

ORIGINAL ARTICLE

Early identification and management of the unstable adult patient in the emergency department

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Aims and objectives. The focus of this research was to standardise an emergency observation chart, the Adult Emergency Department Flow Chart, which incorporates elements designed to allow clinicians to more readily recognise the trends of patient deterioration.

Background. Patients present to the Emergency Department with some form of instability. Core skills and principles of Emergency Department care are to rapidly and continually assess the clinical condition of the patient, prioritise their care and treat accordingly. Often, however, deterioration of these patients is missed. The incidence of missed deterioration is set within a background of increasing presentations to Emergency Departments, greater complexity of the patient health status, longer length of stay within the Emergency Department and an ageing population.

Design. This quantitative research study comprised a retrospective medical record audit. Only those records containing notes relating to an Emergency Department admission were included.

Methods. An online data collection tool based on the Adult Emergency Department Flow Chart was developed. A total of 181 medical records were reviewed: 80 during the pre-implementation audit and 101 during the post-implementation audit.

Results. The Adult Emergency Department Flow Chart enabled clinicians to better identify deteriorating patients, with a higher number of abnormal vital signs being identified at the post-implementation audit. Identification of pain also dramatically increased at the post-implementation audit. Documentation of notification to Medical Officers also increased, as did documentation of the number of patients receiving medication to help treat the abnormal vital sign.

Conclusion. The introduction of the Adult Emergency Department Flow Chart facilitated the essential role of nurses in the identification, documentation and monitoring of the unstable or deteriorating patient in the Emergency Department. Further research is required with larger samples to determine the impact of the Adult Emergency Department Flow Chart on the timely management of abnormal vital signs.

Relevance to clinical practice. The Adult Emergency Flow Chart provides a valuable tool for the early identification and subsequent management of an unstable /

What does this study contribute to the wider global clinical community?

- A core skill of emergency department care is to rapidly and continually assess the clinical condition of the patient.
- The Adult Emergency Department Flow Chart (AEDFC) provides a valuable tool for the early identification and subsequent management of an unstable/deteriorating adult in the emergency department.
- The importance of the AEDFC in clinical practice is highlighted.

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deteriorating adult in the emergency department, particularly for clinicians with limited experience.

Key words: adults, early diagnosis, early warning signs, emergency nursing, nursing education, nursing observation charts

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Introduction

Patients presenting to the Emergency Department (ED) do so with some form of instability. As such, their clinical condition can either improve or become compromised within a short period of time. An essential role of clinicians working in the ED is the early identification and management of the unstable or deteriorating patient. Monitoring of the patients' vital signs forms a pivotal part of the day of a clinician in the ED (Endacott *et al.* 2007) with clinicians reporting their reliance on the observations of vital signs in identifying, assessing and managing deteriorating patients (Goldhill & McNarry 2004, Cioffi *et al.* 2006, Endacott *et al.* 2007).

Indeed, lack of recognition of abnormal vital signs in the ED, wards and ICU, has been found to lead to adverse patient outcomes including longer hospital stay, cardiac arrest (Tippins 2005) and higher mortality rates (Goldhill *et al.* 2005). Abnormal vital signs are often observed up to eight hours prior to admission to ICU (from wards and theatre), indicating these patients could have been identified and treated more effectively at an earlier stage in their care (Hillman *et al.* 2002). While some have found a lack of recognition of deterioration to be unrelated to the number of ED presentations (Considine *et al.* 2012), there is potential for the number of adverse events experienced by patients to increase as more demand is placed on facilities and clinicians' time.

Background

Changes in patient's signs and symptoms herald deteriorating health status and these 'warning signs' are the basis of a plethora of rapid response systems. One of the main features of these systems is the monitoring of vital signs and criteria for triggering a call (Australian Commission on Safety and Quality in Health Care 2007). Various systems, such as the Early Warning Score (Morgan *et al.* 1997) and the physiological observation track and trigger system (POTTS©) (Oakey & Slade 2006), use the monitoring of multiple vital signs to alert clinicians to a deteriorating patient requiring intervention.

