

EVALUATION OF RAPID RESPONSE TEAM FLAG-ALERT PARAMETERS

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INTRODUCTION

It is technically feasible to construct a single system that extracts real-time data from an unlimited number of disparate cardiac and respiratory monitors. Management of these data requires rules-based, context aware intelligent software. Such software has recently been introduced to command infusion pumps, generate alarms and notify clinicians of adverse changes in patient status. The purpose of this study was to characterize current flag-alert trigger parameters for deployment of rapid response teams, a prerequisite for designing valid rules-based software for use in this particular clinical setting.

METHODS

The literature was searched electronically (Journals@OvidR) and manually for articles published between 2002 and 2008. Articles that featured flag-alert parameters were reviewed. Inclusion criteria included the provision that selections be published in peer-reviewed journals. Search terms included medical emergency team, rapid response and critical care outreach. Articles that featured flag-alert parameters were reviewed. The methods of the articles were evaluated with respect to flag-alert criteria.

RESULTS

1. Twenty three articles fulfilled the study criteria. Twenty one of these articles provided predetermined vital sign flag-alert parameters and thresholds. By contrast, two featured proprietary, data-driven definition of the upper limit of normal, with multiple threshold and combinations of sub-threshold deviations as a single derived numeral;
2. Ordinate parameters consisted of heart rate, systolic blood pressure, respiratory rate, SpO₂, temperature, urine output and blood chemistry data. Dichotomous parameters consisted of arrhythmias, neurological status and staff and/or family concern for any reason;
3. Ordinate and dichotomous parameters were inconsistent from protocol to protocol;
4. Ordinate parameter thresholds were also disparate. By definition, dichotomous parameter thresholds were similar;
5. Sixteen protocols incorporated the ability to over-ride the system at any time, independently of specific clinical data (staff and/or patient family concern for any reason).

CONCLUSIONS

- 1) A universally-accepted optimal set of flag-alert parameters and parameter thresholds have yet to be defined;
- 2) Conclusions from the comparison of results of studies associating rapid response team intervention to patient outcome should not be based on an assumption of uniformity of study methods;
- 3) The diametrically opposite approaches to the definition of clinically unacceptable vital sign thresholds (open versus proprietary) presents a conundrum to designers of rules-based software.

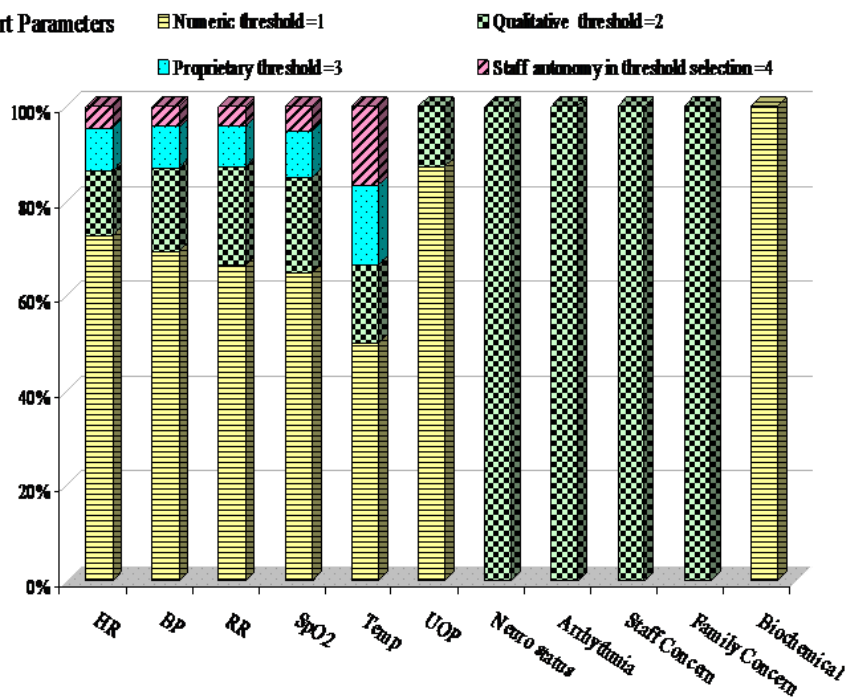
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Flag-alert parameters

