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Title: Effect of a 2-Tier Rapid Response System on patient outcome and staff satisfaction

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CONFLICTS OF INTERESTS

None

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ABSTRACT

Background

Rapid response systems (RRS) have been recommended as a strategy to prevent and treat deterioration in acute care patients. Questions regarding the most effective characteristics of RRS and strategies for implementing these systems remain.

Aims

The aims of this study were to (i) describe the structures and processes used to implement a 2-tier RRS, (ii) determine the comparative prevalence of deteriorating patients and incidence of unplanned intensive care unit (ICU) admission and cardiac arrest prior to and after implementation of the RRS, and (iii) determine clinician satisfaction with the RRS.

Method

A quasi-experimental pre-test, post-test design was used to assess patient related outcomes and clinician satisfaction prior to and after implementation of a 2-tier RRS in a tertiary metropolitan hospital. Primary components of the RRS included an ICU Outreach Nurse and a Rapid Response Team. Prevalence of deteriorating patients was assessed through a point prevalence assessment and chart audit. Incidence of unplanned admission to ICU and cardiac arrests were accessed from routine hospital databases. Clinician satisfaction was measured through surveys.

Results

Prevalence of patients who met medical emergency call criteria without current treatment reduced from 3% prior to RRS implementation to 1% after implementation; a similar reduction from 9% to 3% was identified on chart review. The number of unplanned admissions to ICU increased slightly from 17.4/month prior to RRS implementation to 18.1/month after implementation ($p=0.45$) while cardiac arrests reduced slightly from 7.5/month to 5.6/month ($p=0.22$) but neither of these changes were statistically significant. Staff satisfaction with the RRS was generally high.

Conclusion

The 2-tier RRS was accessed by staff to assist with care of deteriorating patients in a large, tertiary hospital. High levels of satisfaction have been reported by clinical staff.

KEYWORDS

Critical Care, Nurses' role, Rapid Response System, ICU Outreach, Intensive Care Unit

INTRODUCTION

Rapid response system (RRS) development has been driven by the knowledge that critical deterioration in patients is often preceded by measurable signs of physiological deterioration for many hours prior to that event.[1] Early identification of this deterioration, with implementation of appropriate treatment, has the potential to improve patient outcomes. Yet, hospitals struggle to ensure that RRS are both implemented and activated appropriately.

RRS are conceptualised as having an afferent and efferent arm, both of which are multifaceted.[1, 2] The afferent arm focuses on detecting deterioration and consists of tools such as the modified early warning score [3] and the medical emergency calling criteria.[4] The efferent arm encompasses response strategies such as Intensive Care Unit (ICU) outreach nurses, sometimes called ICU Liaison Nurses [5] and Rapid Response Teams (RRT), also called medical emergency teams (MET).[1] Many single centre, before-and-after studies have suggested that implementing a RRS improves patient morbidity and mortality,[6] although the results of reviews to identify the effects of both afferent and efferent interventions have been mixed.[2] These conflicting results are likely related to the difficulties in conducting high quality studies such as randomised controlled trials of health system interventions as well as heterogeneity of the implementation strategies used.

Despite these inconsistencies, many agree that early intervention makes 'sense' and widespread recommendations for the implementation of RRS in acute care hospitals have been made.[7, 8] Questions around the most effective characteristics of RRS and methods for implementing these systems remain. There are variations in characteristics such as activation criteria, membership of the RRT and funding for RRS activities.[9-11] An additional question includes whether RRT should act separate from, or as an extension of any 'code' (cardiac arrest) team that exists.[12, 13] Recent literature has suggested RRS models that incorporate both afferent and efferent strategies provide benefit over single purpose systems.[1, 4]

Despite widespread support for RRS, there has been little documentation and analysis of the strategies used to implement, sustain or evaluate these systems.[14, 15] Use of RRS remains inconsistent and probably underutilised, and although reasons for lack of activation are not entirely clear,[2, 16] some beginning understanding of relevant factors is available.[17] Given this beginning knowledge, the recommendations made by the Australian Commission on Safety and Quality in Healthcare for all healthcare facilities to have systems in place to recognise and respond to clinical deterioration[7] and anecdotal evidence to suggest the current local system did not meet all clinical needs, a revised 2-tier RRS was planned. The two tiers of this system were to consist of an ICU Outreach Nurse service and a RRT, with the aim of enabling easy and rapic escalation of care for patients who condition was deteriorating.[7] A system that takes account of the structures that exist within the surrounding organisation, supports effective processes of care, is perceived as being easy and relevant to use and produces a high level of outcomes is essential to achieve intended goals.[18] The aims of this present study were therefore to (i) describe the structures and processes used to implement a 2-tier RRS, (ii) determine the success of the 2-tier RRS using patient-centred outcomes and (iii) to determine clinician satisfaction with the 2-tier RRS.