Other systems differentiate between early warning signs, the response to which is based on clinical judgement, and

late warning signs, the response to which is mandatory. The most notable of these is the Medical Emergency Team (MET) criteria (Hillman *et al.* 2005). Other studies, for example, the NSW between the Flags program and the SOCCER studies (Harrison *et al.* 2005, 2006, Jacques *et al.* 2006), have combined the use of early and late warning signs to trigger specific actions relating to those changes. Enabling clinicians to assess and recognise the severity of deterioration (e.g. the Modified Early Warning Score (Subbe *et al.* 2003)) is an essential component of these systems, potentially preventing severe adverse events. The use of early warning systems is now an accepted practice, with national and international guidelines being issued by the National Institute of Clinical Excellence (Cuthbertson 2008).

However, much of the research in the area of patient deterioration has been ward based, with very little conducted on the recognition of the deteriorating patient in the ED setting. A recent study examining the use of an early warning system within the ED found that early recognition of deterioration in the ED resulted in better patient outcomes, with abnormal vital signs being rectified with relatively simple interventions before more advanced criteria (such as responding to MET criteria or before the onset of late warning signs of deterioration and further escalation of care) were necessitated (Considine *et al.* 2012).

Abnormal vital signs

There are a range of track and trigger systems that use either single or multiple parameters to trigger a response. While there is no conclusive evidence identifying the best system for specific circumstances or environments (Australian Commission on Safety and Quality in Health Care 2007), several strategies have been found to facilitate the early identification and subsequent management, including treatment and notification of medical officers, of deterioration in the patient's health status (Chatterjee *et al.* 2005, Oakey & Slade 2006).

Some vital signs, such as abnormal respiratory rate and high pulse rate have been found to be independent predictors of adverse events or deterioration (Chaboyer *et al.* 2008). Similarly, there is a large body of research showing that other vital

signs such as heart rate, blood pressure, respiratory rate, oxygen saturation, level of consciousness, pulse rate, temperature, age and cardiac complaints are also associated with, or predictors of, deterioration in patients (e.g. (Considine *et al.* 2012, Goldhill & McNarry 2004, Hillman *et al.* 2002).

Identification and management of abnormalities in these vital signs leads to improvements in patient outcomes (Considine *et al.* 2012). Further, unidentified or unmanaged abnormalities in some of these vital signs (Glasgow Coma Scale [GCS], blood pressure, heart rate and oxygen saturation) is significantly associated with higher mortality rates (Buist *et al.* 2004) highlighting the importance of monitoring a wide range of vital signs to detect deterioration in the patient's health status.

Documentation of abnormal vital signs and actions taken

With the use of early warning systems, clinicians in the ED readily identify and act upon abnormal vital signs. Often, however, delays occur due to inadequate documentation and inaccessibility of other staff (Cioffi *et al.* 2006). Clinicians have reported notifying more experienced staff as one of the first actions they take on observing the abnormal signs (Cioffi *et al.* 2006). Consequently, patients are often seen by medical officers before their deterioration becomes severe due to the action taken by clinicians (Considine *et al.* 2012), highlighting the importance of documentation and communication between clinicians and other staff (Endacott *et al.* 2007).

The use of early warning systems to track abnormal vital signs has also facilitated an improvement in the documentation of observations (Considine *et al.* 2006, Wilson *et al.* 2013). The documentation of some vital signs (e.g. pain (Considine *et al.* 2006), urinary output and level of consciousness (Endacott *et al.* 2007)), however, remains relatively low, potentially leading to patients experiencing adverse outcomes. Therefore, systems which facilitate the observation and documentation of a comprehensive range of vital signs are necessary to detect deterioration in the patient's health status. Indeed, regardless of the system in place, the improved documentation resulting from their use has led to an increased ability to identify deterioration (Australian Commission on Safety and Quality in Health Care 2007).

Design of observation charts

The design and layout of observation charts can either facilitate or hinder recording information and the subsequent interpretation of that information (Australian Commission on Safety and Quality in Health Care 2007). This has an impact on the detection of deterioration in the patient's

health status. Essential aspects of an observation chart include clarity, logical progression from admission to discharge, accurate recording of clinical data, test results and physiological parameters, prompts for clinicians, avoiding repetition or additional paper inserts and ease of use (Knight *et al.* 2002). Incorporating specific parameters has been found to increase detection of abnormal vital signs (Chatterjee *et al.* 2005). Further, 'plotted parameters' have been found to lead to higher rates of detection than written values (80% compared to 58%), supporting graphical plotting of parameters (Chatterjee *et al.* 2005). Indeed, clinicians have found graphical representation of parameters to assist in their early detection and management of patients who are deteriorating (Green 2013).

