Title page

Title: DEVELOPMENT AND PRAGMATIC EVALUATION OF A RAPID RESPONSE TEAM WITHIN A 3-TIERED ADULT INPATIENT CLINICAL EMERGENCY RESPONSE SERVICE: THE FIRST FIVE YEARS

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Abstract

Background

In response to national and local drivers a clinical emergency response system (CERS) incorporating an intensivist-led rapid response team (RRT) was implemented at a Sydney (Australia) hospital. We present a pragmatic evaluation of the five years since this major initiative was commenced.

Implementation and evaluation

A "partner not conquer" philosophy was adopted. Implementation of the RRT was based on a collaborative pragmatic quality improvement approach. A team of intensive care specialist trained medical doctors (n=2) and clinical nurse consultants (n=2) set up the service with executive support and funding. Roles and responsibilities were clearly detailed, reinforcing a positive, partnership driven culture. A constantly evolving education strategy was a critical element of implementation and maintenance.

Ongoing evaluation includes process and patient outcome data. Serious patient deterioration related incidents have decreased significantly (from 7 to 1 per year) and the RRT has been universally accepted by clinicians.

Discussion

Key lessons learned include the need for specific protected funding, a partnership approach ensuring hospital clinicians retain responsibility of patient treatment, ongoing education and reinforcement and strong nursing leadership. However generalisations cannot be made about the implementation of the CERS. It is important to consider context; 'one size does not fit all'.

Key words: Hospital Medical Emergency Team, quality improvement, clinical deterioration

Text

Background

Clinical incidents, such as patient deterioration, resulting in actual or potential patient harm have always been a concern for clinicians working in hospitals. Before the advent of the rapid response system (RRS) paradigm formal procedures for detecting and intervening early in cases of patient deterioration were not universal. However, 'Cardiac arrest' teams were called by clinicians during serious patient collapse instead of seeking to intervene early for the deteriorating patient.

Rapid response systems are now widely used in acute care hospitals in North America, United Kingdom and Australia/New Zealand in order to respond to patient deterioration. They are acknowledged as an essential element of early resuscitation. The RRS typically comprises an afferent (detection) and efferent (activation) limb [1]. The afferent limb usually involves a type of chart or medical record documentation track and trigger system. Observation charts and medical record triggers guide clinical decision-making during routine patient assessment or in the case of suspected deterioration. When deterioration is detected, depending on the trigger, the clinician is required to escalate treatment and notify either the medical emergency or rapid response team (RRT) for review (the efferent limb is activated). The RRS model is described as either two-tiered or three-tiered. Typically for a two-tiered model the first tier requires an early clinical review by the inpatient team and the second tier requires medical emergency team (MET) activation. The MET attends to both general medical emergencies and cardiopulmonary arrests. The first tier of a three-tier RRS model comprises activation of a clinical review by the inpatient team for clinical deterioration and for more serious deterioration (tier two) the rapid response team is activated. Tier three is activated when clinical deterioration is significant and requires immediate attendance by the RRT/MET.

In New South Wales (NSW), Australia prior to 2013 clinical deterioration and patient collapse was managed according to a typical 'RRS' design many hospitals in; triggers for escalation of care were subjective, early signs of deterioration were detected and informally escalated at the individual

nurse/midwife's discretion and a traditional intensive/emergency care led medical team attended cardiac/respiratory arrest medical emergencies. The impetus for the implementation of a new RRS was the occurrence of some serious adverse clinical incidents which were likely a result of poor recognition of clinical deterioration or inadequate escalation by clinicians in the public health system in NSW. Concurrently the Australian Commission of Safety and Quality in Health Care National Safety and Quality Health Service Standards were released in 2012 (standard 9)[2]. As a result the NSW public health system implemented a state wide early recognition of the deteriorating patient program termed Between the Flags (BTF) [3]. The BTF system was designed to facilitate early recognition, escalation and management of clinically deteriorating patients and included the five main elements of governance; standardised calling criteria; clinical emergency response systems; education; and evaluation. Each public health hospital was required to implement standardised observation charts and a context specific RRS. There were challenges associated the implementation of the BTF program locally; no additional resources were allocated and intensive care clinicians could not meet the demand associated with attending the number of rapid response calls. In order to ensure intensive care patients were not disadvantaged intensive care clinicians were compelled to limit their contribution to attendance for resuscitation only ('code blue team'). Inpatient medical teams were responsible for managing rapid response calls for ward patients. Consequently clinicians with varying levels of experience were required to manage critically ill patients without the benefit of a "fresh set of eyes" to oversee their assessment and management. Locally there were a series of critical patient incidents and it was realised that a hospital wide system change was required.