METHOD

A quasi-experimental, pre-test post-test design was used to assess the impact of a new 2-tier RRS within the Princess Alexandra Hospital (PAH) in Brisbane, Australia on the:

1) Prevalence of deteriorating patients;

2) Incidence of unplanned admissions to ICU from the hospital wards and cardiac arrests (excluding ICU and Emergency Department [ED] arrests); and

4) Staff satisfaction with the new service.

The PAH is a 750 bed tertiary hospital that caters to most specialties except maternity and paediatrics.

Pre-implementation RRS practice

Prior to implementation of the new service, if hospital staff were concerned about the condition of a patient and unable to access assistance from the relevant medical team they requested assistance from

a Medical Registrar based on Medical Emergency Call (MEC) criteria consistent with those used internationally for RRS (i.e. abnormal blood pressure, heart rate, respiratory rate or conscious level, low oxygen saturation, threatened airway, ongoing seizures, significant blood loss or any other clinical condition causing concern to the staff). If a patient deteriorated further definitive assistance was available from a Cardiac Arrest team. Both of these strategies to access help were managed via a phone call to the hospital switchboard who paged the relevant clinical staff.

RRS Interventions

The 2-tier RRS implemented during this study consisted of:

1. Intensive Care Unit Outreach Nurse (ICUON) – senior ICU nursing staff available to assist with stabilisation and care of deteriorating patients
2. Rapid Response Team (RRT) – multi-disciplinary team that replaced the previous MEC system and Cardiac Arrest team to manage medical emergencies.

Any clinical staff member throughout the hospital was able to activate either tier of the RRS by phone 24/7. Activation of the ICUON was achieved by direct phone call or via the hospital switchboard who transferred the call to the ICUON, while activation of the RRT was achieved via the hospital switchboard who paged the relevant team members. MEC criteria did not change with implementation of the new system and included changes in airway, breathing, circulation, neurology and other factors. Staff could make a decision to call either the ICUON or the RRT – in practice they called the RRT if a patient met the specific physiological alert criteria, but called the ICUON for general concern prior to a patient meeting any specific physiological alert criteria. Patients who had been reviewed by the ICUON or RRT or discharged from the ICU received daily review by the ICUON until they were considered stable.

The ICUON provided a dedicated service from 0700 – 2300; overnight the service consisted of an ICU nurse allocated reduced patient load to allow them to provide the outreach service. The RRT was a single team that responded to both deteriorating patients and cardio/respiratory arrests and included a Medical Registrar and Resident, ICU Junior Registrar, ICUON, Coronary Care Unit (CCU) or ED nurse, Resuscitation Coordinator and Operational Officers from 0800 – 1700 (in hours). After hours

the team included the afterhours Medical Resident, ICU Junior Registrar, ICUON and a CCU or ED nurse. When a RRT was called the treating team Registrar and Resident were also notified during hours.

Implementation strategies

Prior to introduction of the 2-tier RRS for the management of deteriorating patients a number of structural and process strategies were implemented to facilitate this change and optimise use and potential success of the service. Activities were multidimensional and included 1) Preparation, 2) Policy and documentation, and 3) Education. Preparation included development of a project plan that documented the proposed service and its evaluation and meetings with stakeholder groups were held. The ICUON positions were advertised, appointments made and physical resources were organised. Policy and documentation activities included revision of all emergency policies, training manuals and related documentation. An extensive in-servicing program, with tailored sessions for various stakeholder groups such as CCU, ED and general ward nurses, consultants, registrars, etc was delivered. Resources including posters, RRT calling criteria lanyards and computer screensavers were developed to promote the new service. The RRS was implemented in October 2009.

Outcome measures

Prevalence of deteriorating patients

The prevalence of deteriorating patients was assessed through both a point prevalence assessment and chart audit. All patients on six randomly selected wards were assessed against the MEC criteria by a team of critical care nurses during a point prevalence assessment on one day prior to, and 8 months following, implementation of the RRS. The team of four critical care nurses entered each ward and assessed each patient against the MEC criteria. For each patient who met the MEC criteria the health record was reviewed and nursing staff consulted to determine if treatment was currently being administered to address the element of deterioration.