The Adult Emergency Flow Chart

In 2008, NSW Health introduced an Adult Admission and Discharge (AAD) form which included various risk assessment tools, admission assessments and early discharge planning. The AAD was in addition to existing ED charts. However, the AAD was only able to document isolated episodes of the patient's clinical condition rather than continuous monitoring of their clinical progress.

The Adult Emergency Department Flow Chart (AEDFC) was a redesign of an existing ED observation chart, incorporating three aspects: location of the mandatory trigger for notification (MET criteria) on the chart; use of colour where parameters are abnormal (yellow and red) to promote early identification and action by clinicians and other health professionals; and the use of plotting for reporting vital signs (see Fig. 1).

The AEDFC incorporated the AAD and also captured other information not previously included, such as pain, GCS, a fluid balance chart and a free text area which could be used for any additional regular observation that the nurse deemed necessary.

Ethics

Ethics approval for the observational audit and patient satisfaction was obtained from the health service human research and ethics committee.

Method

Design

This quantitative research study involved a retrospective medical record audit using an online data collection form based on the Adult Emergency Department Flow Chart.

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statistics and *t*-tests were calculated to determine differences between the two audit times.

Demographics

Most patients presenting to the ED were triaged as a Category 3 – requiring treatment within 30 minutes (78.8% pre, 73.3% post). There were no statistically significant dif-

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ferences in the age of patients presenting to the ED at the two audit times (Pre: $M = 54.71$ years, $SD = 21.87$; Post: $M = 49.45$ years), nor in the time patients spent in the ED (Pre: $M = 6$ hours 23 minutes, $SD = 4$ hours 41 minutes; Post: $M = 6$ hours 30 minutes, $SD = 3$ hours 35 minutes). When leaving the ED, the majority of patients were either sent home (51.3% pre, 56.4% post) or admitted to a general ward (35.0% pre, 35.6% post).

Similarly, upon discharge from the ED, the majority of patients had vital signs within normal limits (85.3% pre, 76.7% post). No patients at either audit times had an emergency called within eight hours of discharge from the ED.

Number of abnormal vital signs

Patients at the pre-implementation audit were statistically significantly less likely to be identified as having an abnormal vital sign when compared to those at the post-implementation audit (30.0% pre, 53.5% post; $\chi^2 = 14.261$, $p = 0.007$). Further, the number of vital signs identified at the pre-implementation audit was statistically significantly lower than at the post-implementation audit (Pre: $M = 0.41$, $SD = 0.688$; Post: $M = 0.74$, $SD = 0.868$; $t = -2.779$, $p = 0.006$). However, for those who were identified as having at least one abnormal vital sign, there were no statistically significant differences in the number they presented with (Pre: $M = 1.38$, $SD = 0.495$; Post: $M = 1.39$, $SD = 0.712$; $t = -0.087$, $p = 0.931$).

Presentation of abnormal vital signs

Very few patients presented with abnormal vital signs. There were no statistically significant differences (p -values ranging from 0.120 to 0.813) in the number of patients identified as having abnormalities in their systolic blood pressure (>20 or <90), pulse rate (>140 or <40), respiratory rate either (>24 or <9), GCS <15 or oxygen saturation $<90\%$.

Documentation of a number of vital signs was poor at both the pre- and post-implementation audits. In the majority of cases, urinary output was not documented or unable to be determined (83.8% pre, 86.1% post). Similarly, data relating to pain (new, change, uncontrollable since arrival in the ED) and recurrent/prolonged seizures were missing.

The patient's pain score on arrival in the ED was also assessed. The proportion of patients who were identified as having a pain score >2 was statistically significantly lower at the pre-implementation audit (6.3%) compared to the post-implementation audit (33.7%) ($\chi^2 = 78.884$, $p < 0.001$).

However, the pain score of the majority of patients at the pre-implementation audit was not documented (86.3% pre, 19.8% post).

Time taken from triage to identification of abnormal vital signs

There were no statistically significant differences in the time taken from triage to identification of individual abnormal vital signs (p -values range from 0.244 to 0.546). On average, the first abnormal vital sign was identified about one hour after triage (Pre: $M = 1$ hours 1 minutes, $SD = 1$ hours 48 minutes; Post: $M = 58$ minutes, $SD = 1$ hours 50 minutes).

