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Factors Leading to Rapid Response Team Interventions in Adult Medical-Surgical Patients

Christine M. Tarver

Northern California Consortium, Doctor of Nursing Practice Program, California State University, Fresno and San José State University

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FACTORS LEADING TO
RAPID RESPONSE TEAM
INTERVENTIONS IN ADULT
MEDICAL-SURGICAL PATIENTS

By
Christine M. Tarver

A doctoral project in partial fulfillment of the
requirements for the degree of
Doctorate of Nursing Practice
in the California State University,
Northern California Consortium,
Doctor of Nursing Practice Program,
California State University, Fresno

May 2015

APPROVED

For the Department of Nursing

We, the undersigned, certify that the doctoral project of the following student meets the required standards of scholarship, format, and style of the university and the student's graduate degree program for the awarding of the doctoral degree.

Christine M. Tarver
Doctoral Project Author

Diane L. Stuenkel EdD RN

Dr. Diane Stuenkel	San Jose State University, School of Nursing
Chairperson's Name	Affiliation

Debrah Gayle EdD(c)

Dr. Elizabeth (Pepe) Greenlee	El Camino Hospital
Committee Member's Name	Affiliation

Debrayh Gayle, EdD(c)	San Jose State University, School of Nursing
Committee Member's Name	Affiliation

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Dedication

First, this project is dedicated to the patients who entrust us with their care. Second, this project and my doctoral work are dedicated to my daughters, Holly Noelle and Vanessa Rae, with the hope that they are inspired to continue a path of life-long learning in a career that brings them joy. Finally, I dedicate this work to my husband, Damon Ray Tarver, who has given me constant support since undergrad study decades ago, and in our home life, and without whom, this achievement would have never been possible.

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Christine Tarver

Northern California Consortium, DNP Program

Dr. Diane Stuenkel

May 1, 2015

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Abstract

Rapid Response Team Intervention (RRTI) is a widely used intervention in acute care hospitals in the United States. Demonstrated effectiveness in preventing transfer to higher level of care or in decreasing in-hospital mortality has not been established. This exploratory study used a retrospective chart review to examine differences between medical-surgical acute care inpatients who had an RRTI and a control group. Current literature lacks information on proactive detection of patients who may be more likely to deteriorate and therefore require a Rapid Response Team Intervention.

Therefore, this study's PICO question was: Are there statistically significant differences between medical-surgical adult inpatients who required Rapid Response Team Intervention and those who did not for demographic characteristics and selected clinical parameters (vital signs, level of consciousness, etc.)?

The charts of all RRT patients on three medical-surgical units in a community hospital for a period of one year were reviewed (n=135) with an accompanying chart review of three control patients for every RRT patient (n = 331). Variables included a descriptive set, the study hospital's policy of "criteria for calling an RRT" and other independent predictor variables.

Results yielded five statistically significant differences between RRT and control patients: age, history of psychiatric/mental illness, use of respiratory medications such as inhalers and steroids and use of medications to treat psychiatric/mental illness. There was a large variation in response time to "criteria for calling an RRT". Abnormal vital signs were documented in the electronic medical record (EMR) but at times it was hours before the RRT was summoned.

This variation in the reaction of the primary nurses caring for the deteriorating patient suggests automation of calling an RRT could improve patient care by reducing delays. There also is a need to increase awareness of the vulnerability of psychiatric/mentally ill patients and chronic cardiac disease patients, and their greater likelihood of needing RRTI during hospitalization.

Chapter 1: Statement of Problem

In response to the 1999 landmark report from the Institute of Medicine (IOM) “To Err is Human” (Kohn, Corrigan, & Donaldson, 1999), the Institute of Healthcare Improvement (IHI) developed the “Save 100,000 Lives” campaign with the goal of saving 100,000 patient lives in the first 18 months of the campaign, and then 100,000 annually thereafter (“100k Lives,” n.d.). Rapid Response Teams (RRT) were introduced in the 1990s but were not widely utilized until they were identified as one of six “bundle items” IHI believed would save patient lives as part of the national campaign started in 2006 (“100k Lives,” n.d.).

RRT is a patient safety practice whereby a team is summoned by a direct care provider when a patient has shown signs of deterioration. The goals are to prevent transfer to a higher level of care and/or prevent cardiac/respiratory arrest and/or mortality (“Rapid Response,” 2012). Rapid Response has become an expected standard of patient care because the practice fulfills The Joint Commission (TJC) standard requiring acute care hospitals to: develop a system to respond to patients deteriorating outside the ICU setting (Jones, Bleyer, & Petree, 2010). Meeting TJC standards are vital to hospitals because without accreditation by TJC a hospital risks losing reimbursement for government-insured patient care.

Unfortunately, the problem is that the TJC-mandate to create a patient deterioration response system, fulfilled by many hospitals through creation of RRTs, has not been shown to conclusively prevent transfer to critical care nor reduce mortality (Young, 2010). The question of RRT being a true “quality initiative” remains unanswered due to lack of evidence supporting the success of RRTs. Due to inconclusive findings supporting RRT, this Doctor of Nursing Practice (DNP) project attempted to discover factors common to patients who had an RRT Intervention to predict patients at risk for deterioration. A proactive risk assessment could lead to

implementation of interventions earlier in the hospital course, thereby increasing the potential for positive patient outcomes, namely preventing transfer to ICU or reducing in-hospital mortality.