The point prevalence assessment was followed by a chart review of patients from all wards throughout the hospital where it was expected that use of the ICUON and RRT was likely (i.e. all patients on acute medical, surgical and cancer division wards on the predetermined dates of the chart review were eligible for random selection to be included in the chart review). The sample size for the chart review was determined as being twice the number of patients present in the wards for point prevalence assessment and post hoc analysis indicated a power of 0.8 for this sample of patients who met criteria and were not currently receiving treatment. Patients included:

- the same patients assessed during the point prevalence assessment
- randomly selected additional patients who were either inpatients on the day of the point prevalence assessment or on the following weekend.

Patient charts were reviewed for a 24 hour period. An experienced critical care nurse reviewed all relevant observation charts and notes to identify if there was any evidence of the patient meeting the MEC criteria as well as any evidence of current treatment targeted at correcting each element of deterioration.

Incidence of unplanned admission to ICU and cardiac arrests

Incidence data for this project were accessed electronically from hospital databases including the ICU patient database and the cardiac arrest database. Unplanned ICU admission data (excluding ED) and cardiac arrest data (excluding ED and ICU and patients who were not for active resuscitation) were collected for 20 months prior (January 2008 – August 2009) and 48 months after (November 2009 – October 2013) implementation of the new RRS.

Staff Satisfaction

Two different surveys were used to measure staff satisfaction in relation to the components of the RRS. The first of these surveys (General Staff Survey) was available for all hospital staff to complete, while the second survey was targeted specifically to Medical Consultants. Both questionnaires were distributed using various mechanisms including all staff emails and manual distribution in relevant forums and department meetings.

The surveys were based on that reported by Metcalf and colleagues[19], with additional items informed by issues raised in the literature[20, 21] and through local consultation. Open ended questions were included to allow staff to provide additional comments. The initial survey was piloted by a small group of clinicians, with changes made to item wording and grammar to clarify understanding.

Data Analysis

Descriptive statistics were used to summarise the number of patients who met the MEC criteria and staff satisfaction, as well as to identify the frequency of unplanned ICU admissions and cardiac arrests. Differences in the numbers of patients not receiving current related treatment identified by chart review pre and post intervention were tested using Chi-squared statistics. Differences in mean unplanned ICU admissions and cardiac arrests pre and post intervention were tested using two-sided Student t-tests. $P<0.05$ was considered significant for all analyses. Statistical process control charts were used to identify process change over time. Specifically, the count "c" charts were used to examine the Poisson distributed number of unplanned ICU admissions, the number of RRT calls, and the number of cardiac arrests. These charts included the central line or mean and the system upper (UCL) and lower (LCL) control limits, with limits set at three standard deviations (3 sigma) (95% confidence limits) from the mean central line. Accepted rules for stability were adopted to demonstrate process change.[22]

Ethical Considerations

This study was approved by the Human Research Ethics Committees of the hospital and associated university. Consent for patient data was waived. All patient data were de-identified immediately following data collection and only group data used in presentation of results. Consent for staff satisfaction surveys was implied by voluntary return of the completed questionnaires.

RESULTS

RRS usage

Implementation of a new 2-tier RRS was associated with an increase in requests to escalate care for deteriorating patients. Prior to the change, 498 RRT and 86 cardiac arrest calls were received over a 12 month period. After the change to having 24/7 ICUON availability, with a RRT available when desired, the ICUON and RRT reviewed a total of 2030 patients in the first twelve months of operation (Table 1). These 2030 patients received multiple reviews including 5179 ICUON reviews and 1091 RRT and 75 cardiac arrest calls. This activity was evenly distributed throughout the 24 hour period and the days of the week, 24% of ICUON visits were during weekdays (Monday – Friday 0800 – 1700); 39% on mid-week nights (Monday – Thursday 1700 – 0800) and 37% over the weekend. The demand on the ICUON and RRT has trended up slightly throughout the following 36 months (Figure 1).

Insert Table 1 about here

Insert Figure 1 about here

Prevalence of deteriorating patients

Of the 112 patients reviewed during the pre-intervention point prevalence assessment, 6 (5%) met the MEC criteria; 3 of these patients were not receiving current related treatment. Of the 115 patients reviewed during the post-intervention point prevalence assessment, 6 (5%) met the MEC criteria with only 1 of these patients not receiving current related treatment.

Of the 237 patients assessed during the pre-intervention chart review 48 (20%) patients met the MEC criteria (Table 2); 22 these patients were not receiving current related treatment. Of the 232 patients assessed post-intervention 14 (6%) met the MEC criteria (Table 2); 8 of these patients were not receiving current related treatment; this was significantly less than those identified during the pre-intervention chart review (p=0.01).