As a result, there was universal support from local executive and patient safety and quality and clinical governance units for the implementation of a 3-tiered clinical emergency response system (CERS) at our hospital including an intensivist-led RRT. Literature on the pragmatics of implementing such systems is limited, thus the aim of this paper is to describe the development and pragmatic evaluation of a RRS in our hospital.

Setting

The intensivist-led RRT was developed for a large tertiary referral hospital located in Sydney, NSW, Australia. The 600-bed hospital provides treatment for three main patient cohorts including adults, maternity and paediatrics and state wide services including; trauma, severe burns, neonatal, spinal cord injury and interventional neuroradiology.

Implementation

The development and implementation of the CERS was based on a collaborative pragmatic quality improvement approach. A project team was formed after in principle agreement from the hospital executive and funding was secured to test the feasibility of an intensivist-led RRT for adult patients, which is the focus of this paper. Management of paediatric and mental health in-patients and outpatients was tackled with separate but overlapping organizational changes. The project team (two intensive care specialists and two clinical nurse consultants) developed the mission statement and agreed on the values and vision for the RRT. The mission statement 'to improve the quality of care of critically ill patients at RNSH' was underpinned by a 'partner not conquer' vision emphasizing the intention of working with the hospital inpatient teams as partners in patient care. The aim was to exceed the National Safety and Quality Health Care standard, 'Recognising and Responding to the Deteriorating Patient' [2]. The RRT values included teamwork, respect for others, support and innovative education and research. The service's mission, vision and values are continually promoted and reflected in the design of the RRT and way it operates.

A governance structure was established from the outset to ensure effective operation of the CERS and that any problems were reviewed appropriately. Formal reporting pathways were established to the hospital Resuscitation and Emergency Response, Serious Incident Review and Emergency Planning committees overseen by the hospital Patient Safety and Quality committee (Figure 1.). The existing hospital mandatory incident monitoring and management system was used to log, manage and track incidents related to the CERS.

[Insert Figure 1. Clinical Emergency Response Service governance]

The project team designed a 3-tiered activation system for inpatient wards areas. These tiers were Clinical Review (attended by ward junior medical doctor within 30 minutes), Rapid Response (RRT and ward medical team jointly review within 15 minutes) and Code Blue (Code Blue Team respond immediately). The level of response was based on the clinical criteria of the patient and the urgency of the situation (Figure 2.).

In order to meet the needs of patients in this large tertiary hospital campus, two zones were created with zoning determining the composition of the responder team for code blue calls. An ICU staffed code blue team (including the RRT members) were required to respond to patient deterioration on inpatient adult wards and an ED staffed code blue team were required to attend the paediatric ward and ambulatory care areas and campus outer buildings.

[Insert Figure 2. The 3-tier Clinical Emergency Response System.]

The development of roles and responsibilities of all personnel from the executive level through to ward clinicians were clearly elucidated. The aim was to establish and maintain a positive collaborative culture i.e. for the RRT to partner; consulting with the inpatient ward team and not 'take over' patient treatment and care unless the patient was moving to the ICU. The RRT works closely with the treating team to work towards the best outcome for the patient. In some cases this involves facilitating timely discussions about end of life care so that patients' wishes about treatment are kept at the forefront of decision making. Unless the patient is dying at the time of the call this discussion remains the responsibility of the treating team.

The project team partnered with information technology colleagues to build an intranet based application for activation of clinical review and rapid response calls and automated system for extracting details of the clinical review, rapid response and code blue activations. This application was designed to provide call activation data for evaluation. A NSW state wide electronic medical record (EMR) based rapid response/red zone form was used for RRT call.