Theoretical Framework

Sister Callista Roy developed the Roy Adaptation Model (RAM) in the mid-1960s, although the first article describing the theory was not published until the early 1970s, and her first theory book in 1976 (Whetsell, Gonzalez, & Moreno-Ferguson, 2011). Roy's theory is based upon concepts outside of the nursing profession, specifically the work of psychotherapist Harry Helson who described a process of how an individual adapts to three different levels of stimuli (Whetsell et al., 2011).

Roy stated the "goal of nursing care is to foster successful adaptation" (Masters, 2011). By studying RRTI patients in comparison to a control group of patients who did not have an RRTI, there is potential to eventually create a system in which nurses can promote successful adaptation. Roy describes adaptive levels in which a person may or may not have safely managed internal and external stimuli (Whetsell et al., 2011). The relationship of adult inpatients at risk for Rapid Response to Roy's three Adaptation Levels is:

- (1) Roy's "integrated" level = a stable acute care patient,
- (2) Roy's "compensatory" level = a stable patient transitioning to unstable state,
- (3) Roy's "compromised" level = deterioration of patient condition to the point of Rapid Response.

A hospitalized patient is exposed to various stimuli, and when a patient is no longer able to adapt to the stimuli, their adaptation level will fall to "compensatory" and coping processes will be utilized (Whetsell et al., 2011). These coping processes include a "cognator subsystem" of emotions, learning, information processing and judgment, as well as "regulator subsystems"

which include physiological adaptation coping processes such as an increased heart rate to compensate for a low hematocrit level (Whetsell et al., 2011). As individuals try to manage stimuli, they add coping processes. For a patient physiologically deteriorating, this may be an increasing respiratory rate to try to get more oxygen to the brain or heart. If these added coping mechanisms do not manage the negative internal or external stimuli, the patient will then fall to a “compromised” level. At the compromised level, a patient’s coping processes are no longer effective. In the case of Rapid Response, deterioration from integrated to compromised can happen slowly or very quickly, depending on the stimuli causing the deterioration. For instance, decreased respiratory rate due to opioid over-sedation can come on gradually as the effects of the medication reach their peak effect over minutes to hours. However, an opioid naïve patient who has received an intravenous dose of a larger amount of opioid can have a sudden decline in level of consciousness and respiratory rate.

As other researchers have used RAM to guide mid-range theory development, Roy’s model is applied to this study. A Roy model scholar, Dr. Debra Hanna, offered insight as to why Roy fits well with this author’s desire to create a tool to prevent deterioration to the point of needing Rapid Response (or the point of reaching Roy’s compromised level): “if the person has some obstacle to finding the way to adapt or to cope, a nurse...might be able to facilitate the pathway to adaptation or coping” (Clarke, Barone, Hanna, & Senesac, 2011).

Chapter 2: Review of the Literature

Strength of Body of Literature

RRTs and their outcomes have been studied almost continuously for over twenty years. An Agency for Healthcare Research and Quality (AHRQ) Patient Safety Practices' meta-analysis described results from 38 studies (Winters, Weaver, & Dy, 2013). The first 18 studies were completed from 1990 - 2008 and found promising results after implementation of RRTs (Winters et al., 2013). Since 2008 however, an additional 20 studies described by AHRQ have found mixed results (Winters et al., 2013).

Another "classic" meta-analysis and systematic review of 18 studies was published in 2010 (Chan, Jain, Nallmothu, Berg, & Sasson, 2010). This review included studies from 2000 to 2008 and found inconclusive support for RRTs, including seven studies in a row from 2004 to 2008 which did not show any decrease in mortality (Chan et al., 2010).

Weaknesses of Body of Literature

Lack of standardization of RRTs and therefore lack of consistent research designs and metrics studied, does affect the comparison in terms of meta-analysis (Chan et al., 2010). There are differences in members of the RRT (for example, the team may or may not include a physician) and criteria to activate RRT are not standard across hospitals ("AHRQ," 2012). Chan et al. (2010) commented on the high heterogeneity of the studies attributed to the significant differences in research design as well as differences in RRT activation rates at the various organizations. These researchers reported "RRT use rate per 1000 admissions", and found a variation (among studies that reported this statistic) from 2.5 to 40.3 (Chan et al., 2010). Chan et al. (2010) also found a great difference in the interventions of the RRT. It was suggested that more rigorous research designs and standardization of RRT criteria and interventions could aid

in understanding the true effect of RRT on preventing transfers to higher levels of care and reducing mortality (Chan et al., 2010). Chan et al. (2010) also offered a discussion about the sample size needed to detect a difference in mortality rates, and that although their study represented over one million patients, it still may not have been a large enough sample size.

There also is a lack of research on alternatives or improvements to the current reactive RRT model. To date, this author located two articles studying alternatives to traditional RRT. One study focused on an education program for bedside clinical nurses and support staff (CNAs and technicians) rather than instituting an RRT, which resulted in a decrease in both cardio-pulmonary arrests and transfers to critical care units (Moldenhauer, 2009). A second article focused on expansion of an RRT program to include proactive rounding of patients recently transferred out of critical care units (Butcher, Vittinghoff, Maselli, & Auerbach, 2013).