Insert Table 2 about here

Some patients met multiple criteria (Table 2) resulting in 64 occasions when the physiological alert criteria were activated during the pre-intervention period and 18 occasions during the post-intervention period. Where a patient met the same physiological alert criterion on multiple occasions during the day one event was recorded.

Incidence of unplanned admission to ICU and cardiac arrests

A total of 1214 unplanned ICU admissions from the wards occurred during the 68 months of the study (excluding implementation in September-October 2009). There were 347 unplanned ICU admissions in 20 months pre-intervention (mean 17.4 /month) and 867 unplanned ICU admissions in 48 months post-intervention (mean 18.1/month). The monthly number of unplanned admissions to ICU increased slightly after implementation of the 2-tier RRS however this was not statistically significant ($t = 0.76$, $p=0.45$). The Shewhart c chart (Figure 2a) demonstrates that the average monthly unplanned admissions to ICU (the central line) also increased slightly during the post-implementation period. Wide variability was seen prior to implementation of the intervention; this wide variability continued in the first 6 months after implementation of the RRS, but appeared to be more controlled in the following 42 months. However these changes did not meet the criteria for process change indicating that the level of variability in the monthly rate of unplanned admissions to ICU did not improve throughout the study period.

Insert Figure 2 about here

A total of 465 patients had a cardiac arrest on the wards during the 68 months of the study (excluding implementation months). There was a decrease in the number of cardiac arrests from 151 (mean 7.6/month) pre-implementation to 314 (6.5/month) post-implementation of the RRS however this was not statistically significant ($t=1.23$, $p=0.22$). This lack of significant change in the rate of cardiac arrests can also be seen on the Shewhart c chart (Figure 2b) where monitoring has continued for a longer period of time. There was wide variability in the rate of cardiac arrests throughout both the pre

and post-implementation periods, resulting in no criteria for process change being met and indicating that improved control or reduced variability was not achieved.

Staff Satisfaction

The General Staff Survey was completed by 192 respondents including 155 (81%) nurses and 35 (18%) medical officers (2 unknown respondents), while the second survey was completed by 51 Medical Consultants. A majority of the general staff respondents (n = 140; 73%) had used the ICUON service and 121 (63%) had used the RRT. Fewer Medical Consultants had used either level of the service [15 (29%) and 21 (41%) respectively].

Satisfaction with both the ICUON and the RRT was universally high for general staff, although was somewhat lower for Medical Consultants (Table 3). Medical Consultants did consider the RRT assisted with timely and effective care of deteriorating patients. General staff indicated a high level of satisfaction in several areas including support provided to enhance comfort with practice, and enabling patients to receive more timely interventions and have complications managed more effectively.

Insert Table 4 about here

Themes from both groups of respondents' comments were similar and generally positive, although one negative theme emerged. Themes included:

Conduit between ICU and the wards: The role of the ICUON acting as a liaison between ICU and the wards was repeatedly acknowledged, with the benefits of this conduit being multi-dimensional. The routine follow-up of patients discharged from ICU was seen as beneficial.

Catalyst for escalation and timely intervention: Outreach nurses were considered to facilitate escalation and timely intervention for patients. Their role in confirming concerns about deteriorating

patients and then accessing appropriate help was acknowledged by many respondents. The ability of the ICUON to activate timely response from other members of the health care team, particularly medical clinicians, was highlighted.

Careful vigilance: The role of the ICUON in monitoring and reviewing patients to prevent further deterioration was recognised by members of the health care team.

Practical assistance with skills and knowledge: The knowledge and ability to assist with new or infrequent skills was recognised, particularly related to the ICUON role. Assistance was not limited to clinical skills but included communication and patient advocacy.

Undermining the home team: Concern that the ICUON undermined the 'home' team, including staff confidence, was expressed. It was noted that members of the home team sometimes choose to 'abdicate' their responsibility for the patient, relying on the ICUON to review the patient.

Interpersonal characteristics of the ICU Outreach Nurses: Characteristics such as approachable, accessible, generous, friendly and knowledgeable were noted as being integral to the success of the ICUON service.

DISCUSSION

The objective of this study was to successfully implement a 2-tier RRS that integrated with current structures and processes, provided a mechanism for delivering urgent care to deteriorating patients and was met with satisfaction by the clinicians. This study is one of the first to examine implementation of a RRS from these multiple perspectives as recommended in the international consensus guidelines.[1]

Patients were identified during the point prevalence assessment and chart review as meeting the MEC criteria but not receiving current treatment for the identified deterioration. More patients were

identified on chart review than on point prevalence, however this is expected given the point prevalence assessment was at one point in time while the chart review covered 24 hours.