Evolution and maintenance

A multimodal evolving education strategy has been a critical element of the implementation and maintenance of the CERS. A key component of this multidisciplinary multifaceted education program has included short films developed in-house as an initial method of orientation to the new system for all hospital clinicians. On-going education includes hospital wide orientation and annual mandatory education using case based simulation teaching with actors and manikins ('mock' clinical emergencies), and didactic teaching sessions and case discussions reinforcing operations as well as pertinent technical and non-technical knowledge and skills. Our education strategy continues to be provided in addition to the NSW state mandated 'Detecting Deterioration, Evaluation, Treatment, Escalation and Communicating in Teams (DETECT) and Basic/Advanced Life Support (BLS/ALS) training programs that continues to be central to maintaining the system. A weekly critical care program focusing on recent RRT events and cases using a range of teaching strategies open to all ICU and ward clinicians continues to be highly attended and has always been multidisciplinary. These sessions are targeted to address any recent problems or areas for improvement. In addition real-time education is offered, if appropriate, during the RRT attendance. The orientation education for ICU clinicians includes operational as well as non-technical skill/communications training.

Evaluation

Evaluation is key to effective maintenance and improvement of the CERS. Data are used to benchmark internal CERS performance and performance of other facilities. Any possible areas for improvement identified from the thorough and on-going evaluation are discussed by the project team, RRT management and local governing committees.

A dashboard of both qualitative and quantitative outcome measures was selected to determine the on-going effectiveness and impact of the CERS. These measures included:

- Serious patient incidents (defined as Severity Assessment Code[4] [SAC] 1 and 2)
- Hospital standardised mortality ratio[5] (HSMR); this is the expected mortality based on the age and health status of patients with diagnoses that account for 80% of in-hospital mortality

nationally, who are admitted to the hospital. HSMR is calculated using the actual number of in-hospital deaths divided by the expected number of in-hospital deaths multiplied by ten

- Extensive audit schedule of process and outcomes (e.g. compliance with frequency and completeness of observations and use of escalation policy by ward clinicians; cardiopulmonary arrest [CPA] rates and survival)
- Quantitative ward and RRT clinician knowledge self-report and satisfaction surveys (e.g. Does the Rapid Response Team contribute in a positive way to patient care and outcomes?)
- RRT activation (calls); the trends in number and pattern
- Weekly incident review, tracking and analysis

Evaluation is scheduled and on-going and the BTF and Resuscitation clinical nurse consultants (CNC) are responsible for monitoring and analysing this data. Adjustments in education and training and operations are made on the basis of the findings.

Outcomes to date

Since the implementation of the RRT there has been a significant reduction in serious patient incidents (SAC 1 and 2). The annual number of SAC 1 and 2 incidents related to clinical deterioration decreased from 7 to 1 per year immediately after the implementation of the RRT and has remained this low (Figure 3).

[Insert Figure 3. Number of serious patient incidents (SAC 1 and 2)]

There has been an improvement in the HSMR from 125 in 2013 to 95 now. In other words the HSMR for our hospital is below the national average (100)[6] and has significantly improved since the implementation of the RRT. Patients demonstrating both early and late signs of deterioration are managed according to local protocols 70 to 80% of the time. Clinician self-report knowledge of the calling criteria and process for rapid response activation is >90% and satisfaction with the RRT is overwhelmingly positive (Figure 4.). Nurses feel well supported by the RRT evidenced by positive

comments such as, 'I feel very supported by this system. Decline in patient's condition is recognised and treated before declining to [needing] a code blue [activation]', are typical free-text survey responses. The 3-tier CERS has been universally accepted.

[Insert Figure 4. Results of the clinician satisfaction survey item, 'The Rapid Response Team (RRT) at RNSH contributes in a positive way to patient care and outcomes in the event of clinical deterioration' 2016]

Since 2015 we have worked to develop a dashboard in which we can more easily examine the number and patterns of rapid response and code blue activations over time and across the hospital. The dashboard assists with planning work flow and identifying departments for targeted education and support. For example, we identified gaps in the uptake of the CERS in maternity services which through targeted education improved dramatically.

As a result of the implementation of the CERS the hospital met and exceeded the Australian Commission on Safety and Quality in Health Care (NSQHS) national standard 8[7] (formally standard 9[2]), recognising and responding to acute deterioration in 2013 and sustained excellence in the most recent accreditation review during 2017. In 2017 the NSW Ministry of Health awarded the CERS implementation project team an innovation award for collaborative teamwork for use of film making as a change management strategy.

Key lessons learned

One of the key lessons learned is that recurrent funding is essential in order to implement and maintain an effective 3-tier CERS. The information technology (eHealth) activation computer application and eHealth expert input were key components for sustainability albeit costly. The personnel costs for the RRT are also not insignificant (two CNCs and one intensivist during office hours and one ICU trainee and one ICU nurse rostered 24/7 that cannot be re-allocated to treat and care for patients in ICU).

