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Whats that noise? Bedside monitoring in the Emergency Department

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ABSTRACT

Objective: To determine the frequency, duration and type of audible monitor alarms in an ED, utilising the standard manufacturer's classification.
Methods: The audible monitor alarms and the timing of any intervention related to the patient monitoring was observed and recorded.
Results: 110 Patients admitted to the Majors area or Resuscitation Room were observed for a total of 93 hours. One monitor was observed at a time. Alarm noise was generated 29% of the observation time. Overall, 429 alarms lasting 21 hours 27 minutes were judged to be positive and 143 alarms lasting 5 hours 47 minutes, negative. 74% of Resuscitation Room and 47% of Majors alarms were silenced or paused. Alarm limit parameters were only adjusted after 5% of alarms in Resuscitation Room and 6% of alarms in Majors.
Conclusions: Whilst high level monitoring is desired from a patient safety perspective, it contributes to a significant ambient noise level, which is recognised by all who pass through an ED, and can be detrimental to patients, relatives and staff. We have demonstrated that there is a high probability of near-continuous alarm noise from patient monitoring in a 10-bedded Majors area. We make suggestions for methods of noise reduction and intend to implement some of these within our own ED.

Introduction

Semi-automated bedside monitors have been in use in critical care units within hospitals for many years, in line with health planning guidance (Department of Health, 2003, 2013a). This has enabled continuous monitoring of heart rate, ECG, respiratory rate, oxygen saturation, end-tidal carbon dioxide, invasive blood pressure and intermittent non-invasive blood pressure. In Emergency Departments (ED) there are clear clinical standards for monitoring patients undergoing procedural sedation in Resuscitation Rooms (College of Emergency Medicine & Royal College of Anaesthetists, 2012). However, there is no generic recommendation about the level of monitoring required in ED from the Royal College of Nursing, College of Emergency Medicine, or in the Health Building Notes 15-01; Emergency Departments (Department of Health, 2013b). This has probably been a contributing factor to the sporadic and relatively recent adoption of integrated monitoring systems across ED witnessed by the authors.

As part of redevelopment programme in 2002, the ED of the John Radcliffe Hospital, Oxford University Hospitals NHS Trust had an integrated monitoring system installed in the Resuscitation Room and Majors area. The Resuscitation Room is a 4-bedded area, staffed by two registered nurses, providing the highest level of care in the ED. Majors is a 10-bedded area, staffed by two registered nurses, providing the next level of care for adults, but excluding those patients with minor injuries or illness. This improved access to equipment has provided the opportunity to continuously monitor a larger number of patients. Monitors are wall mounted, at the bedside, with a central station on the nurses' desk echoing the bedside alarm. Whilst the availability of equipment at each patient's bedside in an ED can be viewed as a positive step in meeting the standard for early recording of vital signs (National Institute for Health and Care Excellence, 2007; College of Emergency Medicine, 2012). Little or no evaluation of using continuous monitoring systems in UK emergency care has been undertaken.

Patients in the ED where the study was completed have continuous vital sign monitoring using these monitors. As part of the standard safety features, the monitors have manufacturer-set alarms associated with abnormally high and low values for each of the vital sign parameters recorded, and for ECG interpretation. These alarms can be set to a new value, as determined by the nurse, although they reset to the factory settings once the monitor has been turned off.

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Within the ED staff and patients are subjected to a high frequency of multiple alarms causing disturbing background noise. Background noise, including that generated due to transient artefact from the automated recordings, has been measured in an Intensive Care Unit (ICU) setting to reach 80 dB(A) (Balogh et al., 1993; Christensen, 2007). Christensen (2007) also notes that the Health and Safety Executive (2005) stipulates that noise levels within a work place should not exceed 85 dB(A). Moreover, the frequency of false alarms can lead to a situation where alarms are ignored, as was found in three international studies of critical care monitoring systems (Phillips and Barnsteiner, 2005; Graham and Cvach, 2010; Siebig et al., 2010). Whilst these studies are useful in identifying the nature and frequency of these alarms in critical care settings, there have been no published papers related to these phenomena in ED.

This audit was completed as part of the background work related to our research into an integrated monitoring system using data fusion technology to detect deterioration in patients (REC no. 08/H1307/56). For this reason we did not consider alarms from other sources or the noise level of the alarms.

Objective

Determine the frequency, duration and type of the monitor alarms in an ED, utilising the standard classification provided by the manufacturer.

Methods

This study was assessed by the local ethics committee chair not to require ethical approval.

Three research nurses who are experienced in emergency care and are known to the remainder of the clinical staff undertook observation over a six-week winter period. This period sees a higher throughput of patients, which enabled an analysis of the nurses' ability to respond when they were most busy, although they were never caring for more than five patients, as defined in departmental policy.

Table 2
Study time in each area.

	Number of observation periods	Total time
Resuscitation Room	61	53 hours 59 minutes
Majors	49	39 hours 3 minutes
Total	110	93 hours 2 minutes

The research nurses were non-participant observers with the caveat that they would intervene if they observed a life-threatening problem, however this did not occur during the audit. To reduce the possibility of sampling bias, monitored patients in four pre-selected cubicle spaces in the ED, two in "Majors" and two in the "Resuscitation Room", were observed. The allocation of patients to a specific cubicle was outside of the control of the research nurses, as was the staff : patient ratios in the department. One monitored patient was observed at a time, either until they were transferred from the cubicle or for a maximum period of one hour.

The frequency, duration and type of any audible alarm related to the patient monitoring was noted. These alarms were classified using the manufacturer's standard alarm definitions (see Table 1, Phillips, 2002).

The timing of any intervention by the clinical emergency nurses in relation to the monitoring alarm was also observed and recorded. A silenced alarm had no audible tone for 1 minute, and a paused alarm had no audible tone for 3 minutes. The audible tone would recommence after this time interval if the alarm condition still existed, and was classified as another episode of alarm noise.

Table 1
Nature of alarms summarised from the manufacturer's classification (Phillips, 2002).

Colour	Sound	Condition	Summary
Red	High pitched sound, repeated once per second	Asystole Extreme Bradycardia Extreme Tachycardia Ventricular fibrillation Desaturation (<80%) Apnoea	Clinically significant, potentially life threatening
Yellow	Lower pitched sound, repeated every two seconds	STII elevation/ depression SVT Saturations low (<90%) Low pulsatile SpO2 RR high >30 RR low <8 HR high >120 HR low <50 NBP high NBP low	Some clinically significant/life threatening alarms Others relate to ECG interpretation
Yellow-short	Same audible indicator as for yellow alarms, but shorter duration	Irregular Missed Beat Multiform PVC Ventricular tachycardia PVC/min (>10) R-on-T PVC Ventricular bigemeni	Relate to ECG rhythm/morphology
INOP (Inoperative)	INOP tone repeated every two seconds	Cannot analyse ECG Leads off alert Probe off alert Disconnect Unreadable Check status log alert	Inadequate signal received