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Implementation of a Proactive Rapid Response Team Nurse Rounding Protocol to Address Afferent Limb Failure in a Mature Rapid Response System

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Abstract

Background. Rapid response system afferent limb failure (ALF) is associated with increased hospital mortality rates, unplanned transfer to the ICU, and increased hospital length of stay. Factors contributing to ALF are complex, including individual, team, organizational, and systemic barriers. The aims of this study were to evaluate the impact of implementation of a proactive rapid response team nurse (RRT RN) rounding protocol on the frequency of ALF preceding adverse events, patient disposition following RRT activation, and discharge disposition of patients experiencing adverse events during their hospital stay at a 281 bed community hospital.

Methods. This was a two part quantitative, descriptive study using retrospective review of patient medical records who experienced adverse events on inpatient medical-surgical units to evaluate the frequency of ALF preceding adverse events, unplanned transfer to the ICU, and hospital mortality following intervention implementation.

Results. Following implementation of the RRT RN rounding protocol there was a decrease in frequency of ALF preceding adverse events (35.1% to 20.8%, $p<.001$), frequency of patients transferred to the ICU following RRT activation (25.9% to 10.7%, $p=.009$), frequency of patients discharged to a skilled nursing following hospitalization (22.6% to 12.6%, $p=.015$). There was no significant change in frequency of patients experiencing in hospital mortality (17.6% vs 22.3%, $p=207$), rates of adverse events (11.5 vs 14.0, $p=.615$), or unplanned transfers to the ICU (3.05 vs 8.05, $p=.077$) per 1000 inpatient medical surgical inpatient day.

Conclusion. Proactive rounding by a RRT RN is associated with improved rate of ALF preceding adverse events and decreased transfer to the ICU following RRT activation.

Implementation of a Proactive Rapid Response Team Nurse Rounding Protocol to Address Afferent Limb Failure in a Mature Rapid Response System

Clinical deterioration is defined as a change from "one clinical state to a worse clinical state" where the risk for mortality and morbidity is increased (Jones et al, 2013, p. 1031). Patients entering into the hospital have an expectation that, in the setting of clinical deterioration, care providers will deliver prompt, effective treatment to intervene in and mitigate preventable harm (National Institute for Health and Clinical Excellence, 2007). Failure to rescue, considered a measurable hospital safety and quality indicator, is a result of the breakdown in this process and may result in death or disability (Agency for Healthcare Research and Quality [AHQR], 2019a). Rapid Response Systems (RRSs) were developed as a strategy to promote early recognition of and swift intervention for clinically deteriorating patients in an effort to reduce failure to rescue events (AHQR, 2019b). The effectiveness of RRSs in improving patient outcome metrics, such as in hospital mortality, cardiac arrests, unplanned admissions to the ICU, and hospital and ICU length of stay, has been the subject of much research, however, to date there has been insufficient evidence to support their use (Hillman et al, 2005; Lyons et al, 2018; Jung, et al, 2016; Salvatierra et al, 2014). Many factors contributing to the lack of effectiveness of RRSs have been identified (Olsen et al, 2019).

Prompt recognition of the early signs of clinical deterioration and deployment of the Rapid Response Team (RRT) to the bedside of the affected patient are the components of the afferent limb of the RRS (Al-Qahanti & Al-Dorzi, 2010). Associated with increased hospital mortality rates, unplanned admission to the ICU, and hospital length of stay, failure of this limb is proposed to be the most significant source of suboptimal performance of the RRS (Chen et al,

2015; Barwise et al, 2016; Boniatti et al, 2014; Braaten et al, 2015; Davies et al, 2014; Reardon et al, 2018; Sandroni & Cavallaro, 2011).

Criteria dictating when the RRT should be activated are institution specific and usually consist of variations in vital signs coupled with clinical concern (Mitchell et al, 2019). Afferent limb failure (ALF) refers to delayed or failed activation of the RRT despite the patient meeting activation criteria as defined by the institution (Devita et al, 2010; Tirkkonen et al, 2013). It has been recommended that, along with other metrics, rates of ALF should be tracked as a RRS performance measure to guide quality improvements processes (Subbe et al, 2019).

Factors that contribute to ALF are complex and include individual, team, organizational, and systemic barriers (Allen, 2020; Braaten, 2015; Jenkins et al, 2015; Padilla, 2018; Petersen et al, 2017). Barriers identified include fear of criticism for "incorrect" activations, reliance on previous system of notifying the attending provider of clinical changes, lack of experience and confidence, previous negative experiences with members of the RRS, lack of administrative support, bedside nurse fear of losing rapid response skills, and nurse disagreement with activation criteria (Braaten, 2015; Braaten et al, 2015; Chua et al, 2017; Davies et al, 2014; Jackson et al, 2016; Smith et al, 2018). In qualitative studies evaluating RRSs, nurses have reported failure to activate the RRS in the setting of meeting activation criteria due to a patient not appearing sick enough to justify a large response, such as that from the RRT (Bagshaw et al, 2010; Braaten, 2015; Massey et al, 2014; Smith et al, 2018).

A strategy frequently employed to reduce ALF is the use of early warning systems (EWS) to help in the identification of patients showing early signs of deterioration. EWS are tools, often embedded into the electronic medical record (EMR), used to alert clinical staff to early

signs of clinical deterioration, thereby triggering activation of the RRT (McGaughey et al, 2017). EWS scores demonstrate high sensitivity for prediction of mortality, in hospital cardiac arrest, and ICU transfer within 24-48 hours of elevated measurements, but low specificity, leading to a high rate of false alarms (Downey et al, 2017; Kirsch et al, 2020; McGaughey et al, 2017; Roney et al, 2015; Smith et al, 2014). Many studies of the effectiveness of the use of the EWS to address ALF and mitigate barriers to RRS activation have demonstrated that, though highly sensitive for predicting clinical deterioration, EWSs do not improve patient outcomes or increase RN activation of the RRS (Bailey et al, 2013; Burns et al, 2018; Kyriacos et al, 2011; Mathukia et al, 2015; McGaughey et al, 2017; Roney et al, 2015; Rose et al, 2015; Smith et al, 2014; Stewart et al, 2014).

RRSs have traditionally been reactive with activation being initiated in response to an event or abnormal vital sign. Proactive rounding involves members of the RRT rounding on patients who meet predetermined criteria such as recent discharge from ICU or specific admitting diagnosis (Lyons et al, 2018). Implementation of proactive rounding has been associated with significantly decreased rates of out of ICU cardiac arrests, deaths from code blues, unplanned ICU transfers, and overall hospital mortality (Davis et al, 2015; Danesh et al, 2019; Guirgis et al, 2013; Hueckel et al, 2006). RRSs that have implemented proactive rounding demonstrate not only improved patient outcomes, but also have shown significant increases in rates of RRT calls and activation, the primary outcome performance indicator of the afferent limb (Danesh et al, 2019; Davis et al, 2015; Guirgis et al, 2013; Kara et al, 2019; Heal et al, 2017). Additionally, proactive rounding by members of the RRT has been shown to promote nurse-to-nurse coaching and education about early signs of clinical deterioration as well as

facilitate comradery and teamwork between medical-surgical RNs and RRT team members, a potential additional benefit positively affecting the afferent limb of the RRS (Burrell et al, 2020; Danesh & Jimenez, 2011; Danesh et al, 2019).

Purpose and Aims

The purpose of this quality improvement project was to evaluate association with and impact of ALF on morbidity and mortality of non-ICU patients in a community hospital. System and patient variables related to ALF, RRT activation, unplanned patient transfers to ICU, and disposition were described. This information was used to develop and implement a proactive RRT RN rounding protocol. The primary aim of this project was to evaluate the impact of protocol implementation on ALF incidence preceding specific adverse events, including RRT activations, unplanned ICU transfers, Code Blue events, and patient deaths. Secondary aims were to assess effect of implementation on patient in-hospital disposition after RRT activation as well as patient discharge disposition after RRT activation, unplanned ICU transfer, or Code Blue events.

Method

Setting

This quality improvement project was implemented at the University of Washington Medical Center-Northwest Campus (UWMC-NW), located in Seattle, Washington. Part of the University of Washington Medical System, UWMC-NW is a 281 bed community-based, non-profit hospital providing emergency, surgical, and therapeutic services. UWMC-NW has 13 intensive care unit (ICU) beds and 126 non-ICU medical surgical beds, spread over 5 units.

Rapid Response System

The afferent limb of the rapid response system at UWMC-NW typically starts with a staff member, most often the bedside RN, who recognizes that a patient is demonstrating high risk clinical criteria as defined by the "Rapid Response Team" policy (Table 1), triggering a call to the RRT via the central operator. Members of the RRT receive the page or hear an overhead announcement and respond to the bedside of the patient meeting RRT criterion (University of Washington Medical Center, 2021). The RRT consists of a RRT RN, hospitalist, respiratory therapist (RT), and nursing supervisor. Prior to implementation of this quality improvement project, staff members would frequently contact the RRT RN for clinical recommendations or support if they assessed the patient to be less than the critical level required for activation of the entire RRT. The RRT RN would respond to the bedside to assess and provide clinical recommendations based on their assessment in the medical ongoing care of the patient. Report on this patient would be passed from one RRT RN to the next until the RRT RN deemed the patient to be stable. Use of the RRT RN for this purpose was not fully understood by the bedside RN or hospital administration. There was no standardized method for requesting an RRT RN assessment, documentation of the RRT RN assessment, or ongoing follow up and monitoring of the patient. RRT RN evaluations as part of the afferent limb were not being tracked or considered in the quality evaluation of the RRS.