Key Systematic Review

The article designated by AHRQ as “classic” for systematic review is Chan et al’s 2010 article (“AHRQ,” 2012). This article will be discussed in the next section of this paper. Also, AHRQ itself, in their 2013 update of patient safety practices, included a chapter on recent studies of RRTs and their findings (Winters et al., 2013). AHRQ also found no conclusive support for RRTs, and stated the cost of RRTs to healthcare organizations as being moderate (Winters et al., 2013). An example of cost at a Silicon Valley, California hospital: an RRT nurse average salary is \$75.00 per hour. RRT coverage at this hospital is 7 days per week, 24 hours per day, which translates into 4.2 FTEs. One FTE is 2080 hours; 4.2 FTEs is 8,736 hours. This would equate to \$655,200 annually spent on labor alone.

Rigor of Study

Researchers have gone to great lengths to ensure a complete systematic review. Chan et al.'s (2010) meta-analysis spanned 1950 to 2008, and included searches in over five search engines and a hand-search of article bibliographies and scientific conference abstracts from 2006 through 2008.

In 2013 AHRQ summarized the agency's opinion regarding the state of evidence for RRT, which is targeting a problem (patient deterioration) deemed "common" in frequency and "high" in severity: there is moderate strength of existing evidence in RRTs reducing cardiopulmonary arrest; however, there is inconclusive evidence of mortality reduction in adults (Winters et al., 2013).

Summary and Critique of Literature

Study/Author. Rapid Response Teams: A systematic review and meta-analysis by Chan, Jain, Nallmothu, Bery & Sasson, published (Chan et al., 2010).

Strength of evidence. A systematic review and meta-analysis is regarded as the strongest level of evidence in the Evidence Based Medicine (EBM) Pyramid (EBM Pyramid, 2013). As described previously, Chan et al. (2010) conducted a rigorous search for RRT studies that included randomized clinical trials (RCTs) and prospective studies that included results explaining change in in-hospital mortality (primary outcome) and cardiopulmonary arrest (secondary outcome). Their search found an initial 532 potential articles that yielded 18 studies that met inclusion criteria for the meta-analysis (Chan et al., 2010). In rating the quality of the 18 studies, Chan et al. (2010) ranked five as high quality, two as fair quality and the remaining as low quality.

Risk/benefit rationale of the procedure. The final conclusion of the meta-analysis was there is not acceptable evidence to demonstrate RRTs lead to improved patient survival (which was to be the primary goal of RRTs), and therefore the support for their use should be reevaluated by healthcare quality agencies. A commentary of Chan et al.'s meta-analysis goes even farther, questioning the high cost of RRTs without evidence of contributing to saving lives (Young, 2010).

Study/Author. Introduction of the medical emergency team (MET) system: A cluster-randomized controlled trial (RCT) by Hillman, Chen, Cretikos, Bellomo, Brown, Doig, Finfer & Flabouris published in 2005 (Hillman et al., 2005).

Strength of evidence. RCTs are considered the best method for determining the effectiveness of an intervention (Gordis, 2009). The randomization of intervention versus control group for this study was done. There were a total of 23 Australian hospitals participating in the study, divided randomly into two groups: 12 had a MET program started and 11 continued with "business as usual" thereby becoming the control group (Hillman et al., 2005). Results of this study found no statistically significant difference between the intervention and control hospitals for any of the patient outcomes studied: cardiac arrest, unplanned ICU admissions, and unexpected deaths (Hillman et al., 2005). These researchers suggested that the sample was not large enough to detect a difference in outcomes, and that at least 100 hospitals would be needed to establish statistical power (Hillman et al., 2005). Another limitation was researchers could not control for external influence on the study hospitals. During the timeframe of their study, local media in Australia was widely reporting on the concept of METs in mainstream news (Hillman et al., 2005).

Risk/benefit rationale of the procedure. As the results did not reveal a positive influence on saving patient's lives, the researchers could not recommend implementation. They acknowledged that patient care still is not optimal and more research is needed (Hillman et al., 2005).

Study/Author. A Literature Review: Do rapid response systems reduce the incidence of major adverse events in the deteriorating ward patient? by Massey, Aitken & Chaboyer, published in 2010 (Massey, Aitken, & Chaboyer, 2010).

Strength of evidence. The authors of this literature review conducted a search for articles from January 1995 through June 2009 using four database search engines (Massey et al., 2010). Sixteen studies were selected as meeting inclusion criteria. Results of the analysis indicated there is a lack of high quality data to support the premise that RRTs reduce in-hospital cardiac arrest, unplanned ICU admissions or death (Massey et al., 2010).

Risk/benefit rationale of the procedure. This study commented on the lack of standardization including response time variation expectations, clinical trigger variation and inconsistent summoning of an RRT team by direct care staff as possible contributing factors to the lack of positive patient outcomes (Massey et al., 2010). Massey et al. (2010) also called for more research including a suggestion of an international collaboration to complete an RCT to garner a larger sample size.

Next, is the review of two articles regarding alternatives to traditional RRT programs.

Study/Author. "Clinical triggers" program cuts cardio arrest rate by Moldenhauer published in 2009 (Moldenhauer, 2009).

Strength of evidence. This would be considered a "weak" study design as there was no control group, no randomization, and the study occurred at one hospital in the Denver, Colorado

area (Moldenhauer, 2009). Lacking resources to start an RRT program, the hospital elected to focus on educating nurses and residents (Moldenhauer, 2009). The rationale for the education was that having bedside caregivers more adept at recognizing patients heading toward crisis/deterioration was perhaps better than an RRT program because it eliminated handing off the patient from those who had been caring for the patient to a “new” team (an RRT for instance) who did not know the patient well (Moldenhauer, 2009). Reported results included reduction in cardiopulmonary arrest and a “significant” decrease in ICU readmissions within 48 hours; however there was no mention of mortality reduction (Moldenhauer, 2009).