Activities undertaken to prepare for and support implementation of the 2-tier RRS were extensive and included aspects of preparation, policy and documentation and education. These structural changes, particularly revised policies, processes for activating help and knowledge of the systems available, were essential to facilitate effective implementation.

The 2-tier system was consistent with guidelines for a graded response to deteriorating patients [7] as well as strategies that address both the afferent and efferent limbs of a RRS.[1] Continued use of the MEC criteria addressed the principles of the afferent limb of a RRS while the ICUON and RRT provided a 2-tier graded response within the efferent limb of the RRS. Importantly, with the implementation of the 2-tier system in this setting there has not been emphatic separation of the criteria for activating either level of the RRS; instead there has been a liberal approach to encouraging staff to activate whichever level of response they felt most comfortable with. This approach may be beneficial in optimising timely response to deteriorating patients.[12, 13] A number of ward staff indicated they did not always feel confident to activate the RRT but were prepared to request ICUON assistance. This lack of confidence, or fear of activating higher levels of response, is consistent with previous reports [5, 15, 23, 24] and is often related to previous negative experiences with RRT members. The broad criterion of 'staff member worried' that has been included in the RRS activation criteria in this and many other hospitals is particularly helpful in enabling staff to call for assistance and bypass traditional hierarchies when necessary.[14]

Implementation of the 2-tier system resulted in a large number of requests for ICUON reviews, as well as an increased number of RRT calls. The precise reason for this is not known but possibly due to the increased education and support provided by the ICUON to encourage clinical ward staff to request assistance when required. The 2-tier RRS has operated 24/7, although with slightly different staffing arrangements overnight. The actual visits by the ICUON were spread relatively evenly

throughout the day, night and weekend. It appears that the assumption that the service would be accessed less at night, with only an ICU nurse available 2301 – 0659 to provide the service as required, was not supported and a dedicated service was required 24/7; this has now been implemented consistent with recommendations in national guidelines.[1, 7, 15] Utilisation of the service has continued to increase since implementation consistent with patterns seen in many other Australian centres.[25]

Importantly, the 2-tier RRS that has been implemented has met with generally high levels of clinician satisfaction. Characteristics that might contribute to this satisfaction include 24/7 access across the hospital[1] as well as the important core characteristics of the ICUON being approachable, knowledgeable and competent and achieving the desired outcome without causing disruption.[26]

Implementation of a 2-tier RRS in this setting resulted in a trend downwards in the number of cardiac arrests in wards. This is consistent with a systematic review of 18 studies that identified similar improvements.[27] The small increase in number of unplanned admissions to ICU was recognised as possibly due to better recognition and quicker response to deteriorating patients who require ICU care. Given both the ICUON and the RRT identify and intervene in the care of patients who deteriorate, some of these patients may be transferred to ICU for ongoing intervention. The association between rates of unplanned admissions to ICU and RRS has been variable, with both increases[28] and decreases reported.[29, 30] There may be a relationship between the two outcomes of cardiac arrest and unplanned admission to ICU, with patients who previously might have arrested in wards now being reviewed and transferred to ICU as an unplanned admission. Alternatively the trend downwards in the cardiac arrest numbers may be driven by improved planning and discussion leading to acute resuscitation plans, or 'do not resuscitate' orders, that are prompted by the ICUON when appropriate. Although the ICUON believe anecdotally that the frequency of these discussions is increasing, no quantitative data are available to confirm this belief. As identified from the Shewhart c charts (Figure 2), the monthly rates of both cardiac arrests and unplanned admissions to ICU are highly variable.

Limitations of this study include that it has been conducted in a single centre, with the point prevalence assessment limited to a random selection of wards. The response rate from the survey was small and likely represented those who were either extremely satisfied or extremely dissatisfied with the system that was implemented. The ability to identify statistical differences was also limited by the small number of outcomes, particularly in regard to cardiac arrests.

Lessons have been learned from this study that should inform practice, education and research in the future. Adequate resourcing of the RRS is essential; continued demand for the service through the night has led to a dedicated ICUON being available 24/7. Work within the hospital has continued to explore structures and processes for assisting staff to recognise when to activate the RRS, for example additional educational forums including orientation programs, workshops and simulation sessions that focus on recognition and management of the deteriorating patient and ad hoc forums such as Grand Rounds and departmental meetings. Development of strategies to improve nurses' assessment skills and timely response to clinical deterioration continue to be required. Implementation of a colour coded observation chart, with clear indication of the appropriate level of response for abnormal observations of differing severity, is the most recent related structural change.[31] These changes all require appropriate evaluation to determine influence on processes and outcomes.