Table 1

Rapid Response Team Activation Criteria

Criteria
Acute change in heart rate to less than 40 beats/minute or greater than 130 beats/minute
Acute drop in systolic BP of 10 mmHg to less than 90 mmHg or an acute drop of more than 20% from baseline systolic BP
Acute increase in systolic BP to greater than 190 mmHg or diastolic BP to greater than 110 mmHg
Acute change in respiratory rate to less than 8 or greater than 28 breaths/minute
Acute change in arterial oxygen saturation less to than 90%, despite oxygen therapy
Stridor/noisy airway
Acute change in mental status
Substantial bleeding or acute drop in hematocrit of more than 6%
New onset seizures
Acute change in urine output to less than 50 ml in 4 hours
New onset chest pain

Note. Rapid response team activation criteria as defined in the "Rapid Response Team" policy at the University of Washington Medical Center- Northwest Campus. mmHg=millimeters of mercury; ml=milliliters

RRT RN

Each RRT RN at UWMC-NW has greater than five years of nursing experience, with training in either emergency nursing or intensive care nursing. Staffed twenty four hours per day, seven days per week, the RRT RN is a house resource dedicated exclusively to responding to urgent patient needs. In addition to responding to RRT activations and assessing worrisome patients, the RRT RN participates in code blue events and massive transfusion protocol activations, assists in the transfer of critical patients, and serves as a resource to RNs with patients with difficult intravascular access.

Intervention

Following analysis of the data extracted in part one of the study, a standardized proactive RRT RN rounding and documentation protocol was developed and implemented

institution-wide. The protocol outlined a method for staff members to place a patient on the RRT RN watchlist based on clinical concern or complexity and without defined clinical criteria. Placement of this order was not intended to be a substitute for activating the RRT, but to provide a method to engage a member of the RRT in the care of the patient proactively. The workflow for the proactive RRT RN rounding protocol is displayed in Figure 1.

An order was created in the EMR, which gave access to all clinicians with ordering capability (RNs, RTs, and providers) to place a patient on the RRT RN watch list. When placed, the order triggers a page to the RRT RN, notifying them that a patient has been added to the RRT RN watch list. If the order is placed by an RN or RT, a notification is sent to the patient's provider, via the EMR. Within 2-4 hours of receiving the notification page and then during each subsequent 12 hours shift for which the patient has an active RRT RN watch list order, the RRT RN performs an assessment of the patient, and discusses recommendations with the bedside RN. Upon order placement and each subsequent 12 hour shift, the RRT RN documents their assessment findings and recommendations in the EMR using a standardized format. Patients remain on the RRT RN watch list until they are deemed clinically stable by the RRT RN, discharged to home, transferred the ICU, or placed on "comfort only" measures. At any of these points, they are removed from the watch list and the EMR order is discontinued.

A census list of all patients with active RRT RN watch list orders is accessible to any staff member with EMR access, allowing for situational awareness of worrisome patients. An RRT RN watch list log was created as a means of tracking RRT RN utilization and watch list order placements for quality monitoring purposes. This log, completed by the RRT RN, includes documentation of patient name, hospital medical record number, unit, and date and time of

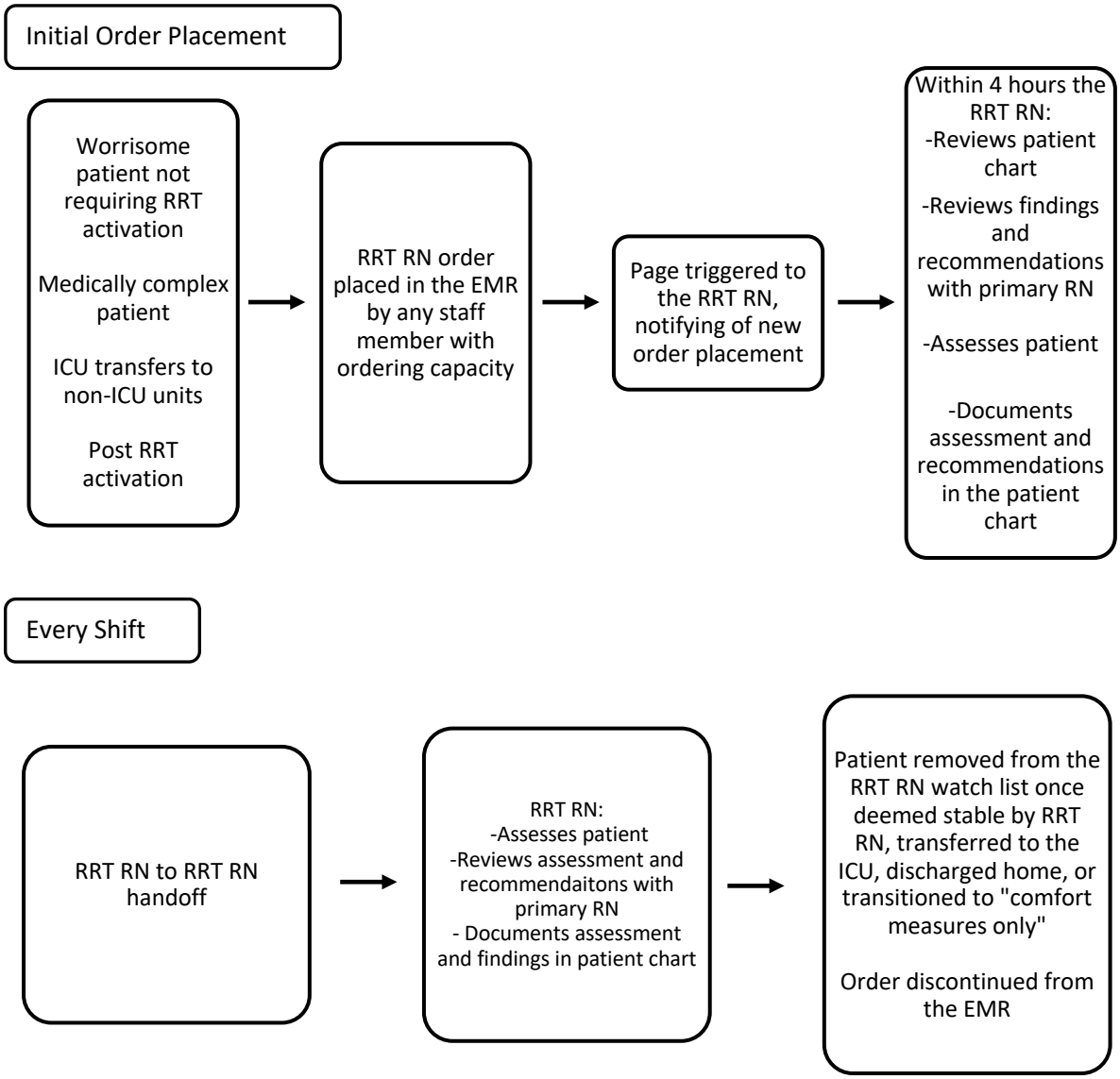
order placement and discontinuation. The log is accessible to the RRT RNs and RRT RN leadership team and is stored as an electronic spreadsheet on the RRT RN Microsoft Teams page.

In addition to placement of patients on the RRT RN watchlist due to clinical worry or complexity, all patients transferred from the ICU to a medical surgical unit and those who experience RRT activation and are not immediately transferred to the ICU are automatically placed on the RRT RN watch list. Patients transferred from the ICU to a medical-surgical unit are placed on the RRT RN watch list for at minimum 24 hours following transfer. Patients experiencing RRT activation and not transferred to the ICU are placed on the RRT RN watch list for a minimum of 12 hours post activation.

Education to RRT RNs about the protocol and documentation was completed in-person by the RRT RN supervisor. Supplemental education material and documentation examples were available for reference in the RRT RN office and on the RRT RN Microsoft Teams page. Frontline medical-surgical nursing, provider, and multidisciplinary team education consisted of presentations at virtual staff meetings, emails, unit postings, and huddle reminders (See Appendix for education material and education rollout plan).

Figure 1

Proactive Rapid Response RN Rounding Protocol



Note. Workflow for proactive rapid response RN rounding protocol implemented at the University of Washington Medical Center-Northwest Campus. RRT= Rapid response team; ICU=Intensive care unit; EMR=electronic medical record

Study of the Intervention

Data Collection and Measures

This two part quantitative, descriptive study of this quality improvement project consisted of a retrospective review of consecutively sampled charts to evaluate the RRS afferent limb characteristics and patient outcomes at UWMC-NW before and during implementation of the proactive RRT RN rounding protocol.

In part one of the study, charts of all UWMC-NW medical-surgical inpatients who experienced code blue, death, unplanned transfer to the ICU, or RRT activation between the dates 10/1/2019-2/29/2020 were reviewed. Because ALF has been associated with increased morbidity and mortality among patients experiencing RRT activation, the frequency of ALF preceding adverse events was the primary outcome measured in the study of this intervention (Barwise et al, 2016; Boniatti et al, 2014; Chen et al, 2015). ALF was deemed to have occurred if there was documentation of the patient meeting criteria for RRT activation in the 24 hours prior to the adverse event and there was a delay, of greater than 20 minutes, or failure to activate the RRT or to document an RRT RN evaluation. Variables evaluated to describe the study patient population, baseline frequency of ALF for patients experiencing adverse events, and patient outcomes associated with adverse events preceded by ALF are displayed in Table 2.

In part two of the study, charts of all UWMC-NW medical-surgical patients who experienced code blue, unplanned transfer to the ICU, death, RRT activation, or received the study intervention between the dates 10/20/2020 to 1/20/2021 were reviewed. Variables evaluated to describe the patient population experiencing adverse events and/or placed on the RRT RN watch list, the frequency of ALF preceding adverse events, RRT RN watch list order

utilization during the study period, and outcomes for patients experiencing adverse events preceded by ALF are detailed in Table 2.

Patients who experienced adverse events while located in any other location outside of the medical surgical unit (emergency department, operating room, post procedure areas), those who were transitioned to "comfort measures" only status, or those under the age of 18 years old were excluded from the study.

Table 2

Variables Extracted From The Retrospective Chart Review of Patients Experiencing Adverse Events[a]

Variable
Gender
Code status during adverse event
Time of event
Age
Hospital length of stay at time of event
Previous admission to the ICU during hospitalization
Fluid bolus administered in the 24 hours prior to adverse event[b]
Meeting criteria for severe sepsis[c] or septic shock[d] during admission, prior to adverse event
Meeting SIRS criteria[e] in the 24 hours prior to adverse event
RRT activation disposition
Discharge disposition

Note. Variables extracted in the retrospective chart review of patients experiencing adverse events in the pre-intervention and intervention implementation period. RRT= rapid response team.