Risk/benefit rationale of the procedure. There is not enough information about the results to know if education regarding triggers for deterioration is superior to RRT. The article does not specify time frames of the study so it is impossible to discern sustainability. Whereas there is no risk in educating staff, and an increase in knowledge would not cause harm, the benefit to the patient is unclear.

Study/Author. The impact of proactive rounding by a rapid response team on patient outcomes at an academic medical center by Butcher, Vittinghoff, Maselli & Auerbach published in 2013 (Butcher et al., 2013).

Strength of Evidence. This retrospective observational study occurred at one hospital, and did not include a concurrent control group, but rather a pre- and post-chart review, therefore it not a strong study design (Butcher et al., 2013). Metrics measured were: ICU readmission rate, ICU average length of stay, and in-hospital mortality (Butcher et al., 2013). Patient charts from 17 months prior to the proactive rounding program (n=4,902 patients), and patient charts for 25 months after the proactive rounding program (n = 6,785 patients) were the sample for this study (Butcher et al., 2013). Results concluded there was no statistically significant difference in any

of the three metrics after implementation of proactive rounding (Butcher et al., 2013). A limitation of this study was that proactive rounding only focused on patients discharged from critical care units, yet other types of patients also require RRTI, and perhaps proactive rounding on other types of patients may have yielded different results.

Risk/benefit rationale of the procedure. Proactive rounding occurred for all patients discharged from the ICU at a large academic medical center in San Francisco, California (Butcher et al., 2013). While proactive rounding posed no risk to the patient as it consisted of a critical care trained RN and Respiratory Therapist checking on patients recently transferred out of a critical care unit, it also did not demonstrate any benefit to the patient (Butcher et al., 2013). The concern is that because a benefit for proactive rounding has not been discovered, it may not be the best use of time and skills of the personnel assigned to respond to RRT's (Butcher et al., 2013).

Because the review of literature did not reveal consistent improvement in patient outcomes related to the intervention of an RRT, this study was designed for the purpose of attempting to retrospectively examine various demographic characteristics and clinical parameters for the patients who deteriorated to the point of needing an RRT versus control patients who did not meet RRT activation criteria.

Chapter 3: Methods

Project Design/Type of Project

This DNP Project is an exploratory retrospective chart review of adult medical-surgical RRTI Patients versus Control Patients to collect information on variables that may indicate patient deterioration and need for RRTI. The case-control design utilized a ratio of one case patient to three control patients. The case patients will be referred to as “RRT patients” from this point.

The study’s PICO question was: Are there statistically significant differences between medical-surgical adult inpatients who required Rapid Response Team Intervention and those who did not for demographic characteristics and selected clinical parameters (vital signs, level of consciousness, etc.)?

Setting

The setting was a 443-bed community not-for-profit hospital in California’s Silicon Valley. There are three medical-surgical units in the hospital, varying in size from 32-39 beds. Each medical-surgical unit cares for patients of similar acuity levels with a variety of medical and surgical diagnoses. Hours per Patient Day (HPPD) varies by less than 0.5 HPPD across the three units. All three medical-surgical units’ patients are cared for in a 5:1 patient to nurse ratio in accordance with California ratio law (“Ratio Law,” 2004), do not require telemetry monitoring, and do not have continuous sustained interventions more frequently than every four hours. For example, patients needing every two hour neurological assessments would be placed in a higher level of care such as a step-down unit.

The RRT at the hospital consists of a critically-care trained RN and a Respiratory Therapist; there is no physician member. RRTs did not include a physician member in three of the seventeen studies fully reported in Chan et al. 2010 meta-analysis.

Population and Sample

RRT Patients were pulled from the monthly list of RRTI patients maintained by hospital staff for the time period of July 1, 2013 to June 30, 2014. The RRT can be called for patients on medical-surgical units, telemetry units, mother-baby units or in procedural areas; only the RRTs occurring on the three medical-surgical units were included in this study. By spanning 12-months, any possible seasonal changes in patient population, such as an increase in influenza patients between the “flu season” of October – March, were mitigated.

Control Patients included patients cared for in these same units during the same time period who did not require RRTI. Records for three control patients were selected for every one RRT patient. The control patients were randomly selected from the census list using a random number table. The methodology for the random selection used the date of the RRT. For example: if the RRT for the “case” patient was noted to have occurred on June 6, then the 6th row down on the random number table was selected. If the first number on the 6th row down was a “2” then the 2nd patient admitted on the same day as the RRT patient and who was still hospitalized on the day of the RRT was control patient #1, the 3rd patient admitted with commensurate length of stay as RRT occurrence was control patient #2 and the 4th patient admitted with commensurate length of stay as RRT occurrence was control patient #3.

Each month, approximately 12,000 patients are cared for at the hospital. On average, the ethnic mix is primarily Caucasian (n = 6400), Asian Indian (n = 984), Asian “other” (n = 812)

and Chinese (n = 670). The remaining patients reported an additional seven ethnic groups, with no one group exceeding 260 patients in a month.

The ethnicity of the community is tracked by the hospital's Marketing Department. Analysis was most recently presented in March 2012. Of the growing population ethnicities, Asians represented 73% of the population growth and for every one Caucasian leaving the marketing area, 2.9 Asians moved into the community.