Time taken from identification of abnormal vital signs to management

Time taken from identification of an abnormal vital sign to its subsequent management was, in the majority of cases, slightly longer at the pre-implementation audit (average = $M = 40$ minutes, $SD = 57$ minutes) than at the post-implementation audit (average = $M = 30$ minutes, $SD = 44$ minutes), although these differences were not statistically significant (see Table 1).

Although there appeared to be a large difference in the time between identification and management of patients with a pain score >2 (Pre: $M = 1$ hours 31 minutes, $SD = 1$ hours 30 minutes; Post: $M = 44$ minutes, $SD = 48$ minutes) and oxygen saturation $<90\%$ (Pre: $M = 27$ minutes, $SD = 10$ minutes; Post: $M = 0$ minutes, $SD = 0$ minutes), these differences were not statistically significant due to the relatively low number of patients identified with these abnormal vital signs (see Table 1). Time taken from identification to management of the other abnormal vital signs was also examined, with no statistically significant differences found (see Table 1).

Individual vital signs

Data were available at both audit times for five vital signs. There were no statistically significant differences between the two audit times in the number of patients presenting with a systolic blood pressure <90 , GCS <15 , or oxygen saturation $<90\%$. Nor were there differences in the notification of a medical officer or subsequent treatment of these abnormal vital signs. Similarly, there was no difference in the number of patients presenting with a respiratory rate >24 , nor in the notification of a medical officer about this abnormal vital sign. However, proportionally more patients who had presented with a respiratory rate >24 were given

Table 1 Time taken from abnormal sign being identified to management

	Pre Mean (SD)	Post Mean (SD)	<i>t</i> (sig)
Systolic Blood Pressure >200	(none)	(no data available)	(not calculated)
Systolic Blood Pressure <90	0 hour 18 minutes (0 hour 26 minutes)	0 hour 05 minutes (0 hour 11 minutes)	1.008 (0.358)
Pulse Rate >140	(none)	0 hour 31 minutes (0 hour 46 minutes)	(not calculated)
Pulse Rate <40	(none)	(none)	(not calculated)
Respiratory Rate >24	0 hour 00 minutes (-)	0 hour 06 minutes (0 hour 09 minutes)	-0.622 (0.550)
Respiratory Rate <9	(none)	(none)	(not calculated)
Urinary Output <200 ml per 8 hrs or <20 ml per hr for 2 hrs	(none)	(none)	(not calculated)
Pain Score >2	1 hour 31 minutes (1 hour 30 minutes)	0 hour 44 minutes (0 hour 48 minutes)	1.012 (0.380)
New/Change/Uncontrollable Pain	(none)	(none)	(not calculated)
Glasgow Coma Scale <15	0 hour 18 minutes (0 hour 13 minutes)	0 hour 10 minutes (0 hour 12 minutes)	0.860 (0.436)
Recurrent/Prolonged Seizures	(none)	(none)	(not calculated)
O ₂ Saturation <90%	0 hour 27 minutes (0 hour 10 minutes)	0 hour 00 minutes (0 hour 00 minutes)	3.667 (0.170)
Fastest Management	0 hour 40 minutes (0 hour 57 minutes)	0 hour 30 minutes (0 hour 44 minutes)	0.668 (0.507)

medication at the post-implementation audit (40% pre, 100% post; $\chi^2 = 8.743$, $p = 0.003$).

There was a statistically significant increase in the number of patients identified as having a pain score >2 (Pre: 33.7%; Post: 6.3%; $\chi^2 = 78.884$, $p < 0.001$). However, there were no statistically significant differences in the documentation of the notification of a medical officer, nor in the number of patients receiving medication to manage this abnormal vital sign. Although not statistically significant, unlike other vital signs a small proportion of the medication administration was initiated by a nurse (20% pre, 13.0% post).

At the pre-implementation audit, no patients had presented with systolic blood pressure >200 or a pulse rate >140 with only three patients presenting with either of these vital signs at the post-implementation audit. However, all medical notes audited contained documentation about the assessment/monitoring of these vital signs. Similarly, no patients had presented with a pulse rate <40 or a respiratory rate <9 at either the pre-implementation or post-implementation audit. However, as noted above, all medical notes at both audit times contained documentation about the assessment/monitoring of these vital signs.