CONCLUSION

The newly implemented 2-tier RRS has been highly accessed by staff to assist with care of deteriorating patients in a tertiary hospital. Activity has been spread across all days of the week and time of day. The number of cardiac arrests has trended downwards with implementation of the 2-tier RRS. The RRS has generally been evaluated positively by stakeholders, with evidence that it is meeting local needs.

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Table 1: ICU Outreach and RRT Activity throughout PAH

Activity	Pre-Implementation (12 months)		Post-implementation (12 months)	
	n (total)	**Monthly average**	**n (total)**	**Monthly average**
RRT calls (excluding arrest calls) (classed as MEC prior to change)	498	42	1091	91
Cardiac arrest / RRT calls[#]	86	7	75	6
ICU Outreach Nurse reviews	N/A	N/A	5179	432
Total visits by ICU Outreach Service	N/A	N/A	**6345**	**529**
Number of patients reviewed by ICU Outreach Service			**2030**	**169**

Note: all calls to review a patient because 'staff were worried about a patient' were included in the MEC calls prior to the change, however these calls may be included in either the RRT calls or the ICU Outreach Nurse patient reviews after the implementation of the changed Service.

Arrests that occur in ICU and ED are excluded from these data

N/A – not applicable; RRT – Rapid Response Team; MEC – Medical emergency calls

Table 2: MEC criteria met on chart review of 24 hours of care prior to and post implementation of a 2-tier RRS

Criteria	Pre-implementation n = 237 Frequency	Post-implementation n = 232 Frequency
Staff worried about patient	31	3
Fall in systolic BP <90 mmHg	15	6
SpO2 <90%	7	4
Significant blood loss	4	-
Respiration rate <8 or >36/minute	3	1
Pulse <40 or >140 / minute	1	-
Threatened airway	1	2
Fall in GCS >2 points	1	2
Repeated or prolonged seizures	1	-
TOTAL criteria met	**64**	**18**
No. of pts meeting 1 criterion	37	11
No. of patients meeting 2 criteria	6	3
No. of patients meeting ≥3 criteria	5	-
Total no. of patients meeting any criteria	**48 (20%)**	**14 (6%)**

MEC – medical emergency call; RRS – rapid response system; SpO_2 – pulse oximeter oxygen saturation; BP – blood pressure; GCS – Glasgow Coma Score; No. – number

Table 3: Staff Satisfaction

Item (possible response 1 = strongly disagree – 5 = strongly agree)	**Median (IQR)**
General Staff Survey	
ICU Outreach Nurse	
a) Having access to the ICU Outreach Nurses enhances my comfort with my practice	4 (4 - 5)
b) I have learned new skills and assessments from the ICU Outreach Nurses	4 (3 - 5)
c) The ICU Outreach Nurse has assisted my patients to receive more timely interventions	4 (4 - 5)
d) The ICU Outreach Nurse helps me manage patient complications more effectively	4 (4 - 5)
e) Having access to the ICU Outreach Nurses assists me to remain satisfied and working at PAH	4 (3 - 5)
f) The ICU Outreach Nurses are approachable	5 (4 - 5)
g) The ICU Outreach Nurses have caused disruption to the plan of care of the deteriorating patient	2 (1 - 2)
h) I have received sufficient information about the ICU Outreach Nurse to be able to use them effectively	4 (4 - 5)
Rapid Response Team	
a) Having access to the RRT enhances my comfort with my practice	4 (4 - 5)
b) I have learned new skills and assessments from the RRT	4 (3 - 5)
c) The RRT has assisted my patients to receive more timely interventions	5 (4 - 5)
d) The RRT helps me manage patient complications more effectively	4 (4 - 5)
e) Having access to the RRT assists me to remain satisfied and working at PAH	4 (3 - 5)
f) The members of the RRT are approachable	4 (4 - 5)
g) The RRT has caused fragmentation of care of the deteriorating patient	2 (1 - 2)

h) When the RRT has attended my patient there has been appropriate communication with me / my team	4 (4 - 5)
i) I have received sufficient information about the RRT to be able to use it effectively	4 (4 - 5)
Medical Consultant Survey	
ICU Outreach Nurse	
a) The ICU Outreach Nurse has assisted my patients to receive more timely interventions	3 (3 - 4)
b) The ICU Outreach Nurse helps me /my team to manage patient complications more effectively	3 (3 - 4)
c) The ICU Outreach Nurses have caused fragmentation of care of the deteriorating patient	3 (2 - 4)
Rapid Response Team	
a) The RRT has assisted my patients to receive more timely interventions	4 (3 - 4)
b) The RRT helps me / my team to manage patient complications more effectively	4 (3 - 5)
c) The RRT has caused fragmentation of care of the deteriorating patient	2 (2 - 3)
d) When the RRT has treated my patient there has been appropriate communication with me/my team	4 (4 - 4)