	HR	BP	RR	SpO ₂	Temp	UOP	Neuro status	Arrhythmia	Staff Concern	Family Concern	Biochemical
Calzavacca (2008)	1	1	1	1		1	2				
Genardi (2008)	1	1	1	2		1	2	2	2	2	
Hravnak (2008)a	1	1	1	1			2	2			
Hravnak (2008)b	3	3	3	3							
Hunt (2008) #	2	2	2	2			2		2	2	
Brilli (2007) #			2	1			2		2	2	
Dacey (2007)	1	2	1				2		2		
Halvorsen (2007)	1	1	1	1	2		2	2	2		
McFarlan (2007)	1	1	1	1	1		2	2			
Offner (2007)	1	1	1				2	2	2		
Sebat (2007)		1	1		1	1	2				
Sharek (2007) #	2	2	2	2			2		2		
Garretson (2006)	1	1	2	1		1	2		2		
Murray (2006)	2	2	2	2		2	2		2		
Tarassenko (2006)	3	3	3	3	3						
Watkinson (2006)	4	4	4	4	4						
Jones (2005)	1	1	1	1			2		2		
Hillman (2005)	1	1	1				2		2		
Tibballs (2005) #	1	1	1	1			2		2		
Bellomo (2004)	1	1	1	1		1	2		2		
DeVita (2004)	1	1	1	1							
Bellomo (2003)	1	1	1	1		1	2		2		
Buist (2002)	1	1	1	1			2		2		
Hodgetts (2002)	1	1	1	1	1	1	2		2		1

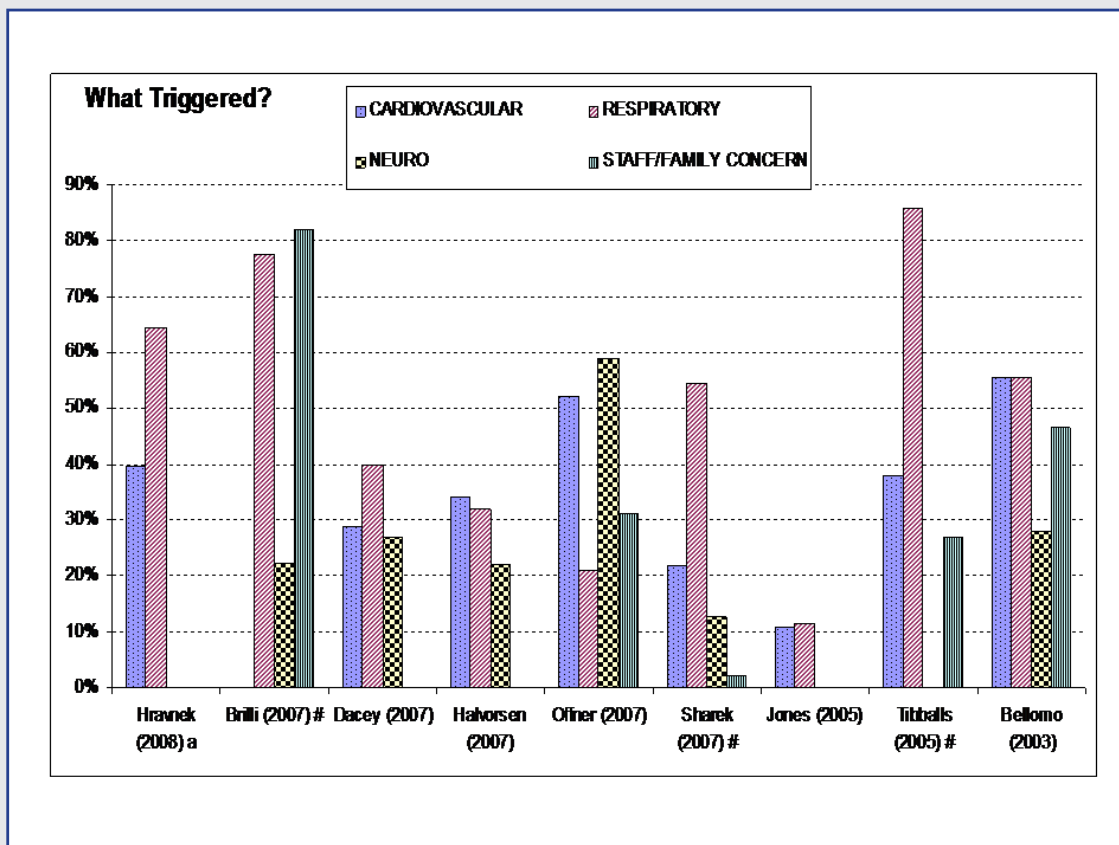
(1 = Numeric threshold, 2 = Qualitative threshold, 3 = Proprietary threshold, 4 = Staff autonomy in threshold selection, # = Pediatric)