[a] Adverse events consist of Code Blue events, deaths, RRT activation, or unplanned transfer to the ICU.

[b] Fluid bolus is defined as a volume of fluid ≥ 250ml administered at ≥ 500ml/hour in the 24 hours before an adverse event.

[c] Severe sepsis is defined as meeting SIRS criteria with suspected infection and evidence of end organ dysfunction (lactic acid > 2mmol/l, creatinine >2 mg/dl, total bilirubin >2 mg/dl, need for non-invasive positive pressure ventilation or intubation).

[d] Septic shock is defined as meeting SIRS criteria with suspected infection and lactic acid > 4mmol/l or hypotension (SBP< 90 mmHg or mean arterial pressure < 65 mmHg).

[e] SIRS criteria is defined as 2 or more of the following variables occurring at the same time: heart rate>90 beats per minute, temperature > 38.0°C or < 36.0°C, respiratory rate > 20 breaths per minute, white blood cell count > 12,000 cells/mm^3 or < 4,000 cells/mm^3 in the 24 hours preceding adverse event.

Data Analysis

Data were analyzed using statistics software (SPSS 26, IBM and Microsoft Excel 2020 with Analysis Tool Pak). Descriptive statistics were used to report patient demographic characteristics, length of time between admission and adverse event, previous ICU placement during admission, length of time between ICU downgrade and adverse event, and RRT criteria met before adverse event. These values are expressed as means (SD) and percentages for the entire sample, by adverse event (code blue event, cardiac arrest, death, unplanned transfer to the ICU, and RRT), and +/- ALF. Categorical variables comparing the groups by +/- ALF were examined by X^2 Test for Independence analyses to describe the association of patient variables with ALF (De Muth, 2009). Fisher Exact test was used when the sample size was less than 5. One way analysis of variance (ANOVA) and t-tests were used to determine group differences by +/- ALF and inclusion event for continuous variables (age, event, time between admission and event, time between ICU downgrade and event) (De Muth, 2009). Descriptive statistics were also used to report patient disposition following RRT activation and discharge disposition of patients experiencing adverse events with associated frequency of ALF. Frequency of ALF for each discharge and RRT disposition were analyzed utilizing X^2 Test for Independence to determine the association of ALF with disposition following RRT activation and upon hospital discharge. X^2 Goodness of Fit analyses were used to compare frequency of ALF, patient disposition following RRT activation, and discharge disposition for the intervention implementation and pre-intervention periods (De Muth, 2009; Hazra & Gogtay, 2016). Rate of adverse events per 1000 inpatient medical-surgical patient days was also calculated and reported for each full calendar month of the pre-intervention and intervention implementation

period to describe the incidence rate and provide a standardized method of comparison (Centers for Disease Control, 2006). Rates of adverse events per 1000 inpatient medical-surgical day were compared using X^2 Goodness of Fit analyses. p-values of ≤0.05 were considered to be statistically significant for all analyses.

Counts of RRT RN watch list orders and adverse events were calculated weekly and displayed on a run chart to monitor for variation in process following intervention implementation (Anhoj & Olesen, 2014; Perla, Provost, & Murray, 2011). Statistical process control was used with the primary measure of rate of afferent limb failure preceding adverse events displayed on a p chart to reveal special and common cause variation during the implementation of the RRT RN rounding intervention (Benneyan et al, 2003; Duclos, 2010).

Ethical Considerations

This study was deemed to be a quality improvement initiative and not human research after review by the University of Washington Institutional Review Board.

Results

Pre-Intervention Period

Adverse Events

There were a total of 10,444 medical surgical inpatient days in the preintervention period. In that time, there were 198 unique adverse events among 159 patients. Patient demographics are displayed on Table 2. There were 5 deaths, 5 code blue events, 83 RRT activations, and 107 unplanned transfers to the ICU among these patients. 29 (18.1%) patients experienced more than one event during their hospital stay. Of the unplanned transfers to the ICU, 21(19.6%) were following RRT activation and 4 following (3.7%) a code blue event. 7 (4.4%)

patients experienced more than one unplanned transfer to the ICU. 4 (2.5%) patients experienced more than one RRT activation during their admissions. Of the 5 deaths on the medical surgical units, 2 (40%) deaths were immediately preceded by RRT activation. 2 (40%) of the code blue events were the same patient on different days, with an unplanned ICU admission between them. There were no code blue events that resulted in death on the medical surgical units.

There was no significant association between type of adverse event and patient gender (p=0.319), age (p=.052), or code status (p=.054); event occurrence time of day (p=.555); or time in hospital before event (p=.983).

Afferent Limb Failure

35.4% (n=70) of adverse events in the pre-intervention period were preceded by ALF. With 51 (72.9%) instances of ALF preceding unplanned transfer to the ICU, there was a significant association of ALF occurring prior to unplanned transfer to the ICU compared to other adverse events (p<.001). Only 19.8% (n=16) of RRT activations were preceded by ALF. Compared to other adverse events, RRT activations had a statistically significant association of no occurrence of ALF preceding the event (p<.001).

Table 2

Demographics for Patients Experiencing Adverse Events[a] During the Pre-Intervention Period

	All Events	Code Blue	Deaths	RRT Activation	Unplanned Transfer to the ICU
	n (%)	n (%)	n (%)	n (%)	n (%)
No. of events	198	5 (2.5)	5 (2.5)	81 (40.9)	107 (54)
Male gender	69 (34.8)	1 (20.0)	4 (80.0)	24 (29.3)	40 (37.4)
Code status					
Full Code	155 (78.2)	5 (100)	0 (0)	62 (76.5)	88 (82.2)
DNR and/or DNI	43 (21.7)	0 (0)	5 (100)	19 (23.5)	20 (18.7)
Time of day of event					
05:59-18:00	122 (61.6)	1 (20)	5 (100)	52 (64.2)	63 (58.9)
18:01-06:00	77 (38.9)	4 (80)	0 (0)	29 (35.8)	44 (41.1)
	$\bar{X}$ (SD)	$\bar{X}$ (SD)	$\bar{X}$ (SD)	$\bar{X}$ (SD)	$\bar{X}$ (SD)
Age (years)	68.3 ($\pm$16.4)	80.8 ($\pm$6.9)	83.4 ($\pm$9.3)	67.2 ($\pm$16.5)	67.8 ($\pm$16.3)
Time in hospital before event (hours)	80.5 ($\pm$118.0)	100.2 ($\pm$80.3)	88.3 ($\pm$86.7)	79.9 ($\pm$115.6)	79.7 ($\pm$123.5)

Note. Demographics of patients experiencing adverse events while bedded on a medical surgical acute care unit at University of Washington Medical Center-Northwest-10/1/2019-2/29/2020. RRT=Rapid Response Team; ICU=Intensive Care Unit; SCU=Specialty Care Unit; MSE=Medical Surgical Extend; 2E=2 East; DNR=Do not resuscitate, otherwise full medical care; DNI=Do not intubate, otherwise full medical care; ED=Emergency department; OR=Operating room.

[a] Adverse events consist of Code Blue events, deaths, RRT activation, or unplanned transfer to the ICU.

Variables Associated with ALF. Variables extracted from charts of patient experiencing adverse events with associated ALF frequency including fluid bolus administration, meeting systemic inflammatory response[1] (SIRS) criteria; prior admission to the ICU, and septic shock or severe sepsis[2] during admission; and code status, gender, age at time of adverse event, and length of stay prior to adverse event are displayed Table 3. Of those, only administration of a fluid bolus ($p<.001$), meeting SIRS criteria ($p<.001$), and septic shock or severe sepsis ($p=.016$) during admission were significantly associated with ALF.

RRT Activation Criteria. There were 149 unique RRT activation criteria documented in the 20 minutes to 24 hours preceding patient adverse events during the preintervention period. These are displayed in Figure 1. 34 (32.4%) adverse events meeting criteria for RRT activation had more than one RRT activation criteria documented in the 20 minutes to 24 hours prior. There was a significant association between a documented decrease in systolic blood pressure of greater than 20% from baseline and ALF ($n=16$; $p=.006$). There was no significant association between remaining criteria and occurrence of ALF.

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[1] SIRS criteria is defined as 2 or more of the following variables occurring at the same time: heart rate>90 beats per minute, temperature >38.0C or <36.0C, respiratory rate > 20 breaths per minute, white blood cell count > 12,000 cells/mm^3 or < 4,000 cells/mm^3 in the 24 hours preceding adverse event.

[2] Severe sepsis is defined as meeting SIRS criteria with suspected infection and evidence of end organ dysfunction (lactic acid >2, creatinine >2, total bilirubin >2, need for non-invasive positive pressure ventilation or intubation). Septic shock is defined as meeting SIRS criteria with suspected infection and lactic acid >4mmol/l or hypotension (SBP<90 or mean arterial pressure <65).

Table 3

Frequency of Afferent Limb Failure[a] During the Pre-Intervention Period[b] with Associated Patient Variables

Variable	n (% total events)	n ALF (% ALF within variable group)	p-Value
Fluid bolus[c]	45 (22.7)	28 (62.2)	<.001
Meeting SIRS criteria[d]	69 (34.8)	36 (52.2)	<.001
Previous admission to the ICU during this hospital admission	37 (18.9)	15 (40.1)	.860
Severe sepsis[e] or septic shock[f] prior to event during admission	26 (13)	15 (57.7)	.016
DNR/DNI code status	43 (21.7)	14 (32.6)	.861
Male gender	69 (34.8)	33 (31.4)	.555
Time of day of event (hh:mm)			
0559-1800	122(61.6)	47 (38.5)	.222
1801-0600	76 (38.4)	22 (28.9)	
	$\bar{x}$ (SD) with ALF	$\bar{x}$ (SD) without ALF	p-Value
Age at time of event	69.6 ($\pm$12.0)	67.5 ($\pm$16.5)	.385
Hospital length of stay at time of event	84.7 ($\pm$133.4)	78.2 ($\pm$109.3)	.711

Note. Patient variables preceding adverse events with frequency of afferent limb failure in the pre-intervention period at University of Washington Medical Center-Northwest. Statistical significance of association of patient variable or characteristic to frequency of afferent limb failure is reported. DNR=Do not resuscitate, otherwise full medical care; DNI=Do not intubate, otherwise full medical care; ICU=intensive care unit; SIRS=systemic inflammatory response syndrome; $\bar{x}$=mean.