The widespread clinician acceptance and high satisfaction with the RRT is mostly likely a function of the 'partnering not conquering' philosophy. Hospital clinicians still retain responsibility and 'ownership' of patient care and treatment during CERS activation. It is known that successful CERSs are underpinned by this philosophy[8]. This has been important to avoid conflict over management and consistency in communication with families and patients during end of life discussions.

Clear local governance structure and strong nursing focus and leadership were vital for the successful implementation and maintenance of the CERS. The governance structure allowed any initial problems to be addressed and resolved early. Having clear reporting lines also enables loop communication in which data are examined and adjustments made without lengthy delays. The strong nursing focus has empowered nurses locally to escalate and respond effectively to patient deterioration. This together with the CERS nursing leadership (BTF/resuscitation CNCs working with ward clinical leaders) has positively transformed the culture and affected acceptance of the service in a culture that was previously very medically focused.

We were also aware that change initiatives require persistence and mindful consideration of the needs and views of others and we believe that these were crucial attitudinal aspects of managing the process. The requirement for the CERS was mandatory but the way in which it was implemented and communicated lead to widespread acceptance. Regular reinforcement of requirements of clinicians for each tier of the CERS and the 'partnership not conquering' philosophy is necessary to ensure the collaborative system continues to be effective. Orientation of newly employed clinicians has been vital but we also found individual one to one input from the RRT during patient encounters highly effective. Oversight by the hospital medical director of 'home team' medical response times provides added incentive for engagement in the CERS process. Failure of treating team medical doctors to attend calls in a timely manner is not tolerated.

It became clear early in the implementation phase that we could not necessarily bench mark all of our RRT outcomes with those of other facilities'. For example the call (activation) rates were always higher than those of other similar facilities' in NSW because the system mandated that clinicians activated a

response when patients showed signs of early deterioration. Internal bench marking of activations and external bench marking of more meaningful outcomes such as critical incidents and CPA rates is our on-going approach to continuous evaluation.

Future developments

As the CERS reaches maturity the future focus is on maintaining excellence. For example refinement of the loop communication to assist departments to come up with their own strategies to prevent patient deterioration and reduce call rates is in progress. We are keen to foster research using the now extensive CERS database. Alliances have been forged with academics and a research program is in the beginning stages.

Recommendations

While there is much others may take from reading about our experience, undue generalisations cannot be made about the implementation of the CERS. It is important to consider context and culture in any plan to implement a CERS; 'one size does not fit all'. Considerations for setting up a CERS must include an appreciation of the context and needs of the patient cohort, resources required, on-going maintenance, managing culture change and consistently reinforcing the CERS procedures.

References

1. Winters BD, Weaver SJ, Pfoh ER, Yang T, Pham JC, Dy SM. Rapid-response systems as a patient safety strategy: a systematic review. *Ann Intern Med.* 2013;158(5 Pt 2):417-425.
2. Australian Commission on Safety and Quality in Health Care. National Safety and Quality Health Service Standards In. Sydney: ACSQHC, Commonwealth of Australia 2012.
3. Clinical Excellence Commission. Between the Flags 2013. Accessed 03/10, 2018.
4. Clinical Excellence Commission. Incident Management System Clinical incident notifications: Strengthening the learning and reporting culture in healthcare. 2007-2018; http://www.cec.health.nsw.gov.au/echartbook/cec-indicators-intro-echartbook/iims. Accessed 07 Nov, 2018.
5. Ben-Tovim D, Woodman R, Harrison J, Pointer S, Hakendorf P, G H. *Measuring and reporting mortality in hospital patients.* Canberra: Australian Institute of Health and Welfare 2009.
6. Australian Commission on Safety and Quality in Health Care. *Using hospital mortality indicators to improve patient care: A guide for Boards and Chief Executives.* Sydney: ACSQHC;2014.
7. Australian Commission on Safety and Quality in Health Care. *National Safety and Quality Health Service Standards.* Sydney: ACSQHC;2017.
8. Tee A, Calzavacca P, Licari E, Goldsmith D, Bellomo R. Bench-to-bedside review: The MET syndrome – the challenges of researching and adopting medical emergency teams. *Critical Care.* 2008;12(1):205.

