areas is an ongoing challenge.

Conclusion

There has been a change of emphasis away from a reactive 'crash team' approach to critical illness and sudden clinical deterioration towards a pre-emptive approach based on early recognition of changes in physiology and acute response teams. This means that accurate recording and interpretation of vital signs on a continuous and ongoing basis are essential. We have highlighted the existence of significant variations in the level of observations of vital signs between different geographical locations within a hospital. This is problematic, as acute trauma patients need to be moved around the hospital. If observations are not done and acted upon, subtle clinical deterioration may occur and overt deterioration may be heralded by a catastrophic event. There are areas that have a consistently high level of care and areas in which levels are consistently poor. Of concern are the areas where there is an inconsistent level of care. Part of the problem remains institutional in the sense that there is an ingrained sense of geographical parochialism. This mindset must be addressed, and it is vital that we inculcate in all staff a sense of the importance of the continuity of care of the acute trauma patient. Educational programmes alone are unlikely to be effective, and the implementation of formal scoring systems or EWS may be of considerable benefit. Designing a system that ensures a consistently high level of observations across the entire institution remains a challenge.

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