Flag-alert Parameters



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VITAL SIGN NUMERIC THRESHOLDS									
	Bradycardia	Tachycardia	Hypotension	Hypertension	Bradypnea	Tachypnea	SpO ₂	Temp	Urine Output
Calzavacca (2008)	< 40	> 120	< 90		< 8	> 25	< 90		< 50*4 hours
Genardi (2008)	< 40	> 130	< 90		< 8	> 24			< 50*4 hours
Hravnak (2008) a	< 40	> 140	< 80	> 200	< 8	> 36	< 85*5 min		
Brilli (2007) #					< 8		< 90 (Suppl O ₂)		
Dacey (2007)	< 50*15 min	> 130*15 min			< 8	> 30			
Halvorsen (2007)	< 40	> 130	< 90		< 8	> 30	< 88 (Suppl O ₂)		
McFarlan (2007)	< 51	> 129	< 91		< 8	> 24	< 90 (RA) or < 92 (Suppl O ₂)	< 96 F or > 101 F	
Offner (2007)	< 40	> 130	< 90		< 8	> 24			
Sebat (2007) ##			< 90			> 19		< 36 C	< 30 per hr
Garretson (2006)	< 40	> 130	< 90		< 8	> 30	< 90 (Suppl O ₂)		< 50*4 hours
Jones (2005)	< 40	> 130	< 90		< 8	> 30	< 90 (Suppl O ₂)		
Hillman (2005)	< 40	> 140	< 90		< 5	> 36			
Tibballs (2005) #	Age index						< 90 (Suppl O ₂) or < 60 (Cyanotic HD)		
Bellomo (2004)	< 40	> 130	< 90		< 8	> 30	< 90 (Suppl O ₂)		< 50*4 hours
DeVita (2004)	< 40	> 140	< 80	> 200	< 8	> 36	< 85*5 min		
Bellomo (2003)	< 40	> 130	< 90		< 8	> 30	< 90 (Suppl O ₂)		< 50*4 hours
Buist (2002)		> 130	< 90		< 6	> 30	< 90 (Suppl O ₂)		
Hodgetts (2002)	Weighted								



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OUTCOME MEASUREMENTS	
Calzavacca (2008)	Deaths hospital-wide
Genardi (2008)	Cardiac and respiratory arrests outside ICU, cardiac and respiratory arrests and deaths hospital-wide
Hravnak (2008) a	N/A
Hravnak (2008) b	N/A
Hunt (2008) #	Cardiac and respiratory arrests outside ICU per 1,000 patient days
Brilli (2007) #	Cardiac and respiratory arrests outside ICU per 1,000 patient days and per 1,000 admissions
Dacey (2007)	Cardiac arrests per 1,000 discharges, unplanned ICU admissions and deaths hospital-wide
Halvorsen (2007)	Cardiac arrests, unplanned ICU admissions and deaths hospital-wide per 1000 admissions
McFarlan (2007)	Cardiac arrests outside ICU, cardiac arrests in ICU and unplanned ICU admissions per 1,000 discharges
Offner (2007)	Cardiac arrests outside ICU per 10,000 discharges
Sebat (2007)	Deaths hospital-wide
Sharek (2007) #	Cardiac and respiratory arrests outside ICU per 1,000 patient days and per 1,000 admissions and deaths hospital-wide per 100 discharges
Garretson (2006)	N/A
Murray (2006)	Cardiac and respiratory arrests outside ICU, cardiac and respiratory arrests hospital-wide and deaths hospital-wide
Tarassenko (2006)	N/A
Watkinson (2006)	Cardiac arrests hospital-wide, unplanned ICU admissions, emergency surgical procedures and deaths hospital-wide
Jones (2005)	Cardiac arrests outside CCU, OR and ER – excludes "not for resuscitation" cases
Hillman (2005)	Cardiac arrests, unplanned ICU admissions and unexpected deaths per 1,000 admissions
Tibballs (2005) #	Cardiac arrests outside OR, unplanned admissions to ICU and deaths hospital-wide per 1,000 admissions
Bellomo (2004)	Adverse events (postoperative myocardial infarct, pulmonary edema, pulmonary embolism, respiratory failure, stroke, sepsis and renal failure), unplanned ICU admissions, hospital bed-days and postoperative deaths
DeVita (2004)	Cardiac arrests outside ICU, PACU and ER and post-cardiac arrest deaths per 1,000 admissions
Bellomo (2003)	Cardiac arrests, deaths from cardiac arrest, ICU bed-days occupied by cardiac arrest survivors, hospital bed-days occupied by cardiac arrest survivors and deaths hospital-wide
Buist (2002)	Cardiac arrests per 1,000 admissions – excludes "not-for-resuscitation" cases
Hodgetts (2002)	N/A

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