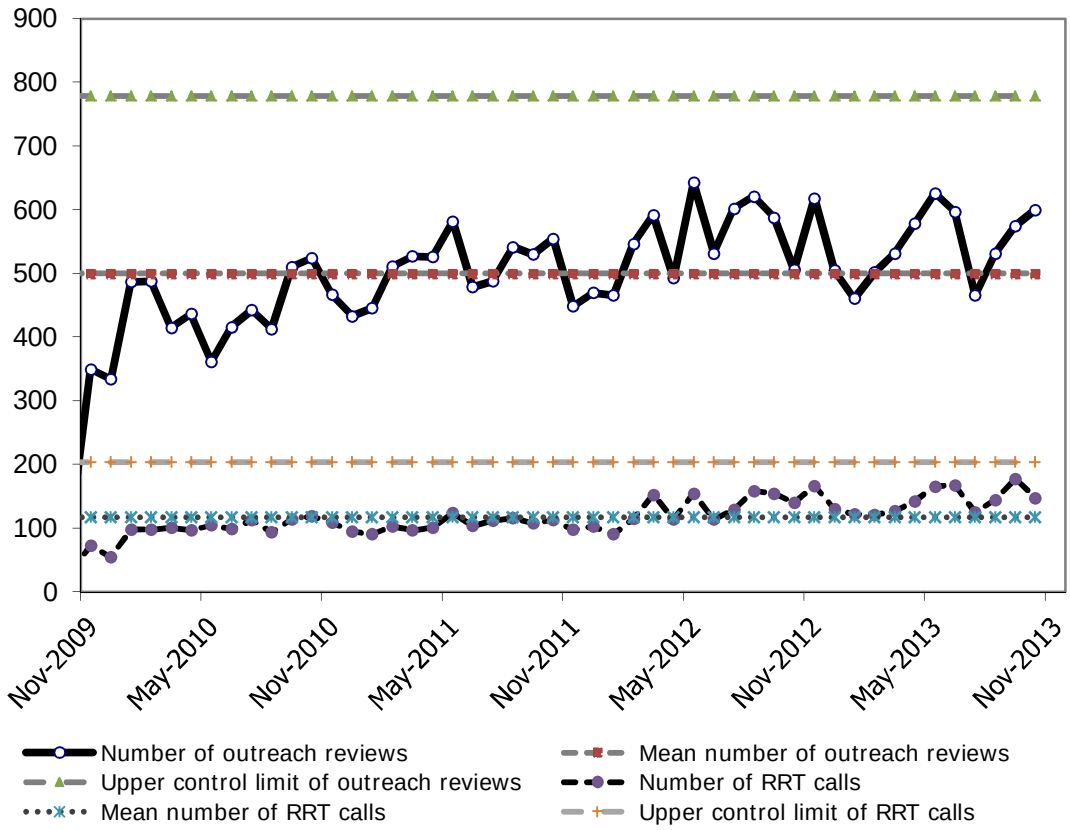
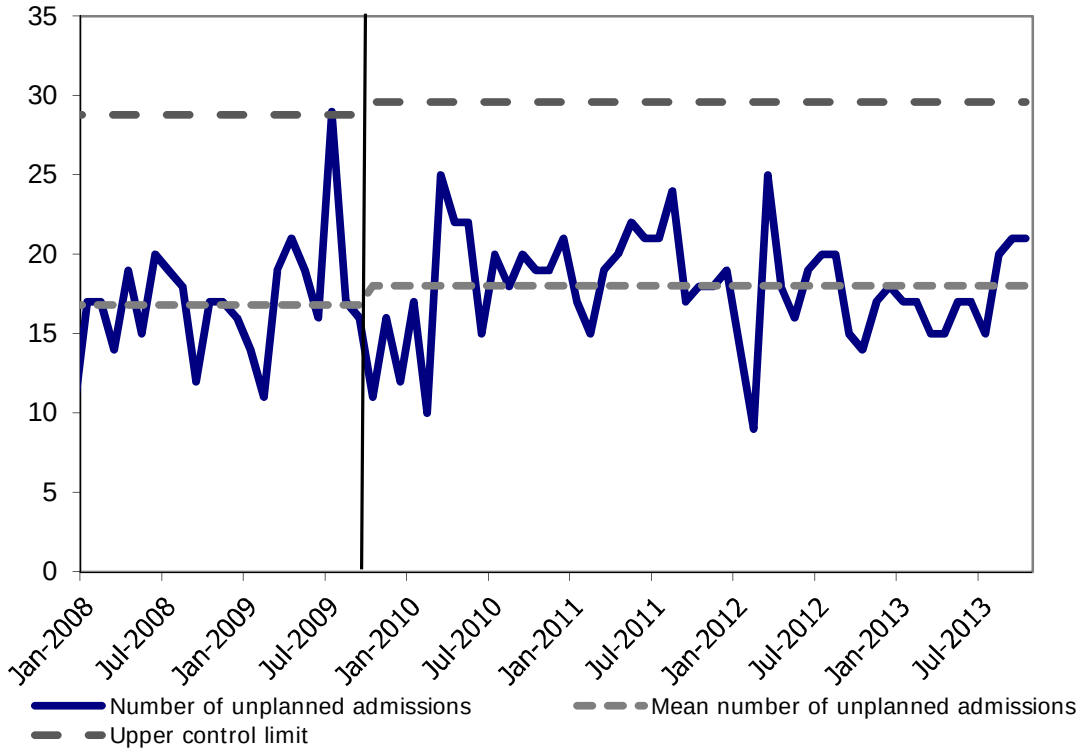