Figure legends

Figure 1. Clinical Emergency Response Service governance

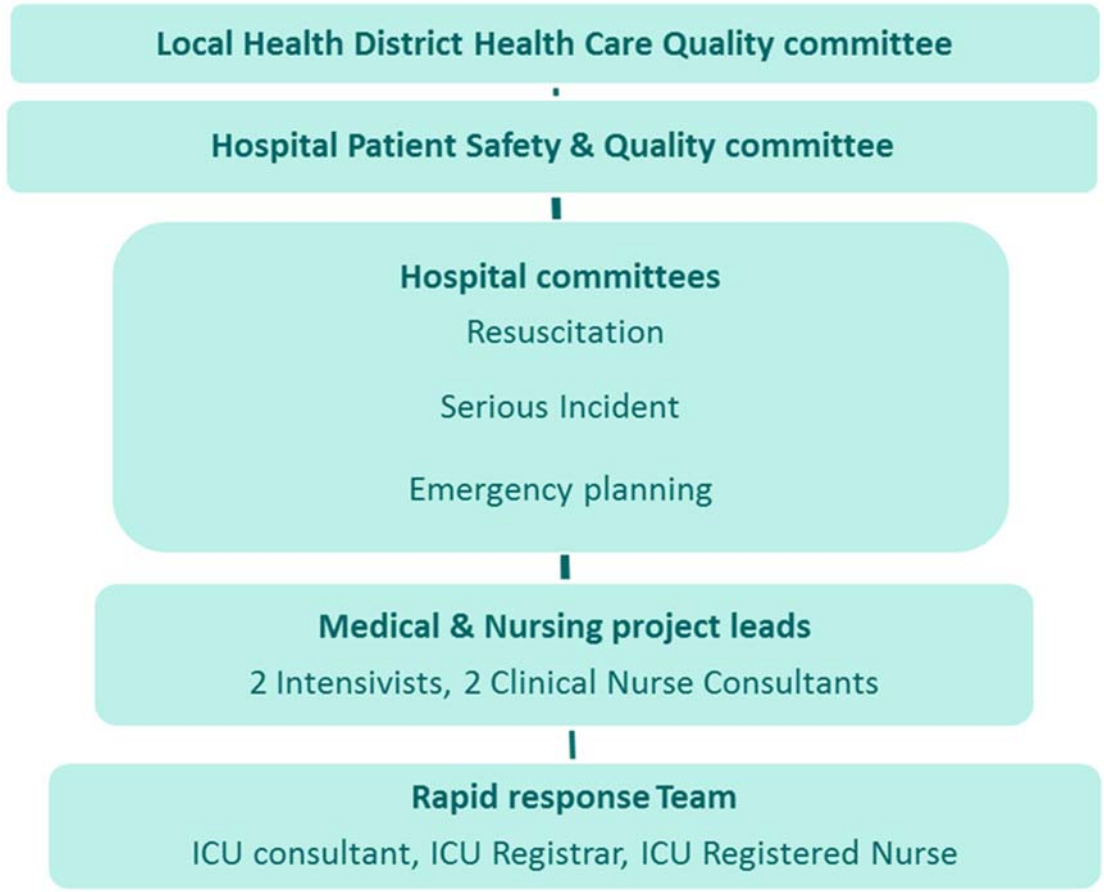
Figure 2. The 3-tier Clinical Emergency Response System. eMR = electronic medical record; [a]treating team = ward intern/resident and ward nurses, [b]treating team = ward registrar (post graduate ≥year 3) and ward nurses, [c]Rapid Response team = ICU medical post graduate trainee and ICU nurse, [d]Code Blue Team = RRT plus ICU medical admitting officer and another ICU medical post graduate trainee

These are the minimum number of attendees e.g. an intensivist attends inpatient calls with some out of hours variability. ICU nurses are experienced Advanced Life Support trained critical care nurses working a rotational roster on the RRT.

