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The challenges of implementation

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03

EMERGENCY CARE WITHIN HOSPITALS: CAN IT BE DONE MORE EFFICIENTLY?

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ABSTRACT

Objectives. Cardiac Arrest Teams (CATs) are frequently activated by nurses when patients experience 'false arrests' (FAs). In those cases activation of the Rapid Response Team (RRT) might be more efficient. We determined the level of urgency of FAs to find a scope for improvement in efficiency within emergency care.

Methods. CAT-activations for FAs in a university hospital from September 2009 to 2012 were retrospectively analysed and classified as urgent or less-urgent.

Results. In 26% (107/405) the CAT was activated for FAs. Calls were classified as urgent in 43% (46/107). Less urgent calls comprised 57% (61/107) of the FAs, difference 14% (95%CI: 1% to 26%).

Conclusions. A significant part of the CAT-activations for FAs were less urgent and an RRT-activation might be more efficient. To minimise the CAT-activations for FAs, nurses need to recognise early patients who clinically deteriorate. Therefore, nurses should use the Modified Early Warning Score correctly.

INTRODUCTION

Increasing economic restraints and awareness about patient safety mean hospitals are encouraged to evaluate their care processes.¹ This should lead to a more efficient healthcare delivery and an improvement of the quality of care. The process of activating teams that are 24/7 on standby in case of medical emergencies, i.e. the traditional Cardiac Arrest Teams (CATs) and the more recently introduced Rapid Response Teams (RRTs), could potentially managed more efficiently.

Approximately 80% of patients have vital signs abnormalities in the 24 hours prior to Adverse Events (AEs), i.e. cardiac arrests, unplanned intensive care unit admissions and unexpected death.^{2,3} These abnormalities could be detected in an early stage, by measuring the vital signs frequently. To aid in this detection process the Modified Early Warning Score (MEWS) has been developed. This is a tool whereby nurses allocate points to the measurement of vital signs resulting in a summary score.^{4,5} When reaching a predefined threshold nurses should act by either calling the doctor on duty or emergency teams.

In the Netherlands there are differences in organisation between the emergency teams. The CAT, with an average of four members, is responsible for immediate response for patients suffering from cardiac arrests.³ The RRT, with generally two members responds within 10 minutes for evaluation, triage and treatment of patients who clinically deteriorate to prevent them from suffering an AE.^{2,3,6,7} CATs are focussed on cardiopulmonary resuscitation or unexpected life-threatening medical emergencies. They intervene according to strict advanced resuscitation protocols⁸, while RRTs have specific expertise in care for clinically deteriorating patients before the occurrence of cardiac arrests.³ The most common reasons for calling RRTs are hypoxia, hypotension, altered conscious state, tachycardia or oliguria.⁹

To monitor CAT performances and outcomes, hospitals are registering CAT activations according to the international Utstein guideline.¹⁰ In a substantial number, CATs are activated while patients do not suffer from cardiac arrests. These activations are called 'false arrests' (FAs).¹¹⁻¹⁴ For these calls basic or advanced life-support is not needed¹⁰ and immediate response of the larger CAT may not be necessary. More importantly, previous studies have shown that most patients with FAs have signs of clinical deterioration that are commonly seen prior to cardiac arrests.¹³ CATs are frequently activated for FAs, proportions ranging from 8% to 30%.¹¹⁻¹³ Nevertheless, the characteristics of these calls are hardly ever reported in detail and little information is available about their medical urgencies. It is suggested that the RRT would be an appropriate and more efficient team

to respond to these calls.¹⁵ If health professionals would know the level of urgency of FAs, this information could be used as a first step to assess the potential to reorganise both emergency teams to achieve greater efficiency. The aim of this study was to assess what proportion of the CAT activations in a Dutch university hospital within a 3-year period were classified as FAs and what percentage of these FAs were classed as urgent or less-urgent in order to find a scope for improvement in efficiency within the emergency care. Therefore, we addressed the following research questions: 1) what proportion of the CAT activations within a 3-year period were classified as FAs? 2) What percentage of these FAs were classed as urgent or less-urgent at the moment the nurses activated the CAT?

METHODS

Ethics

The study was approved by the Medical Ethics Committee of the Academic Medical Center of Amsterdam, the Netherlands. This study conforms to the provision of the Declaration of Helsinki in 1975 and revised in 2008. The Medical Ethics Committee waived the need for informed consent.

Design and setting

A retrospective study was conducted in a university hospital in Amsterdam. All registered FAs that occurred between September 2009 and September 2012 were retrospectively analysed.