[a] Afferent limb failure is defined as failure to activate the RRT or have an RRT RN evaluation in the 24 hours prior to adverse event despite meeting criteria for RRT activation.

[b] Pre-intervention period-10/1/2019-2/29/2020

[c] Fluid bolus is defined as a volume of fluid ≥250ml administered at ≥500ml/hour in the 24 hours before an adverse event.

[d] SIRS criteria is defined as 2 or more of the following variables occurring at the same time: heart rate>90 beats per minute, temperature >38.0C or <36.0C, respiratory rate > 20 breaths per minute, white blood cell count > 12,000 cells/mm^3 or < 4,000 cells/mm^3 in the 24 hours preceding adverse event.

[e] Severe sepsis is defined as meeting SIRS criteria with suspected infection and evidence of end organ dysfunction (lactic acid >2, creatinine >2, total bilirubin >2, need for non-invasive positive pressure ventilation or intubation).

[f] Septic shock is defined as meeting SIRS criteria with suspected infection and lactic acid >4mmol/l or hypotension (SBP<90 or mean arterial pressure <65).

Outcomes for Patients Experiencing Adverse Events

Of patients experiencing RRT activation, 53 (65.4%) patients remained on the unit after their events, 21 (25.9%) were transferred to the ICU, and 7 (8.6%) were transferred to a higher level of care, not the ICU (Table 4). There was no significant association between ALF and disposition of patients following RRT activation (p=.350).

Hospital discharge disposition for patients experiencing adverse events is displayed on Table 5. 36 (22.6%) of patients who experienced adverse events were discharged to a skilled nursing facility (SNF) or rehabilitation facility when they previously were living independently. 19 (52.8%) of these patients experienced afferent limb failure prior their adverse event. There was a significant association between afferent limb failure preceding adverse events and being discharged to a skilled nursing facility or rehabilitation facility (p=.021).

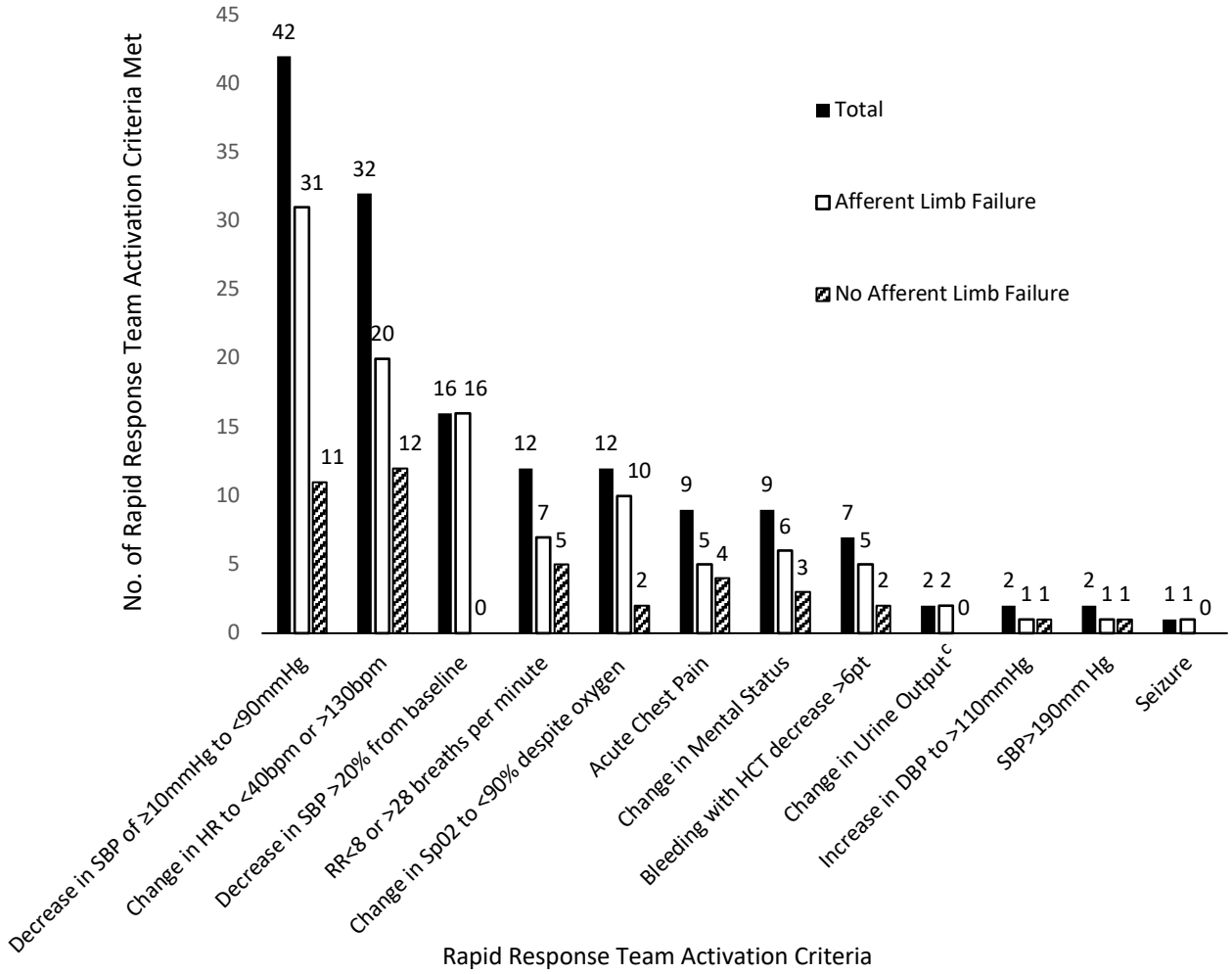
Intervention Implementation Period

RRT RN Watchlist Orders

There were 274 RRT RN watchlist orders placed during the implementation evaluation period. RRT RN watchlist ordering data are summarized on Table 6. The average length of time that a patient had an RRT RN order in place was 36.6 hours $\pm$ 28.7hours with a range of 1.5 hours to 255.1 hours. The most frequent reason for placement of a patient on the RRT RN watchlist was due to transfer out of the ICU to the medical surgical unit (n=88; 32.1%). The RRT RN was the most frequent ordering staff member (n=137; 50%).

Figure 2

Rapid Response Team Activation Criteria Met in the 24 hours Preceding Adverse Events[a] with Afferent Limb Failure[b]



Note. Number of rapid response team activation criteria met in the 20 minutes to 24 hours preceding adverse events with associated frequency of afferent limb failure from 10/1/2019-2/29/2020. SBP=systolic blood pressure; mmHg=millimeters of mercury; HR=heart rate; bpm=beats per minute; RR=Respiratory Rate; Sp02=oxygen saturation; HCT=hematocrit; DBP=diastolic blood pressure.

[a] Adverse events consist of Code Blue events, deaths, RRT activation, or unplanned transfer to the ICU.[b] Afferent limb failure is defined as failure to activate the RRT or have an RRT RN evaluation in the 24 hours prior to adverse event. [c] Acute change in urine output to less than 50ml in 4 hours.

Table 4

Patient Disposition Following Rapid Response Team Activation with Associated Afferent Limb Failure Frequency

Disposition Post RRT Activation	Total(%)	Afferent Limb Failure n (%)	No Afferent Limb Failure n (%)	p-Value
Stayed on unit	53 (65.4)	8 (15.1)	45 (84.9)	.147
Transferred to the ICU	21 (25.9)	6 (28.6)	15 (71.4)	.238
Transferred to higher level of care[a]	7 (8.6)	2 (28.6)	5 (71.4)	.540

Note. Patient disposition following Rapid Response Team Activation with associated frequency of afferent limb failure from 10/1/2019-2/29/2020. Statistical significance of frequency of afferent limb failure and post RRT disposition reported. RRT=Rapid Response Team; ICU=Intensive Care Unit.

[a]Patients being moved to a unit, not the ICU, with more monitoring capabilities following RRT activation. Examples-telemetry monitoring or lower nurse to patient ratios.

Adverse Events And Afferent Limb Failure

During intervention implementation, there were 120 adverse events. In the two full calendar months of the study, there were 7226 medical-surgical inpatient days. The rate of adverse events per 1000 medical-surgical inpatient days for this time period was 11.47, compared to 13.96 adverse events per 1000 inpatient medical-surgical day in the preintervention period (p=.615). The rate of unplanned transfer to the ICU was 3.05 per 1000 medical-surgical inpatient days compared to 8.05 in the pre-intervention period (p=.077). The rate of RRT activation was 2.79 per 1000 medical-surgical inpatient days compared to 6.10 per 1000 medical-surgical inpatient in the preintervention period (p=.179). Given the low sample

Table 5

Discharge Disposition of Patients Experiencing Adverse Events and Afferent Limb Failure During the Pre-Intervention Period.

	Total[a]	ALF Total		Code Blue		Death		RRT Activation		Unplanned Transfer to the ICU	
Final Disposition	n (%)	n (%)[a]	p*	n (%)[b]	p*	n (%)[b]	p*	n (%)[b]	p*	n (%)[b]	p*
Home[c]	80 (50.3)	28 (35)	.697	2 (50)	.938	0	-	42 (55.3)	.102	44 (44.9)	.354
SNF[d]	36 (22.6)	19 (52.8)	.021	0	-	0	-	17 (22.4)	.888	23 (23.5)	.571
Death	28 (17.6)	8 (28.6)	.338	2 (50)	.174	5 (100)	<.001	11 (14.5)	.136	18 (18.4)	.634
Transfer[e]	15 (9.4)	3 (20)	.164	0	-	0	-	6 (7.9)	.352	13 (13.3)	.170

Note. Hospital disposition for patients experiencing code blue, death, RRT activation, or unplanned transfer to the ICU and afferent limb failure 10/1/2019-2/29/2020. Statistical significance of association of afferent limb failure with discharge disposition is reported. ALF=Afferent limb failure; RRT=Rapid Response Team; ICU=Intensive care unit; SNF=skilled nursing facility.