Figure 3. Number of serious patient incidents (SAC 1 and 2)

Notes: SAC = Severity Assessment Code, RRT = Rapid response team

Figure 4. Results of the clinician satisfaction survey item, 'The Rapid Response Team (RRT) at RNSH contributes in a positive way to patient care and outcomes in the event of clinical deterioration' 2016



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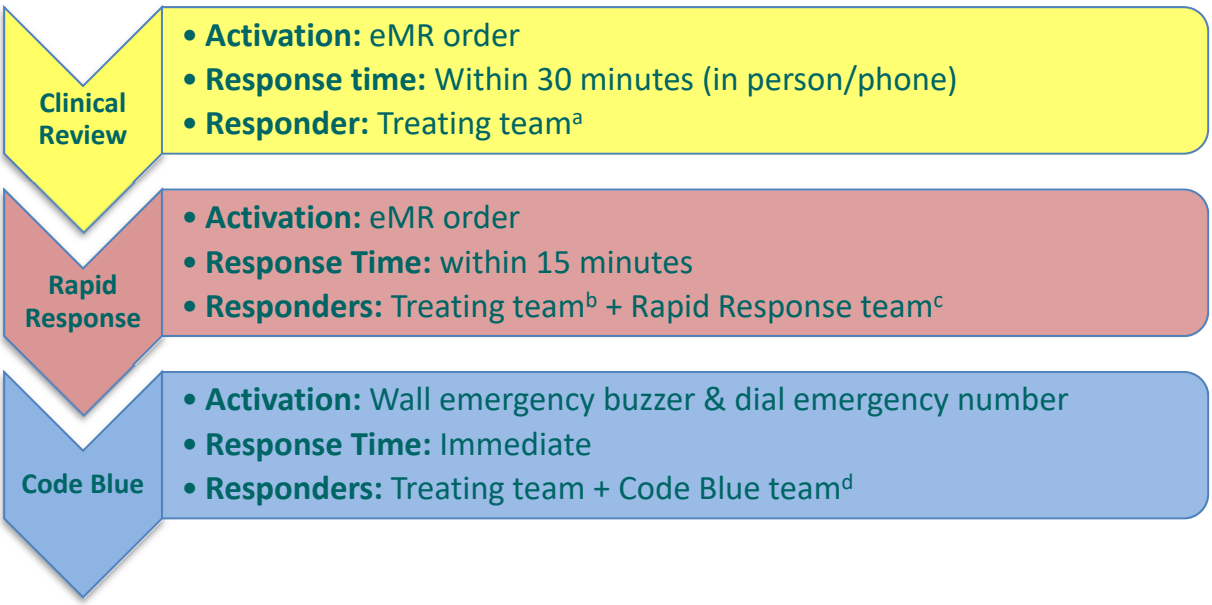

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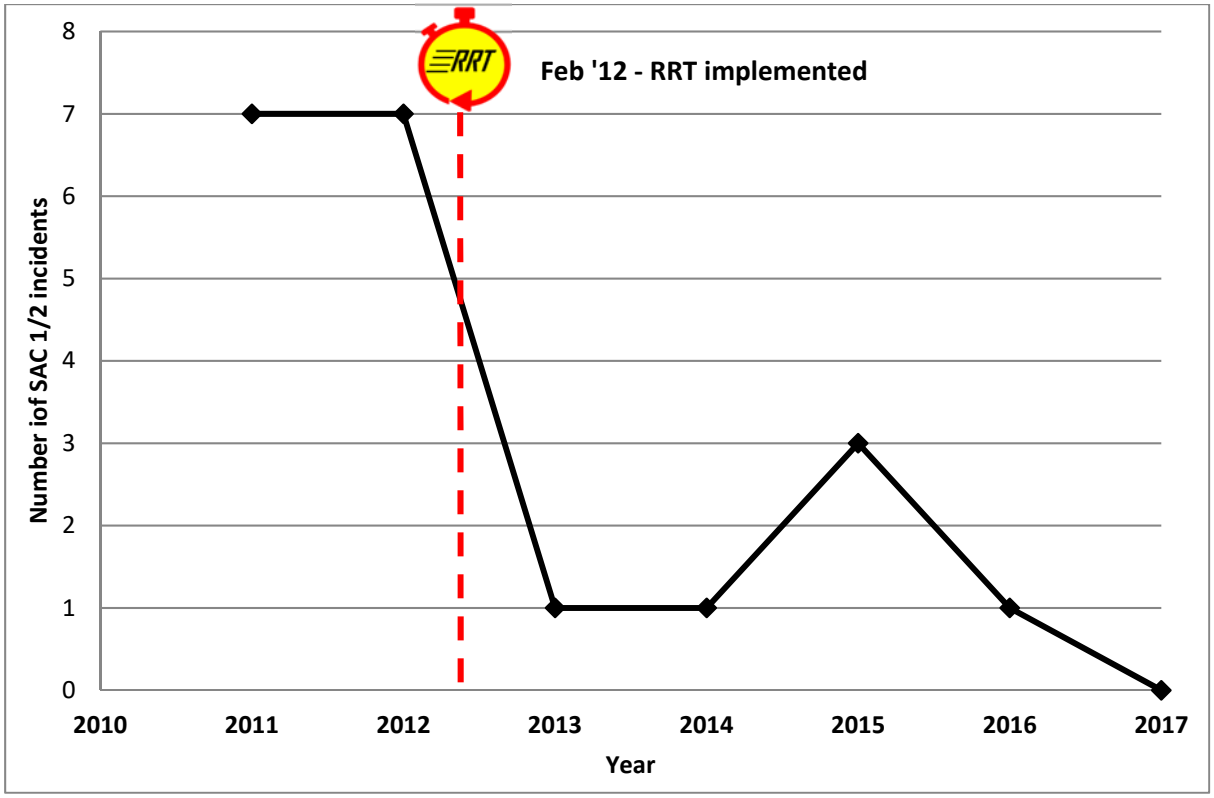