Inclusion and exclusion criteria

Registered CAT activations for FAs for adult patients (≥ 18 years) who collapsed in hospital, i.e. on nursing wards or interventions rooms, were included in this study. In our hospital the RRT can only be activated for patients who are admitted to the hospital and so calls from the outpatients department, emergency rooms, or public areas were excluded from analyses. No information was registered for the cancelled calls and these were excluded from analysis.

Cardiac Arrest Team (CAT)

In our hospital, the CAT is available 24/7 and consists of a resident, and a nurse from the cardiology department and a resident and a nurse from the anaesthesiology department. The CAT-members are formally trained and certified in all aspects of advanced life support and they intervene according to strict resuscitation guidelines.⁸

The CAT is responsible for patients who suffer from cardiac arrests or with an unexpected or suspected life-threatening medical emergency. The CAT attends to the patient within 2 minutes after activation.

Rapid Response Team (RRT)

The RRT is part of a system; the Rapid Response System (RRS). The RRS aims to detect and treat deteriorating patients on general wards and to prevent them from suffering an AE.^{2,3} The first step of the RRS protocol is the detection of deteriorating patients. A commonly used instrument to detect these patients by measuring vital signs is the MEWS.^{4,5} The Dutch MEWS incorporates eight vital signs or parameters (Table 1). Each parameter has a standardised range of cut-off points. Predefined weighted trigger scores should be allocated to each recorded parameter. Nurses should record all 8 parameters for a correct completion of the MEWS. According to the two-tiered Dutch system, the RRS-protocol dictates that when reaching a predefined threshold, the nurse has to notify the physician on duty on the ward. The physician must assess the patient within 30 minutes and could either initiate treatment or activate the RRT instantly.⁶ In case the clinical condition is not improving or if the physician is not able to assess the patient, it is the nurse who must activate the RRT. The RRT consist of an ICU fellow and ICU nurse and is 24/7 available. They attend to the patient within 10 minutes of activation.

Training in emergency care

Nurses are trained in Basic Life Support (BLS), which includes training in: 1) recognizing cardiac arrests; 2) call for help and activate the CAT; 3) acting as a first responder and start resuscitation. Nurses are required to follow the BLS retraining every 3 years. In September 2011 the RRS protocol was implemented in our hospital. All nurses and physicians on the wards were trained in measuring the MEWS and in activating the RRT. New nursing employees are trained in the RRS protocol on the nursing wards by senior nurses specialised in quality improvement.

Table 1. The Modified Early Warning Score (MEWS)⁴

MEWS score	3	2	1	0	1	2	3
Respiratory rate		<9		9-14	15-20	21-30	>30
Saturation with adequate oxygen therapy	< 90						
Heart rate		<40	40-50	51-100	101-110	111-130	>130
Systolic blood pressure	<70	70-80	81-100	101-200		>200	
AVPU score				A (Alert)	V (response to Voice)	P (reacting to Pain)	U (Unresponsive)
Temperature		<35.1	35.1-36.5	36.6-37.5	>37.5		

Urine production below 75 mL during previous 4 hours: 1 point

Worried about patient's condition: 1 point

Upon reaching 3 or more points → call resident in charge

CAT registrations

All CAT activations are real-time registered in an electronic database 'Advanced Life Support Information System' according to the Utstein guidelines.¹⁰ Data belonging to the AE (i.e. patient characteristics, first observed symptoms, location of collapse, cause of the AE, clinical outcomes) are recorded at the bedside by a nurse who participates in the CAT.

Classifying observations

The symptoms that were used to determine the level of urgency of the FAs were systolic blood pressure, Glasgow Coma Score (GCS) and respiratory status. The vital signs are directly recorded in standard categories in the database (Table 2). The data was registered and stored in the electronic database and the calls categorised as 'urgent' or 'less urgent'. Calls were classified as *urgent* when at least one of the following observations was registered: 1) Systolic blood pressure levels between 50 and 75 mmHg or not palpable^{16,17}, or 2) GCS < 9¹⁸, or 3) assumed apnoea or gasping.^{8,19} Calls were classified as *less urgent* when all of the following observations were present: 1) Palpable systolic blood pressure or levels ≥ 76 mmHg^{16,17}, and 2) GCS ≥ 9¹⁸ and 3) breathing normally or with effort.^{8,19}