[a] Percentage of patients per discharge disposition

[b] Percentage of patients experiencing adverse event. Repeating events during hospital admission omitted for this analysis.

[c] Patients discharged to previous living situation.

[d] Patients discharged to a skilled nursing facility or rehabilitation hospital when they previously were living independently.

[e] Transfer to another hospital or inpatient facility.

* Fisher Exact Test used for samples with n<5.

Table 6

RRT RN Watchlist Orders Placed During the Intervention Implementation Period[a]

Ordering Staff	n (%)
RRT RN	137 (50.0)
RN	92 (33.6)
Provider	42 (15.3)
RT	1 (0.4)
CNA	1 (0.4)
OTHER	1 (0.4)

Reason for order placement	n (%)
Post ICU	88 (32.1)
Complex[b]	46 (16.8)
Post RRT	39 (14.2)
Hypoxia/Respiratory concern	24 (8.8)
Hypotension	16 (5.8)
Arrhythmia[c]	13 (4.7)
Sepsis	8 (3.9)
Bleeding	8 (3.9)
ETOH withdrawal	7 (2.6)
Code stroke	6 (2.2)
Altered mental status	4 (1.5)
Chest pain	3 (1.1)
Hypertension	2 (0.7)
Pain	2 (0.7)
Airway concern	1 (0.4)
Hyperkalemia	1 (0.4)
Behavioral	1 (0.4)

Note. RRT RN orders placed during the implementation of a proactive rapid response RN rounding protocol. RRT=rapid response team; RN=Registered Nurse, not RRT RN; RT=Respiratory Therapist; Provider= Physician, Nurse Practitioner, or Physician Assistant; CNA=Certified Nursing Assistant; ETOH=Alcohol.

[a] The implementation period was 10/20/20-1/20/21

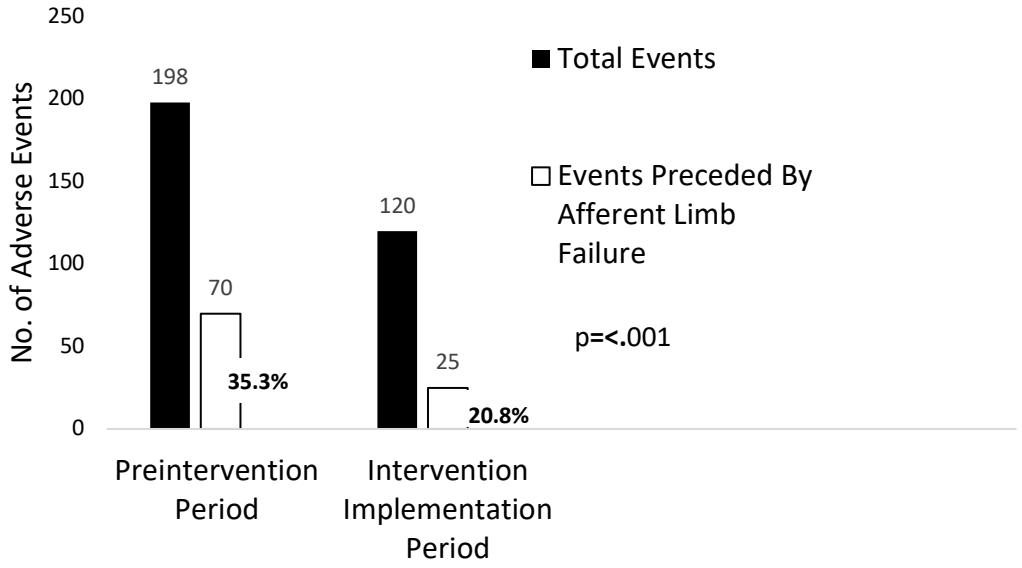
[b] Designation of "Complex" was placed when more than one criteria were documented as reason for RRT RN order placement.

[c] Tachyarrhythmias and bradyarrhythmias grouped together

size of code blue events and deaths, incidence rates were not calculated. Thirty eight (31.7%) events occurred while a patient was on the RRT RN watchlist. Figure 3 displays a count of adverse events in the pre-intervention and intervention implementation period with associated frequency of ALF. 20.8% (n=25) of adverse events were preceded by ALF, compared to 35.3% in the preintervention period. A χ^2 goodness-of-fit indicates a significant decrease in frequency of ALF preceding adverse events in the intervention implementation period compared to the pre-intervention period (χ^2=11.134; p<.001).

Figure 3

Adverse Event Occurrences With Associated Frequency of Afferent Limb Failure[a]



Note. Adverse event occurrences with associated frequency of afferent limb failure in the preintervention and intervention implementation period. There was a statistically significant difference in frequency of ALF preceding adverse events following implementation of the proactive rapid response RN rounding protocol (χ^2=11.134; p<.001).
[a]Afferent limb failure occurs when there is no or delayed RRT activation or notification of the RRT RN despite documentation of meeting criteria for RRT activation in the 20 minutes to 24 hours prior to the adverse event.

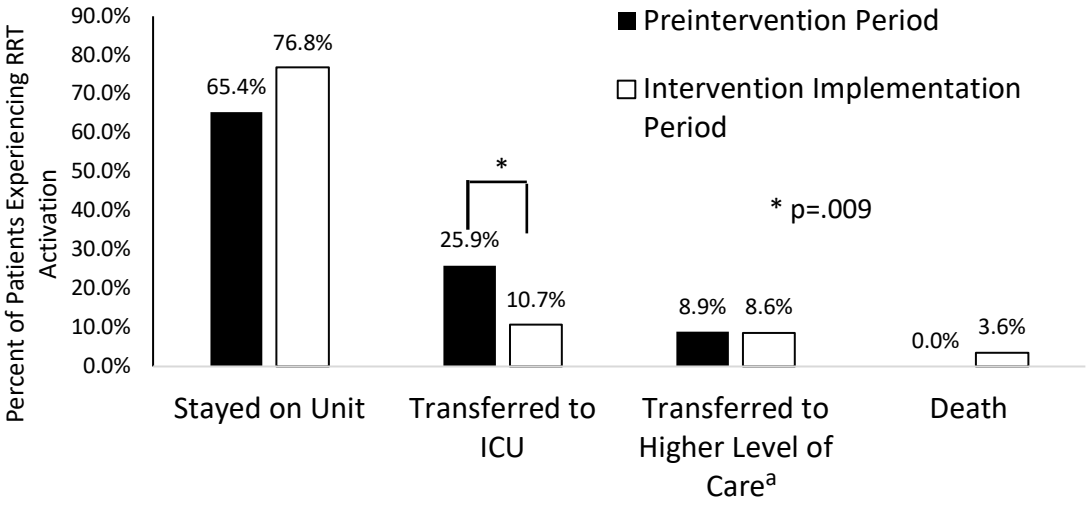
Outcomes During the Intervention Implementation Period

Disposition Following RRT Activation. Disposition of patients following RRT activation in the pre-intervention and intervention implementation period is displayed in Figure 4. Again, A χ^2 goodness-of-fit demonstrated a signficant decrease in frequency of patients being transferred to the ICU (n=6; 10.7%) following RRT activation in the intervention implementation period compared to the the pre-intervention period(χ^2=6.792;p=.009). With 76.8% of patients (n=43) remaining on the unit following their RRT activation, compared to 65.4% (n=53) in the preintervention period, there was an increase in frequency of patients remaining on the unit

following RRT activation during the intervention implementation period, but this change was not statistically significant (χ^2=3.208, p=.073). There was no significant change in frequency of patients trasferred to a higher level of care (n=5) in the implementation period compared to the preintervention period (χ^2=.008; p=.930). In the intervention implementation period, there were 2 deaths following RRT activation, compared to zero in the the preintervention period. Significance of this change was not able to be calculated due to small sample size. It was notable the all patients that experienced an RRT activation while on the RRT RN watchlist (n=7) remained on the medical-surgical unit following RRT activation.

Figure 4

Patient Disposition Following Rapid Response Team Activation



Note. Patient dispostion following rapid response team activation in the pre-intervention and intervention implementaion period (% of total RRT activation). There was a significant decrease in frequency of patients transferred to the ICU following implementation of the proactive rapid response RN rounding protocol (χ^2=6.792;p=.009). [a]Patients being moved to a unit, not the ICU, with more monitoring capabilities following RRT activation. Examples-For telemetry monitoring or lower nurse to patient ratios.

Patient Discharge Disposition. Table 7 displays the discharge disposition of patients who experienced adverse events with associated frequency on ALF in the intervention implementation period. In the intervention period, there was a significant decrease in frequency of discharge to a SNF following an adverse event compared to the preintervention period (χ^2=5.863, p=.015). There was no significant change in frequency of patients discharged to home (χ^2=3.281, p=.070), transferred to another hospital (χ^2=1.546, p=.214), or death (χ^2=1.589, p=.207).

Table 7

Discharge Disposition of Patients Experiencing Adverse Events[a] During Intervention Implementation

	Pre-Intervention Period	Intervention Implementation Period	
Discharge Disposition	n(%)	n(%)	p-Value
Home[b]	80(50.3)	61(59.2)	.070
SNF[c]	36(22.6)	13(12.6)	.015
Death	28(17.6)	23(22.3)	.207
Transfer[d]	15(9.4)	6(5.8)	.214

Note. Hospital disposition for patients experiencing adverse events during the pre-intervention and intervention implementation periods. There was a significant decrease in frequency of patients discharged to a SNF following adverse events following the implementation of a proactive RRT RN rounding protocol. RRT=Rapid Response Team; SNF=skilled nursing facility

[a] Adverse events are code blue events, deaths, RRT activations, or unplanned transfer to the ICU.

[b] Patients discharged to previous living situation.

[c] Patients discharged to a skilled nursing facility or rehabilitation hospital when they previously were living independently.

[d] Transfer to another hospital or inpatient facility.