Data Collection

Data were collected via retrospective chart reviews. All chart reviews were completed by the researcher over a period of four months. Data collection commenced once Institutional Review Board (IRB) approval was obtained from both the study hospital and Fresno State University. As a retrospective chart review study, informed consent was waived by the IRB committees.

Data Analysis Plan

A data collection spreadsheet was developed for recording the information extracted from the hospital's electronic medical record (EMR). Data were used to describe the sample and for statistical analyses. Descriptive and inferential statistics were computed by a contracted statistician, available through the hospital's Nursing Research Council.

For purposes of determining the control group, the admission date, date of RRT and time of RRT was collected for all RRT patients.

Comparisons were made using chi squared and t-tests between those who received RRT and Control Patients, in particular looking at:

- descriptive variables;
- hospital's RRT criteria; and

- other independent predictor variables including medical history items/co-morbidities, medications prescribed, ED admission within eight hours, transfer from CCU within 8 hours if extubated less than 24 hours, CCU length of stay greater than seven days.

The confidence interval was set at $p \leq .05$. Characteristics held in common among RRTI patients that differ from those not requiring RRTI will inform the development of a tool and protocol for nurses to use in determining the need to call for RRT.

Description of Variables

Data collected were analyzed to explore differences between the two groups (RRTI vs. Control) for three sets of variables: descriptive, study hospital's RRT criteria, and other independent predictor variables.

Descriptive variables. The first set of variables was demographic descriptive data:

- age in years at time of rapid response;
- gender;
- race/ethnicity;
- primary language: English versus Language Other than English;
- primary admission reason (surgical, medical, procedural, infusion, other); and
- payer type (private insurance, government funded insurance, cash pay, no insurance, other).

Descriptive variables were examined for purposes of describing the two groups as well as to determine differences, as demographic differences also may be factors that place patients at risk. An example of this is Ann Hendrich's Fall Risk Assessment Tool, in which male patients

had a statistically significant higher rate of falls than female patients and therefore gender was incorporated into the Hendrich II Fall Risk Assessment (Hendrich, Bender, & Nyhuis, 2003).

Study Hospital RRT Criteria Variables. The second set of variables was the study hospital's RRT criteria per internal policy:

- vital sign data within 4 hours prior to RRTI, collected at hourly increments prior to RRT (or commensurate time of RRT for control patients) as well as exact number of minutes prior to RRT call that first detection of abnormal vital signs meeting RRT criteria occurred. These vital sign parameters, based on the hospital's RRT criteria, were:
 - heart Rate less than 40;
 - heart Rate greater than 130;
 - systolic blood pressure less than 90;
 - respiratory rate less than 8;
 - respiratory rate greater than 28;
 - temperature less than 97 degrees Fahrenheit;
 - temperature greater than 100.4 degrees Fahrenheit;
 - oxygen saturation less than 90% with supplemental oxygen;
- other criteria for an RRT call as per the policy include:
 - acute changes in level of consciousness;
 - acute change of urine output to less than 50 milliliters in 4 hours;
 - onset of chest pain with one of the other RRT vital sign criteria changes;
 - and

- new onset: weakness, loss of function one side and/or loss of speech or difficulty understanding others immediately prior to RRT call.

Other independent predictor variables. The third set was independent predictor variables. A rationale for their inclusion in this study follows. These variables are:

- history of opioid use (yes versus no);
- history of substance abuse (yes versus no);
- history of chronic pulmonary disease (yes versus no);
- history of cardiac disease (yes versus no);
- history of psychiatric/mental illness (yes versus no);
- history of diabetes (yes versus no);
- active medications on the electronic medication administration record (eMAR) at time of RRT call or commensurate time for control patient:
 - opioid (yes versus no);
 - non-opioid pain medication (yes versus no);
 - respiratory medications including inhalers and steroids (yes versus no);
 - cardiac medications (yes versus no);
 - anti-anxiety medications (yes versus no);
 - medications to treat psychiatric and/or mental illness other than anti-anxiety medications (yes versus no);
 - anti-emetics (yes versus no);
 - insulin or oral hypoglycemic (yes versus no);
- admission within eight hours of the RRT from the Emergency Department (yes versus no);

- transfer within eight hours of RRT from Critical Care Unit if extubated in previous 24 hours (yes versus no); and
- total length of stay (LOS) in Critical Care Unit was greater than 7 days (yes versus no).

Next, is an explanation of the rationale for inclusion of independent predictor variables chosen for the study:

- **History of chronic pulmonary disease including asthma, chronic pulmonary obstructive disease and emphysema.** Patients cared for in an acute care hospital with known co-morbidities that affect airway and gas exchange are more at risk for adverse events. In a comprehensive literature review of over five decades of research in developing frameworks for adverse events and physiologically unstable patients, Jones, Mitchell, Hillman and Story (2013) called on future research to examine pre-existing conditions in developing clinical deterioration frameworks.
- **History of chronic cardiac disease including myocardial infarction, chronic atrial fibrillation and congestive heart failure.** Patients cared for in an acute care hospital with known co-morbidities that affect heart rate and cardiac function are more at risk for adverse events. As stated in the previous paragraph, examination of pre-existing conditions is an important component of developing tools to describe clinical deterioration (Jones, Mitchell, Hillman, & Story, 2013).
- **History of substance abuse.** Pillett and Eschiti (2008) noted two fundamental difficulties of managing pain in patients with substance abuse history: (1) believing a patient's self-report of pain is difficult because of healthcare provider

bias against those who abuse drugs, and (2) there are no established guidelines for healthcare team members to follow when trying to cover the current pain experience and the amount of illicit drug taken outside of the hospital. The risk for patients therefore is a caregiver lacking knowledge of “where to start” a pain medication regime, which leads to risk of undertreating pain, which cascades to patients feeling the need to revert to illicit drugs to find relief (Pillet & Eschiti, 2008). Opioids administered by the nurse, combined with unknown illicit drugs being taken by the patient, puts the patient at risk for over-sedation, respiratory depression and/or respiratory arrest. These forms of deterioration can be recognized through decreased respiratory rate, which is an RRT criterion.