Table 2. Classifications of the false arrests

	Urgent false arrests All the observed symptoms are present ^a	Less urgent false arrests At least one of the observed symptoms are present ^a
Systolic blood pressure	pressure levels between 50-75 mmHg or not palpable	palpable systolic blood pressure or levels ≥ 76 mmHg
GCS ^b	GCS < 9	GCS ≥ 9
Respiratory pattern	assumed apnoea or gasping	breathing normally or with effort

^a Symptoms observed by hospital staff while activating the CAT

^b GCS: Glasgow Coma Scale

Statistical analysis

Continuous normally distributed variables were expressed by their mean and standard deviation or when not normally distributed as medians and their interquartile range (IQR). Categorical variables were expressed as percentages, numerators and denominators. Differences between groups were tested by using the Student's t-test and if continuous data was not normally distributed the Mann-Whitney *U* test was used. Categorical variables were compared with the chi-square test or Fisher's exact tests when appropriate. Statistical significance was considered to be at $p < 0.05$. Statistical uncertainty was expressed as 95% Confidence Intervals (CI). Data analysis was performed with IBM SPSS version 20, inc., Chicago, IL.

RESULTS

Within the 3-year study period 405 CAT-activations were registered. In 74% (298/405) of these activations, the patients suffered from true cardiac arrests according to the Utstein guidelines. In 26% (107/405) the CAT was activated for FAs (Fig. 1). After analysing the CAT-activations for FAs, we found that 43% (46/107) of the FAs were urgent calls because of the severity of the observed symptoms. Less urgent calls were present in 57% (61/107) of the FAs (Fig. 1), difference 14% (95% CI: 1% to 26%). The median age of patients with an urgent FA was 67 years (IQR 50-76) and in the less urgent group a median age of 62 years (IQR 45-71) was found, $p=0.085$ (Table 3). The median time the CAT spent at urgent calls was 27 minutes (IQR 13-41) versus 20 minutes (IQR 10-30) at less urgent calls, $p=0.072$.

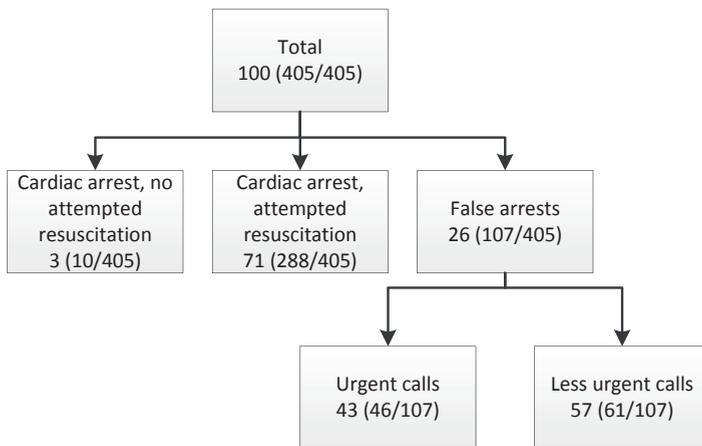


Figure 1. Classification of the CAT activations and false arrests, (% (n/N)).

Table 3. Demographics

	Urgent false arrests	Less urgent false arrests	P-value
Age in years, median (IQR)	67 (50-76)	62 (45-71)	0.085 ^a
Sex, male, % (n/N)	44 (20/46)	66 (40/61)	0.023 ^b
Died during hospital admission, % (n/N)	13 (6/46)	8 (5/61)	0.414 ^b

^a Mann-Witney U test

^b Chi-square test

IQR: interquartile range

DISCUSSION

This study shows that in 26% of the calls, the CAT was activated for FAs. These findings are comparable with previous studies about FAs.¹¹⁻¹³ Nearly 60% of the FAs identified were classified as 'less urgent calls'. Immediate attendance of the larger CAT might not be required for the less urgent calls and the smaller RRT could be activated instead. RRTs have fewer team members than CATs, thus fewer emergency team members are mobilized. RRTs are especially developed to intervene in an earlier stage of clinical deterioration.^{3,7}

Although, the majority of the patients with FAs seem to have non-urgent symptoms, it is noteworthy to mention that these symptoms often exist prior to cardiac arrests.²⁰⁻²² Therefore, even these less urgent calls must be taken seriously.¹¹ This indicates the importance of following the complete RRS protocol. It starts by measuring the vital signs and MEWS frequently to detect patients who are at risk for clinical deterioration. When reaching a predefined threshold nurses should act on this by either calling the primary physician or RRT. By measuring the MEWS nurses will have a clear guideline on how to act when patients clinically deteriorate and who to call. The remaining FAs were classified as 'urgent calls', because at least one serious clinical symptom was observed.^{8,19,20} Despite the urgency of these calls, these are still defined as FAs according to the Utstein guidelines. Nevertheless, given the severity of the symptoms, immediate response of an emergency team is required. Since the CAT attends to patients within 2 minutes, the CAT is the most suitable team to activate for urgent FAs.