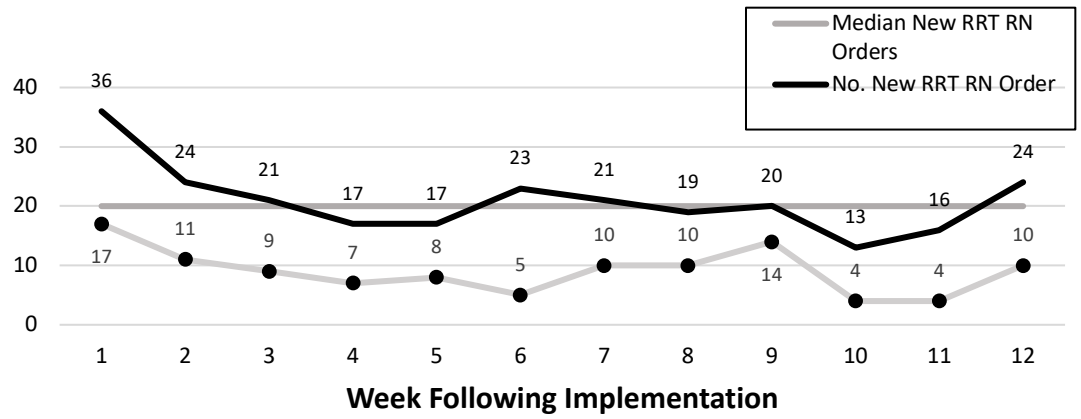
Implementation Process Evaluation

Figures 5 and 6 demonstrate the weekly count of RRT RN watchlist orders with adverse events and rate of ALF following implementation of the intervention. The run chart in Figure 5 displays no trends, runs, shifts, or clustering to indicate special cause variations. The p-chart demonstrates decreased or stable rate of ALF in all weeks, except for week 10, where the rate

of ALF exceeded the upper control limit, signaling a special cause variation warranting further investigation.

Figure 5

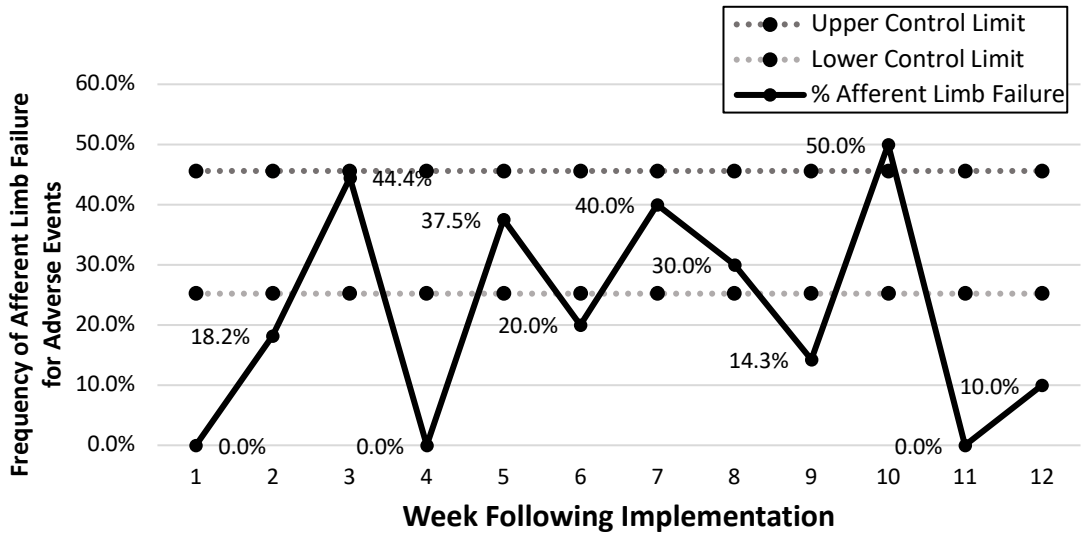
Rapid Response Team RN Watchlist Orders Placed And Adverse Events[a] Per Week



Note. Run chart demonstrating number of new RRT RN orders placed and number of adverse events per week following the implementation of a proactive RRT RN rounding protocol. This run chart demonstrates a stable process with no trends or runs. Median=20. [a]Code blue, death, RRT activation, and unplanned transfer to the intensive care unit.

Figure 6

Afferent Limb Failure Rate Preceding Adverse Events[a]



Note. Control chart demonstrating rate of afferent limb failure preceding adverse events during implementation of a proactive RRT RN rounding protocol. Control limits were calculated based on historical rate of afferent limb failure preceding adverse event from 10/1/2019-2/29/2020 and set a 3 standard deviations from the mean. Lower control limit=25.2%. Upper Control limit=46.5%. [a]Code blue , death, RRT activation, and unplanned transfer to the intensive care unit

Discussion

Key Findings

During the three month study period, there were 274 orders placing patients on the RRT RN watchlist proactive rounding protocol. Most RRT RN watchlist orders were placed by the RRT RN and were triggered automatically following transfer from the ICU to the medical-surgical unit or subsequent to RRT activation. Following implementation of the proactive RRT RN rounding protocol, there was a significant decrease in frequency of ALF preceding adverse events and in frequency of patients transferred to the ICU following RRT activations compared to the pre-intervention period. There was also a significant decrease in proportion of patients who were discharged to a skilled nursing facility or rehabilitation center following the implementation of this quality improvement project.

Key to the success of this quality improvement initiative has been the increased presence of the RRT RNs on the medical surgical units and their process documentation in the EMR as a result of this standardized process. Presence on the unit has allowed for easy access of the RRT RN for “curbside” discussions, which frequently resulted in the placement of a patient on the watch list by the RRT RN. Discussion and documentation of the assessment findings and recommendations provided an opportunity for RRT RN mentoring and teaching of the medical-surgical RNs as well as understanding of the support role of the RRT RN by the medical-surgical RN that had not been fully realized prior to implementation. Finally, implementation of this quality initiative project has provided framework for further understanding and quality evaluation of the RRS at UWMC-NW.

Interpretation and Implication of Findings

The RRT triggers most associated with AFL in the pre-intervention patient population were those that were less apparent, such as a decrease in systolic blood pressure greater than 20%. This change in systolic blood pressure is likely to go unnoticed, and not raise alarm, if the resultant blood pressure is judged to be adequate. Similarly, a high percentage of patients that demonstrated acute change in urine output and bleeding with a fall in hematocrit also experienced ALF. Though there was no significant association with ALF, it is worth noting that when these more subtle signs were present, they did not trigger activation of the RRT. In contrast, those patients who showed more overt signs of decompensation such as a decrease in systolic blood pressure to less than 90mmHg or heart rate changes resulting in extreme tachycardia and bradycardia were more likely to elicit a call for the RRT to respond. These findings infer that the medical-surgical RNs are less apt to activate the RRT for patients that they deem not critical enough to warrant the response of the team, often waiting for further decompensation to support their decision, findings well documented in the literature (Astroth et al, 2013; Braaten, 2015; Massey et al, 2014; Stafseth, 2016).

Many of the reported interventions aimed at addressing ALF have been based on the thought that a lack of nursing knowledge or skills drive decision-making around RRT activation (Connell et al, 2016; Liaw, 2016; Lyons, 2018). For our patient population, ALF was significantly associated with a patient receiving a fluid bolus in the 24 hours prior to their adverse event suggesting that aberrant vital signs or changes in patient condition were not unrecognized by the medical-surgical RNs. Efforts were being made to inform the provider and intervene without guidance or assistance of the RRT, consistent with previous reports of barriers to

activation of the RRT indicating that medical-surgical RNs feel that they should first contact the provider and enlist the assistance of other colleagues on the unit before triggering a RRT activation (Ashroth et al, 2013; Bagshaw, 2010; Jenkins et al, 2015). Fear of "going over their head," undermining the primary provider's role in their patient's care, and the risk of compromising their working relationship with the provider are concerns voiced by medical-surgical RNs contributing their decision to delay activating the RRT in order to first consult the provider (Braaten, 2015; Shapiro et al, 2010; Leach, 2013).

With these considerations in mind, the proactive RRT RN rounding protocol was developed. Because baseline assessment of the patient population who experienced adverse events revealed that there was no significant association between the type of adverse event or frequency of ALF and gender, age, time of day of event, code status, or length of time in hospital, the decision was made to implement this program house-wide targeting all patients bedded on inpatient medical surgical units. Implementation of the proactive RRT RN rounding protocol provided a method for staff to engage a member of the RRT in the care of complex or worrisome patients without the large response that comes with the activation of the RRT. While not intended to be a substitute for activating the RRT, this intervention provided a mode of getting highly trained, expert nursing staff to the bedside of a patient without anxiety or the fear of being reprimanded for triggering a team response or criticism for making the wrong decision to activate, nursing attitudes documented in many qualitative studies (Andrews & Waterman, 2005; Massey et al, 2014; Olsen et al, 2019). Medical-surgical RNs did not need to spend time waiting for further deterioration to justify activating the entire RRT in the setting of subtle clinical changes, potentially delaying critical interventions (Braaten, 2015). Instead, by

placing a patient on the RRT watchlist, the medical-surgical RN engaged the RRT RN in the care of the patient, enlisting expert nursing assessment skills to help guide decision making and intervention implementation. Providers were notified when a patient was placed on the RRT watchlist status in an effort to keep them up to date with concerns being raised about their patient and mitigate RN's worry that they were circumnavigating the providers. The intervention was introduced to the staff as a program intended to encourage a team approach to the care of worrisome and complex patients.

Prior to the implementation of this quality improvement project, the frequency of AFL was not monitored or tracked as part of the quality limb of the RRS. Recommendations from the proceedings from the third international consensus conference on rapid response systems state that, along with number of cardiac arrests occurring on medical surgical units and proportion of cardiac arrests occurring on medical-surgical units that meet local RRT activation criteria in the 24 hours prior to the event, overall ALF frequency should be tracked as a core quality metric in the evaluation of a RRS (Subbe et al, 2019). Following implementation of this quality improvement initiative, the frequency of ALF preceding adverse events was significantly decreased compared to baseline data. Throughout the implementation study period the frequency of ALF preceding adverse events fell within or below the expected range based on baseline data on all weeks, except for week 10. Investigation of that week revealed that it was a holiday week and because, in this institution, holidays tend to have unpredictable staffing and variable patient flow, it was decided that there should not be any further investigation into this variation or changes made to the implementation based on this one data point.