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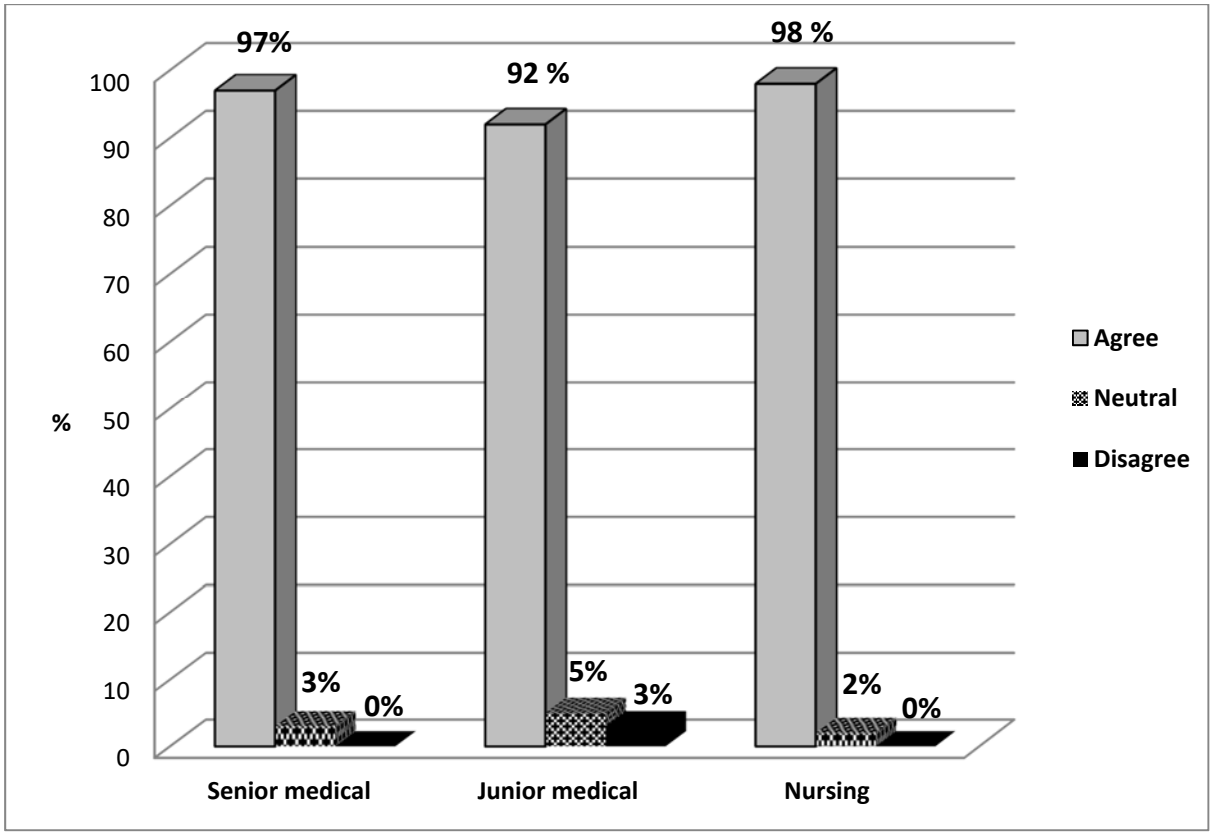

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