Opportunities for enhancement

Although this study was not designed to consider efficiency or potential improvements, the results could still be used to enhance emergency care. Previous studies have shown that cardiac arrests are not unpredictable events. More than 80% of the patients have identifiable signs of physical deterioration in the hours prior to cardiac arrests.^{20,21,23} However, incomplete vital sign or MEWS measurements often exists.²⁴⁻²⁶ It is known that the respiratory rate, in particular, is often not recorded.^{24,27} This is in spite of the fact that there is evidence that an abnormal respiratory rate is an important predictor of serious AEs.^{27,28} Nurses do not always recognise symptoms of physical deterioration and this can lead to delayed care.^{29,30} This is also associated with decreased survival from in-hospital cardiac arrests²⁹ and lower survival rates.³⁰ Protocols are available for activating emergency teams. However, protocols are often not followed completely.^{25,26,31} Education could help with implementation.^{25,32} Measuring the MEWS more often could also help. Standardized measurements of the MEWS 3 times daily significantly improves the correct measurement of the MEWS, i.e. recording of all 8 MEWS parameters.²⁴

The Utstein guideline was developed in order to monitor CAT performances and the effects on patient outcomes.¹⁰ By collecting and reviewing performance data the quality of emergency care can be improved and risks can be reduced. A guideline in the Utstein format for standardising RRT calls, performances and calling criteria is available³³, although not widely used in the literature. Another point emerging from this discussion is the possibility of making one of the teams redundant by either merging the teams or rearranging the team compositions. Originally, the RRT superseded the traditional CAT³⁴ and responded to all types of in-hospital emergency care including cardiac arrests. The

benefit of one emergency team being operational is that there is no uncertainty about which team to call. However, several disadvantages have been described as well. For instance, barriers exist to call a large attending team for clinically deteriorating patients who might not be seriously ill, but for whom the team must be called according to the predefined calling criteria.³⁵ Moreover, inexperienced staffs sometimes feel anxious about seeking help and calling this team.³⁵ This also results in patients receiving delayed care.

Limitations

The present study has some limitations. We analysed the CAT activations for FAs retrospectively. The data was, however, real-time registered in the database. Another limitation is that the data is from a single medical centre and the results may not be generalizable to other hospitals. Another limitation is that in our hospital two emergency teams are operational. The composition and call procedures of emergency teams varies highly between hospitals, which has consequences for the generalisability of our results. By excluding the out-patient department, emergency rooms and public areas in the data-analysis, the total number of patients with FAs for whom the CAT was activated might be an underestimation of the results. Finally, analysis of the RRT calls was not possible due to lack of a predefined system of classifying RRT calls in the hospital.

Future research

Future research is needed in order to find effective strategies for implementing the MEWS on nursing wards and to improve the sustainable adoption of the MEWS. Computerised decision support could play a role especially as we are moving towards systems in which all vital signs are monitored continuously by using a wireless patient monitoring system.³⁶ Use of qualitative research methods are needed to provide data on why and how the implementation succeeded or not as well as to explore nurses' perceptions and experiences of using the MEWS and related protocols.³⁷ Using a qualitative approach would allow exploration around measuring the MEWS, barriers to activate the emergency teams or to identify external environment factors, such as busyness of wards. Furthermore, research should focus on how emergency teams could be optimised by either merging or rearranging the composition of both teams to achieve both financial and qualitative benefits.

CONCLUSIONS

Since nurses are almost continuously present on the ward while caring for their patients, they are responsible for the early detection of clinical deterioration of patients. Nurses are also the first to be confronted with the majority of collapsed patients. Hence, nurses play an important role in the activation of the emergency teams. Our results show that when nurses activated the CAT, a significant part of the FAs were less urgent. In those cases activation of the RRT might be more efficient. In order to avoid cardiac arrests and thus potentially minimise the CAT activations for FAs, nurses should early recognise and respond to patients who clinically deteriorate. In our view, it is therefore imperative that nurses should use the MEWS correctly. When completing the MEWS nurses have a clear guideline on how to act when patients clinically deteriorate and who to call. Future research should focus on finding strategies to implement the MEWS successfully and how the organisation of the emergency teams could be optimised to achieve both financial and qualitative benefits.

Competing interest

The authors declare that they have no competing interests.

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