- **History of psychiatric issues.** Thomson and Henry (2012) noted that patients with mental illness are vulnerable during inpatient hospital stays for conditions being treated by non-mental health care physicians. These researchers described the added complexities of oncology patients with chronic psychiatric problems of depression, bipolar disease and schizophrenia in a case study format (Thomson & Henry, 2012). One cancer patient described in the study delayed treatment due to her mental illness, which then caused the person to come to the hospital in a more debilitated state, leading to higher risks of complications (Thomson & Henry, 2012).
- **List of prescribed medications at the time of the rapid response by drug class.** Medication classes known to adversely affect respiratory rate, sedation level, heart rate, and blood pressure were the focus: opioids, sedatives, benzodiazepines, antiemetics, antiepileptics, antihypertensives. Hendrich (2003)

used “prescribed medications” rather than administered medication, and noted a statistically significant difference in patients who fell compared to those who did not fall for two drug classes: benzodiazepines and antiepileptics.

- **Admission within eight hours prior to RRT from Emergency Department.**

There is not literature to support this variable however, local hospitals are using this variable for their RRT “watch list” (A. Paulson, personal communication, December 8, 2013). This study would provide an opportunity to test for statistical significance of this current practice.

- **Transfer within 8 hours prior to RRT from the critical care unit if within 24**

hours of extubation or critical care length of stay 7 days or longer. Again,

there is not literature to support this variable. Local hospitals are using these

variables for their RRT “watch list” (A. Paulson, personal communication,

December 8, 2013). This study would provide an opportunity to test for statistical significance of this current practice.

Ethical Consideration (Human Subject Protections)

Only archived data were collected. Patient’s medical records were accessed. To maintain confidentiality, the medical record number (MRN) was mapped to a coded number for the study; MRNs were not on the spreadsheet. For example, the first RRT patient was coded as R1, and the first three control patients were C1, C2, and C3.

The MRN/Coded Number Spreadsheet and the separate Data Collection Spreadsheet were stored on a password protected hospital u-drive, accessible only to the researcher. No patient name was recorded as part of this study. The researcher was able to access data from a hospital-issued desktop computer and a hospital-issued laptop.

At the conclusion of all activities regarding the study, the MRN/coded numbers spreadsheet and data collection sheets will be destroyed. As the DNP program includes the requirement for manuscript submittal for publication, there is a potential for the study to be published. Only aggregate data/results will be included in any publications. If that occurs, data will be destroyed upon publication. Confidentiality and security of data will be maintained during the publication process.

Bias

The sample included records for all RRT patients over a 12-month period (n=135) and the records for the Control Patients (n=331) on the medical-surgical units at one Silicon Valley hospital. Including all RRT Patients reduces the chance of selection bias. The Control Patients were randomly selected from the census list using a random number table. Use of a randomization process for the Control Patients decreases the risk of selection bias.

Summary

Through data collection of three sets of variables on RRT Patients and Control Patients, and statistical testing of the data, five statistically significant differences between the two groups were identified. An unexpected finding of delayed activation of RRT was noted in examining the RRT criteria variables.

Chapter 4: Results

Results of Descriptive Variables

Table 1 displays descriptive variables for the RRT and Control Patient groups for all of the descriptive variables except payer type. It was noted during data collection that payer type was not straightforward as many patients had multiple levels of insurance. Patients who were government funded (Medicare for example) also had private payer “gap plans” so they could not be classified in just one group. This mixed payer situation happened so often that the variable “payer type” was excluded from analysis.

Among the descriptive variables, the only statistically significant difference between the RRT and Control Patients was age. The mean age of RRT Patients was statistically significantly older than the mean age of the Control Patients ($p = .003$).

Table 1

Descriptive Variables

<i>Descriptive Variables</i>	<i>RRT Patients</i> n = 135	<i>Control Patients</i> n = 331
Female	58% (n=78)	51% (n=170)
Male	42% (n=57)	48% (n=161)
Mean Age in Years	67.39	62.11
Age Range in Years	21-95	21-97

<i>Descriptive Variables, cont'd.</i>	<i>RRT Patients</i>	<i>Control Patients</i>
	n = 135	n = 331
Primary Language of English	84% (n=113)	90% (n=299)
Reason for Admission		
Surgical	36% (n=48)	51% (n=170)
Medical	58% (n=78)	44% (n=146)
Procedural	7% (n=9)	4% (n=13)
Infusion	0	1% (n=2)
Other	0	0
Outcome of Hospitalization		
Discharged to Home	55% (n=74)	80% (n=266)
Discharged to SNF/Rehab	28% (n=38)	17% (n=55)
Transfer to acute care facility	1% (n=1)	1% (n=4)
Expired	16% (n=22)	1% (n=4)
Other	0	1% (n=2)
Outcome of RRT		n/a
Stayed on Unit	36% (n=48)	
Transferred to higher level of care	62% (n=84)	
Code Blue Called	2% (n=3)	

^a In the hospital's EMR, "Hispanic" patients were in the "other" category

Results of Other Independent Predictor Variables

Statistically significant differences between the RRT Patients and Control Patients were found for four of the "other independent predictor" variables:

- history of cardiac disease ($p = .0395$)
- history of psychiatric/mental illness ($p = .042$);
- respiratory medications including steroids and inhalers are active medications on the eMAR ($p < .001$); and
- medications to treat psychiatric/mental illness other than anti-anxiety medications are active medications on the eMAR ($p = .003$).