Conversely, the assessment/monitoring of some vital signs was very poorly documented. Few records (pre = 16.2%, post = 13.9%) contained documentation of low urinary output (<200 ml per eight hours or <20 ml per hour for two hours). Further, only one record contained documentation about recurrent/prolonged seizures, and no record documented the assessment/monitoring of new or changes in existing pain.

Actions taken in the management of abnormal vital signs

At the pre-implementation audit, documentation of a medical officer being in attendance was statistically significantly lower than at the post-implementation audit (Pre: $M = 0.21$, $SD = 0.495$; Post: $M = 0.45$, $SD = 0.670$; $t = -2.597$, $p = 0.010$) (see Table 2). Similarly, patients at the pre-implementation audit were statistically significantly less likely to receive medication to manage their abnormal vital sign (Pre: $M = 0.15$, $SD = 0.424$; Post: $M = 0.42$, $SD = 0.604$; $t = -3.336$, $p = 0.001$) (see Table 2).

While slightly higher at the post-implementation audit, there were no statistically significant differences in how often IV fluid was administered nor in other actions taken to treat abnormal vital signs, or how often medication administration, IV fluid administration or other actions were initiated by the nurse (p -values range from 0.229 to 0.671) (see Table 2).

Discussion

Observation of vital signs is essential in identifying, assessing and managing unstable or deteriorating patients (Goldhill & McNarry 2004, Cioffi *et al.* 2006, Endacott *et al.* 2007). As such, documentation of vital signs is crucial for clinicians to be able to respond to instability or deterioration in the patient's clinical condition. As with other early warning systems which have included 'triggers' which increase the sensitivity of the instrument (Oakey & Slade 2006), the AEDFC has facilitated the recognition of

Table 2 Number of actions taken per patient

	Pre Mean (SD)	Post Mean (SD)	<i>t</i> (sig)
Medical Officer in attendance (notified or likely to be)	0.21 (0.495)	0.45 (0.670)	-2.597 (0.010)
Medication given	0.15 (0.424)	0.42 (0.604)	-3.336 (0.001)
Medication given nurse initiated	0.08 (0.309)	0.12 (0.355)	-0.873 (0.384)
IV fluid given	0.11 (0.356)	0.19 (0.463)	-1.206 (0.229)
IV fluid given nurse initiated	0.00 (0.000)	0.01 (0.100)	-0.889 (0.375)
Other action taken	0.13 (0.402)	0.19 (0.484)	-0.938 (0.349)
Other action taken nurse initiated	0.11 (0.356)	0.14 (0.448)	-0.426 (0.671)

deterioration in the patient's clinical status by increasing identification, documentation and management of abnormalities in some vital signs.

Identification and Documentation of Vital Signs

Promisingly, documentation rates of eight of the 12 vital signs included on the AEDFC were complete (or near complete) at both audit times, reflecting the standard practice of clinicians to monitor these specific vital signs. It is important to note that there were a relatively low number of abnormal vital signs. This low number is a contributing factor to the failure to find statistically significant differences between the pre- and post-implementation audit.

Despite this, patients at the post-implementation audit were more likely to have an abnormal vital sign identified. While it could be argued that patients at the post-implementation audit did, in actual fact, have a greater number of abnormal vital signs, it is more likely that the AEDFC, which draws attention to specific vital signs, resulted in greater sensitivity in identifying these abnormal vital signs. A prime example of this is the identification and documentation of a pain level >2.

There was a dramatic increase in the documentation of a patient's pain, from 13.8% at the pre-implementation audit, to 80.2% at the post-implementation audit. Historically, pain has been poorly documented (Considine *et al.* 2006) and therefore poorly managed. The AEDFC, in drawing clinicians' attention to a patient's pain, has enabled clinicians an increased opportunity to monitor and manage abnormalities in this vital sign. This reflects the importance of the design of the observation chart (Australian Commission on Safety and Quality in Health Care

2007) to include specific parameters for observation, documentation and action (Chatterjee *et al.* 2005).