Unplanned transfer to the ICU is an adverse event associated with increased hospital mortality and longer hospital lengths of stay (Escobar et al, 2011; Kristinsdottier, 2020; Gabriella et al, 2013; Ridley, 1990). Consistent with findings in literature, there was significant association of AFL occurring prior to unplanned transfer to the ICU compared to other adverse events in our patient population (Trinkle & Flambouris, 2011; Van Galen et al, 2016). It has been reported that unplanned ICU admissions are frequently preventable and the result of failures in monitoring and intervention on medical-surgical units (Van Galen et al, 2016). With a decrease in rate of ALF preceding adverse events and in the proportion of patients transferred to the ICU following RRT, these findings suggest that implementation of a proactive RRT RN rounding protocol could be beneficial in addressing these failures, thereby impacting the frequency of patients transferred to the ICU. Within this framework, the experienced RRT RN can assist in and guide appropriate implementation of care to intervene in decompensation, obviate the need to transfer to the ICU, recognize when implemented interventions are not having their intended effect, and facilitate communication to the provider and subsequent best care. With knowledge that the RRT RN would be following patients and supporting the medical-surgical RNs following RRT activation, the provider's threshold to transfer a patient to the ICU can be higher. This is important as the demand for ICU beds is increasingly exceeding their availability, resulting in patients requiring critical care be cared for in other non-ICU hospital locations (Halpern & Pastores, 2015). Because of the reported negative outcomes associated with ICU patient boarding in other hospital locations, along with the burden that it puts on the areas where patients are boarded, efforts to minimize unplanned transfer to the ICU of medical-surgical patients are essential (Bing-Hua, 2014; Chalfin et al, 2007; Mathews et al, 2018).

As part of the initial evaluation of the RRS, the association of ALF with hospital discharge disposition was evaluated as a surrogate for hospital mortality following adverse events. While there was no significant association between hospital mortality and frequency of ALF within the pre-intervention patient population, ALF was significantly associated with discharge to a SNF compared to other discharge dispositions. Following intervention implementation, there was also a significant decrease in frequency of patients who experienced adverse events being discharged to a SNF. While association of ALF with hospital discharge to a SNF has not been previously reported, variables associated with ALF, such as prolonged length of stay and high risk of mortality have also been shown to be predictors of discharge to SNF (Smith & Stevens, 2009). For certain populations, the risk of sustaining an adverse event while hospitalized has been reported to be significantly higher for patients with increasing age, also a predictor of discharge to a SNF (Nejim, 2018; Schmidt et al, 2019). Further investigation is needed to determine the role that delayed treatment of patients showing early signs of decompensation has in the discharge disposition of patients experiencing adverse events.

The costs to implement the quality improvement project, including man hours spent on planning, the creation of the order in the EMR, and education of the staff prior to rollout, were minimal. This project was able to be implemented without increasing the number of full-time equivalent (FTE) RRT RNs. There was no indication that time spent rounding and coordinating care negatively impacted the other RRT RN work responsibilities. Moving forward, it is anticipated that there will be no additional ongoing costs to continue this program.

Limitations

The study of this intervention has a number of important limitations. Because it was completed at single institution, with a small sample size, generalizability is limited.

The availability of data for the study of this intervention was limited. Inpatient medical-surgical days and inpatient mortality data, obtained from the QI department at the study institution, were available in only full calendar month increments. Because of the limited study period, spanning partial calendar months, evaluation of the impact of this intervention was potentially compromised. Further evaluation of this intervention over a longer period of time could provide a more meaningful evaluation of the impact of this intervention. Inpatient code blue events are not tracked in a standardized fashion at this institution. The list of patients experiencing code blue events was obtained from the ICU clinical nurse specialist and its accuracy could not be verified.

At the time of intervention implementation, not all RRT RN full-time equivalents (FTEs) were filled, leaving some shifts not covered by an RRT RN. In these cases, the ICU charge RN would respond RRT activations and Code Blues, but did not participate in any other responsibilities of the RRT RN. Because of this, there were periods of time that there was a delay in RRT RN evaluation and shifts that patients who were on the RRT RN watch list did not have an RRT RN assessment. Further study of the intervention once all RRT RN positions are filled would provide a more accurate evaluation of the impact of this program.

In the pre-intervention evaluation, if there was documentation of a RRT RN consultation in the setting of a patient meeting criteria for RRT activation prior adverse event, ALF was deemed to have not occurred. It is recognized that there is the possibility that the RRT RN was

engaged in the care of the patient and not it was not documented, given there was no documentation standardization in place prior to implementation of the program, effecting the validity of this evaluation in capturing ALF preceding adverse events. Furthermore, there was no standardization as to how the RRT RN responded to a request for a consultation. As part of the implementation of this intervention, RRT RNs began to document each patient consult, regardless of placement on the RRT RN watchlist making ALF, making true assessment of ALF preceding adverse events possible following implementation of this program.

The impact of the COVID-19 pandemic on the implementation and study of this intervention must be discussed. First, implementation of this intervention was delayed due to hospital resources being redirected toward COVID-19 response efforts. The pre-intervention data was collected prior to the pandemic when the hospital was functioning at baseline. The intervention was implemented during a critical surge in the pandemic when surgical services were limited to only emergencies, affecting the composition of the patient population. Patient care models were changed to accommodate the needs of the institution in light of the influx of infected patients. These factors possibly impacted the validity of the pre and post implementation evaluation.

Conclusion

Implementation of a proactive RRT RN rounding protocol is a low cost intervention that reduces the frequency of afferent limb failure preceding adverse events by minimizing the systemic barriers to RRT activation. Increased collaboration between the RRT RNs and medical-surgical RNs in nonemergent situations provided an opportunity to strengthen their relationship, possibly making the decision to activate the RRT easier for the medical-surgical RN.

A qualitative study of the impact of the implementation of this project on the relationship between medical-surgical RNs and RRT RNs could provide meaningful information to support this idea.

This proactive RRT RN rounding protocol has also exhibited usefulness in addressing issues with ICU overcrowding. With the knowledge that patients would be placed on the RRT RN watchlist following RRT activation, providers were less likely to transfer their patients to the ICU. Furthermore, with automatic placement of patients on the RRT RN watch list following transfer from the ICU to the medical-surgical floors, patients were afforded an extra layer of monitoring that allowed for more provider confidence in their decision to transfer. A study of ICU readmission following placement of patients on the RRT RN watchlist would be useful to describe the impact of this intervention on preventing ICU readmission.

The importance of the qualitative and administrative limbs of the RRS should not be overlooked. Clear protocols and standardized processes, with audits and assessment of quality metrics, are essential to monitor performance and ensure the effectiveness of the RRS in meeting organizational goals. Tracking the frequency of ALF is one metric that can be used to assess performance of the RRS. In order to ensure the validity of the frequency of ALF as a quality indicator, evaluation of the effectiveness of the RRT criteria in reliably detecting deteriorating patients is essential. RRT criteria that are too broad or non-specific could cause confusion and alarm fatigue, contributing to higher rates of ALF that are not reflective of overall RRS performance. Studies to determine which RRT activation criteria are most sensitive for predicting decompensation are needed.

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Appendix

Educational Materials Used in the Implementation of a Proactive RRT RN Rounding Protocol

Figure A1

Education Rollout Plan Powerpoint Presentation

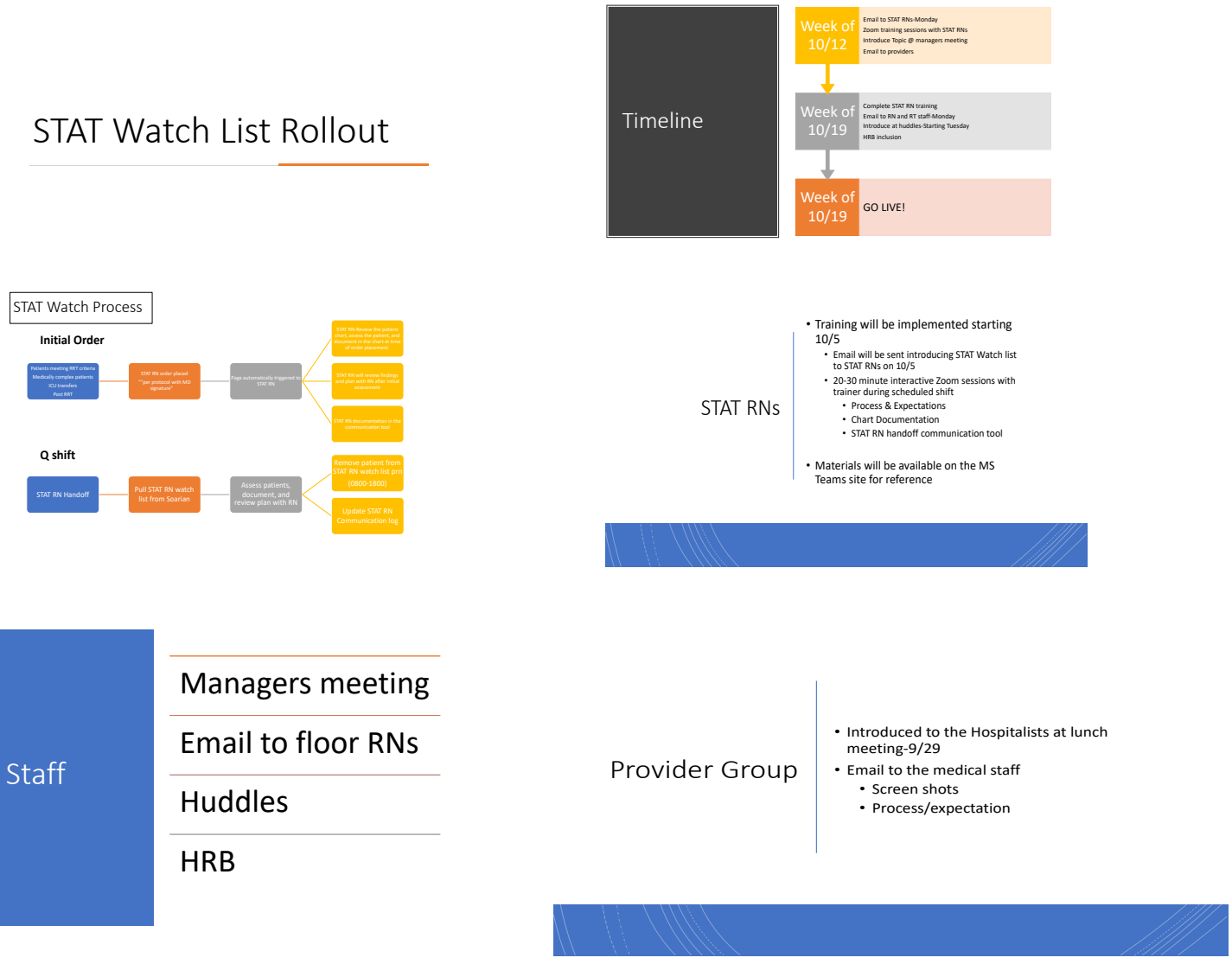


Figure A2

Frequently Asked Questions Regarding the RRT RN Rounding Protocol

STAT Watch List FAQ

What is the STAT Watch List?
A list of patients that will be rounded on and assessed by the STAT RN at least once per shift- including all ICU downgrades and all patients post RRT, if not transferred to the ICU.