The 2x2 table comparison for each of the dichotomous independent predictor variables is found in Table 2 – Table 15. For the four statistically significant variables, the odds ratio is included.

Table 2

History of Opioid Use

	RRT Patients	Control Patients
	n = 135	n = 331
History of Opioid Use	28% (n=38)	24% (n=78)
No History of Opioid Use	72% (n=97)	76% (n=253)

Table 3

History of Substance Abuse

	RRT Patients	Control Patients
	n = 135	n = 331
History of Substance Abuse	12% (n=16)	8% (n=25)
No History of Substance Abuse	88% (n=119)	92% (n=306)

Table 4

History of Chronic Pulmonary Disease

	RRT Patients n = 135	Control Patients n = 331
History of Chronic Pulmonary Disease	19% (n=25)	13% (n=42)
No History of Chronic Pulmonary Disease	81% (n=110)	87% (n=289)

Table 5

History of Cardiac Disease

	RRT Patients n = 135	Control Patients n = 331
History of Cardiac Disease	63% (n=85)	51% (n=168)
No History of Cardiac Disease	37% (n=50)	49% (n=163)

Odds ratio = 1.67

Table 6

History of Psychiatric/Mental Illness

	RRT Patients n = 135	Control Patients n = 331
History of Psychiatric/Mental Illness Disease	36% (n=49)	27% (n=89)
No History of Psychiatric/Mental Illness Disease	64% (n=86)	73% (n=)242

Odds ratio = 1.56

Table 7

History of Diabetes

	RRT Patients n = 135	Control Patients n = 331
History of Diabetes	17% (n=23)	22% (n=73)
No History of Diabetes	83% (n=112)	78% (n=258)

Table 8

Opioid(s) are Active Medication on eMAR

	RRT Patients n = 135	Control Patients n = 331
Opioid(s) are Active Medication on eMAR	80% (n=108)	81% (n=268)
No Opioid(s) are Active Medication on eMAR	20% (n=27)	19% (n=63)

Table 9

Non-opioid Pain Medications are Active Medications on eMAR

	RRT Patients n = 135	Control Patients n = 331
Non-Opioid Pain Medications are Active Medication on eMAR	63% (n=85)	70% (n=232)
No Non-Opioid Pain Medications are Active Medication on eMAR	37% (n=50)	30% (n=99)

Table 10

Respiratory Medications including Inhalers and Steroids are Active Medication on eMAR

	RRT Patients n = 135	Control Patients n = 331
Respiratory Medications including Inhalers and Steroids are Active Medication on eMAR	38% (n=51)	18% (n=61)
No Respiratory Medications including Inhalers and Steroids are Active Medication on eMAR	62% (n=84)	82% (n=270)

Odds ratio = 2.697

Table 11

Cardiac Medications are Active Medications on eMAR

	RRT Patients n = 135	Control Patients n = 331
Cardiac Medications Active Medication on eMAR	55% (n=74)	47% (n=156)
No Cardiac Medications Active Medication on eMAR	45% (n=61)	53% (n=175)

Table 12

Anti-anxiety Medications are Active Medications on eMar

	RRT Patients n = 135	Control Patients n = 331
Anti-anxiety Medications are Active Medications on eMar	24% (n=33)	25% (n=84)
No Anti-anxiety Medications are Active Medications on eMar	76% (n=102)	75% (n=247)

Table 13

Psychiatric / Mental Illness Treatment Medications other than Anti-Anxiety Medications are Active Medications on eMAR

	RRT Patients n = 135	Control Patients n = 331
Psychiatric / Mental Illness Treatment Medications other than Anti-Anxiety Medications are Active Medications on eMAR	31% (n=42)	18% (n=61)
No Psychiatric / Mental Illness Treatment Medications other than Anti-Anxiety Medications are Active Medications on eMAR	69% (n=93)	82% (n=270)

Odds Ratio = 2.01

Table 14

Anti-emetic Medications are Active Medications on eMAR

	RRT Patients n = 135	Control Patients n = 331
Anti-emetic Medications are Active Medications on eMAR	64% (n=86)	70% (n=233)
No Anti-emetic Medications are Active Medications on eMAR	36% (n=49)	30% (n=98)

Table 15

Insulin or Oral Hypoglycemic Medications are Active Medications on eMAR

	RRT Patients n = 135	Control Patients n = 331
Insulin or Oral Hypoglycemic Medications are Active Medications on eMAR	27% (n=36)	24% (n=80)
No Insulin or Oral Hypoglycemic Medications are Active Medications on eMAR	73% (n=99)	76% (n=251)

Table 16 displays the results of the means test: the F-value with the degrees of freedom, and the p-value for all independent predictor variables when comparing the RRT Patients and Control Patients.

Table 16

Independent Predictor Variables Results

Note: Statistically significant results are in bold.