Figure 1: Shewhart c chart of monthly number of outreach reviews and RRT calls



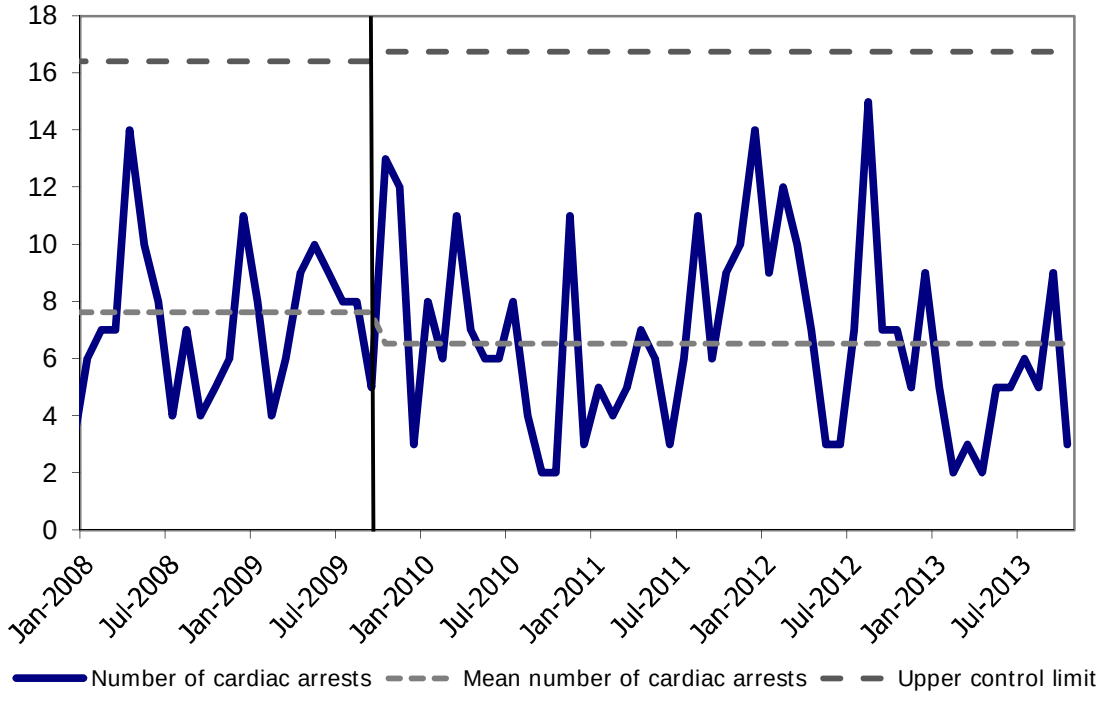


Figure 2: Shewhart c chart of monthly number of a) unplanned admissions to ICU from the wards and b) cardiac arrests