Why are we implementing the STAT Watch List?
We are standardizing the work that the STAT RNs are already doing, making it easier for you to request a STAT RN consult.

What happens when I put a patient on the STAT Watch List?

Who should I add to the STAT Watch List?

- Any worrisome or medically complex patient that you feel would benefit from an extra set of expert RN eyes
- Any patient that is having escalating interventions (fluid boluses, ABGs, increasing fi02 needs, high CIWA scores)
- Any patient who you admit that is a downgrade from the ICU
- Any patient that has had an RRT, that is not transferred to the ICU

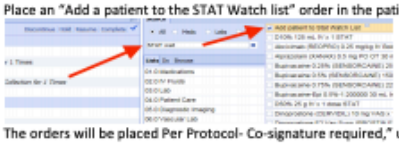
Who shouldn't I add to the STAT RN watch list?

- Patients needing an urgent intervention or STAT RN assistance in less than 2 hours. Please continue to page the STAT RN directly for those needs. The patient can be added to the STAT Watch List once their immediate needs are met.
- Patients that you need help with completing one task-NG tube placement, difficult foley placement, difficult IV placement, assistance with transport.

Who can add patients to the STAT Watch List?
Any provider, RN, or RT.

How do I put a patient on the STAT Watch List?

- Place an "Add a patient to the STAT Watch list" order in the patient chart. This will trigger an automatic page to the STAT RN, notifying them of your order.



- The orders will be placed Per Protocol- Co-signature required," using the attending MD as the ordering provider. Pertinent information can be added to the "Instructions" box.

How do I remove a patient from the STAT Watch List?
You do not need to. Patients will be removed from the STAT Watch List by the STAT RN when clinically indicated.

Does this mean that I don't need to call an RRT?
NO! This does not take the place of calling the Rapid Response Team to the bedside when indicated. Please continue to activate the RRT for patients meeting RRT criteria, even if they are on the STAT RN Watch List.

Can I still page the STAT RN for questions or concerns?
Yes! Please continue to page the STAT RN for questions or concerns. We may decide together to add a patient to STAT Watch List after discussing the situation.

Who do I contact if I have questions or concerns about the STAT RN Watch List/ Order?
Please contact Sarah Welch, STAT RN at welchs@uw.edu or Amy Ungerleider, STAT RN RN3 at nelsonal@uw.edu for any questions or concerns about this program.

Note. Flyer posted on the medical-surgical units and in provider offices describing the RRT RN rounding protocol. Also sent in emails, describing the RRT RN rounding protocol following presentation to the unit managers.

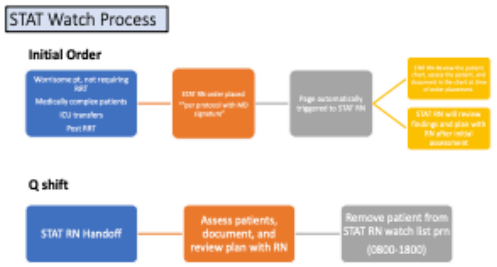
Figure A3

One Pager Describing the RRT RN Rounding Protocol

STAT Watch List

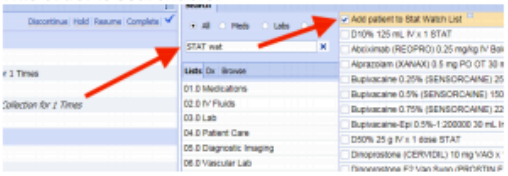
What is the STAT Watch list?

- A list of patients that will be rounded on and assessed by the STAT RN at least once per shift- including all ICU downgrades and all patients post RRT, if not transferred to the ICU.

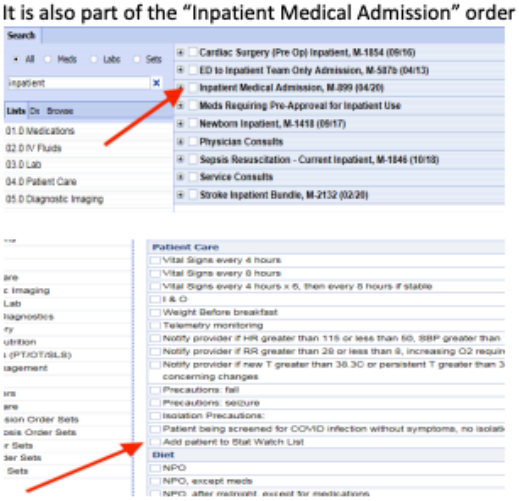


How do I put a patient on the STAT watch list?

- Place an "Add a patient to the STAT Watch list" order in the patient chart.
- This order is searchable.



- It is also part of the "Inpatient Medical Admission" order set, patient care section.



Which patients are appropriate for the STAT watch list?

- Patients bedded in locations where you are concerned about skill/ability to fully implement your plan of care, though do not warrant transfer to higher level of care.
- Patients you think need an extra set of "expert nursing" eyes on at least once per shift.
- Patients showing early signs of decompensation requiring escalating interventions.
- Patients that you are questioning needing higher level of care, though do not meet criteria for transfer yet.

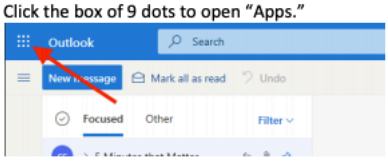
Note. One pager sent to the medical providers via email following staff meeting presentation introducing the RRT RN rounding protocol

Figure 4A

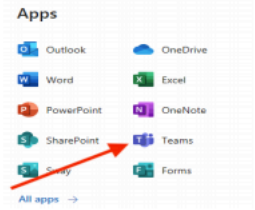
Education Material for the RRT RNs Describing Steps to Access the RRT RN Teams Page

Accessing Microsoft Teams "UWMC NW STAT RN" Page and STAT RN Communication Log.

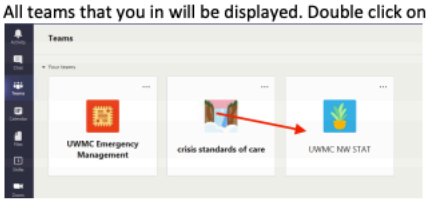
1. Open your Outlook email.
2. Click the box of 9 dots to open "Apps."



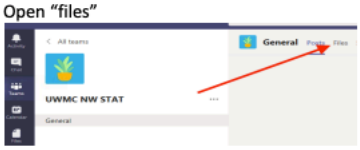
3. Double click on the "Teams" App. You may have to open "All apps" first.



4. All teams that you in will be displayed. Double click on the "UWMC NW STAT"



5. Open "files"



6. Open "STAT watch list" excel spreadsheet.

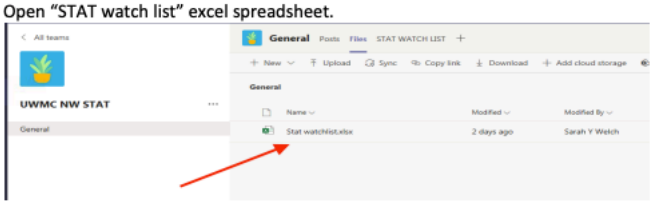
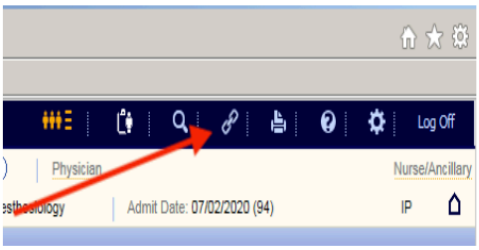


Figure A5

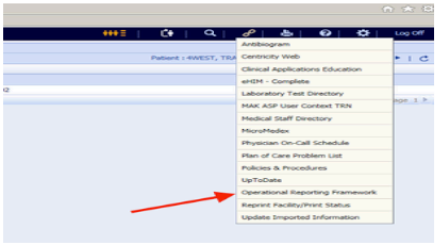
Education Material Describing Process for Printing the RRT RN Watchlist From the EMR

STAT RN Watch List Report from Soarian

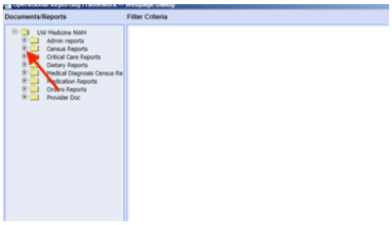
1. Open Soarian.
2. Click the "link" Icon in the upper right corner.



3. Select "Operational Reporting Framework."

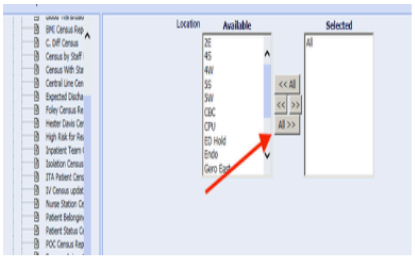


4. In "UW Medicine NWH", Open "Census Reports"



5. Click "STAT Watch Order."

6. Select all locations by clicking "ALL>>" .



7. Click "Preview" to view the list or "Print".