Managing Abnormal Vital Signs

Identification and subsequent documentation of abnormal vital signs is the first step in improving patient outcomes. The AEDFC, in facilitating the identification and documentation of abnormalities, provides a clear path to the notification of these abnormalities and their subsequent management (Australian Commission on Safety and Quality in Health Care 2007). Upon identifying abnormalities in vital signs in the ED, one of the first actions clinicians undertake is notifying a more experienced clinician or medical officer (Cioffi *et al.* 2006). Notes from the post-implementation audit indicated a medical officer was more likely to be in attendance than at the pre-implementation audit. This increased level of awareness and medical attention also resulted in a greater likelihood of medication being administered to manage the abnormal vital signs at the post-implementation audit.

It is interesting to note that there was an increase, though not statistically significant, in the number of actions (medication administration, IV fluid administration, other actions taken) initiated by clinicians. While indicating a more substantial and proactive role for clinicians in the ED, the number of actions taken were small due to the relatively low occurrence of abnormalities and must therefore be interpreted with caution.

A natural progression from increased awareness and notification is the timely management of abnormal vital signs. Although there were minor changes and differences in the times taken to identify abnormal vital signs, these differences were not statistically significant. It is therefore more relevant to examine the time taken from identification of abnormalities in vital signs to management.

There was wide variation in the time taken from identification to management, from 0 minutes (e.g. pre pulse rate <40, post O2 saturation) to 1.5 hours (e.g. pre pain score >2). The low occurrence of most vital signs, however, prevents a meaningful comparison for individual vital signs. Where data was available, time taken from identification to management of abnormal vital signs was shorter (though not statistically significantly so) at the post-implementation audit. Across all vital signs, the average time taken from identification to management was 30 minutes at the post-implementation audit, and 40 minutes at the pre-implementation audit. This appears to be consistent with another recent study which found time taken from identification to management to be approximately 39 minutes (Considine *et al.* 2012).

As stated previously, one of the best indicators of the success of the AEDFC in facilitating the identification, documentation and subsequent management of abnormal vital signs, is a patient's pain score. Although there was no statistically significant difference between the pre- and post-implementation audits, and non-documentation rates at the pre-implementation audit were high, the average time taken to manage a patient's pain was halved (from 1.5 hours at the pre-implementation audit to 44 minutes at the post-implementation audit). Not only does this highlight the importance of attention being given and drawn to specific vital signs as a part of the observation of patients in the ED, there is also an indication that increased awareness results in more timely management of unstable and deteriorating patients.

Limitations

A large number of patients at both audit times were not identified as having any abnormal vital signs, constituting a major limitation of the study. Although some statistically significant differences were found between the audit times (e.g. pain score >2), further research on a larger sample, or a more selective sample of patients presenting with abnormal vital signs, is required for more meaningful analysis and generalisability of the results.

Despite the increase in identifying and documenting some abnormal vital signs, it is worrying that data for others are still not documented (e.g. new/change/uncontrollable pain, recurrent/prolonged seizures, low urinary output). These findings are consistent with other research studies (Considine *et al.* 2006, Endacott *et al.* 2007), and highlight the need for further education about the importance of comprehensive documentation of all vital signs. Similarly, regular auditing of documentation is an important factor in increasing documentation of vital signs.

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This study also aimed to examine the number of MET call activations after the patient left the ED. However, there were no instances of MET call activations after leaving the ED. Again, further research on a larger sample is required for this analysis to be conducted, and comparisons made with other similar research studies.

Conclusion

The introduction of the AEDFC, a standardised observation chart specific to the ED, has facilitated the essential role of nurses in the identification and management of the unstable or deteriorating patient in the ED. Providing clinicians with the ability to accurately and consistently document all vital signs, through the provision of a dedicated space for these observations, led to improved documentation of a number of vital signs. Further research is required with a larger, or more selective, sample to determine the impact on the AEDFC on the rates of MET call activations.

Relevance to Clinical Practice

The AEDFC provides a valuable tool for the early identification and subsequent management of an unstable/deteriorating adult in the emergency department. It is of particular value to clinicians with limited experience. The importance of the AEDFC to clinical practice is highlighted.

Contributions

PH: study design, data collection, manuscript preparation; JE: study design, data collection, manuscript preparation; MJ: study design, data collection, data analysis, manuscript preparation; RL: data collection, data analysis, manuscript preparation.

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