Variable	F-value (degrees of freedom)	p-value with case/control
Age	F(1, 465) = 9.07	.003
Gender	F(1, 465) = 0.54	.464
Race	F(3, 463) = 0.29	.831
Language	F(1, 465) = 3.75	.054
History of Opioid Use?	F(1, 465) = 1.11	.292
History of Substance Abuse?	F (2, 464) = 1.36	.259
History of Chronic Pulmonary Disease?	F (2, 464) = 1.69	.186
History of Cardiac Disease?	F (2, 464) = 3.25	.0395
History of psychiatric/mental illness?	F (1, 464) = 4.17	.042
History of Diabetes?	F (2, 464) = 0.86	.424
Currently prescribed opioid(s)?	F (1, 465) = 0.06	.800
Currently prescribed non-opioid pain medication?	F (1, 465) = 2.30	.130
Currently prescribed respiratory medications including inhalers and steroids?	F (1, 465) = 20.61	< .0001
Currently prescribed cardiac medications?	F (1, 465) = 2.35	.126
Currently prescribed anti-anxiety medications?	F (1, 465) = 0.04	.847
Currently prescribed medications to treat psychiatric/mental illness other than anti-anxiety?	F (1, 465) = 9.20	.003
Currently prescribed anti-emetic?	F (1, 465) = 2.04	.153
Currently prescribed insulin or oral hypoglycemic?	F (1, 465) = 0.34	.561

There were three criteria examined based on practices at local hospitals for proactive patient rounding to help prevent RRTI. Regarding the variable of “admission from the ED within eight hours prior to RRT”, the data for the RRT patients (n=135) revealed a very low occurrence of this situation (n=6). Data for “transfer within 8 hours prior to RRT from the critical care unit if within 24 hours of extubation” or “critical care length of stay 7 days or longer”, revealed zero incidence of either of these criteria for the RRT patients.

Results of Study Hospital RRT Criteria Variables

The reason for the need for RRT was examined by reviewing the four hours prior to the RRT as per this hospital’s RRT policy. It was noted that there was a large variation between time the RRT criteria was documented (i.e. heart rate greater than 130) and when the actual call to the team was placed. There were large standard deviations noted ($SD = 27.6 - 87.73$ minutes). Table 17 displays these results: the range minimum to maximum, mean, and standard deviation of the documentation of criteria prior to call for RRT.

Table 17

Criteria for RRT: documented criteria prior to RRT call in minutes: range minimum, range maximum, mean, standard deviation

Variable	N	Minimum minutes from documented criteria to RRT Call	Maximum minutes from documented criteria to RRT Call	Mean time in minutes	Standard Deviation
Heart Rate less than 40	1	6	n/a	n/a	n/a
Heart Rate greater than 130	23	1	120	17.0	27.60
Systolic Blood Pressure less than 90	23	1	230	45.91	67.83
Respiratory Rate less than 8	3	9	80	29.73	43.75
Respiratory Rate greater than 28	11	2	206	74.18	82.20
Temperature less than 97 degrees Fahrenheit	15	1	195	86.80	71.29
Temperature greater than 100.4	26	0	222	28.76	52.02
Oxygen saturation less than 90% with supplemental oxygen	20	1	238	37.20	67.88
Acute change in level of consciousness	15	3	222	99.93	87.73

As seen in Table 17, at the low end of the range, the nurses are calling for RRT assistance in 0-6 minutes, and at the high end of the range, the call to RRT is delayed 80-238 minutes. The mean time from “RRT-criteria-documentation-to-RRT-call” ranges from 17 to 99.9 minutes for the different variables, also suggesting that on average, patient data indicating deterioration is not being acted upon in a timely manner. Finally, the standard deviations vary from 27.6 to 87.7 minutes, which demonstrates high variability.

There were 87 RRT patients who were transferred to a higher level of care or who's RRT became a Code Blue (respiratory or cardiac arrest). Table 18 displays the activation information for these 87 patients including sample size, minimum, maximum, mean and standard deviation.

Table 18

Criteria for RRT Patients who transferred to higher level of care or whose RRT became a Code Blue: documented criteria prior to RRT call in minutes: range minimum, range maximum, mean, standard deviation

Variable	N	Minimum minutes from documented criteria to RRT Call	Maximum minutes from documented criteria to RRT Call	Mean time in minutes	Standard Deviation
Heart Rate less than 40	1	6	n/a	n/a	n/a
Heart Rate greater than 130	1	1	n/a	n/a	n/a
Systolic Blood Pressure less than 90	17	1	230	39.18	56.5
Respiratory Rate less than 8	1	2	n/a	n/a	n/a
Respiratory Rate greater than 28	8	2	200	72.88	73
Temperature less than 97 degrees Fahrenheit	13	1	195	91.69	70.07
Temperature greater than 100.4	13	7	222	111.15	85.18
Oxygen saturation less than 90% with supplemental oxygen	14	1	199	34.35	54.68
Acute change in level of consciousness	10	0	210	52.2	71.45

Table 18 shows that the majority of RRT patients who were transferred to a higher level of care or converted to Code Blue were the patients whose RRT criteria was "Systolic Blood Pressure < 90", followed by the RRT criteria of "Oxygen Saturation < 90% with Supplemental Oxygen". The variable of "Temperature > 100.4" showed the greatest difference when

comparing all of the RRT patients who had that criteria (n = 26) to just the RRT patients with that criteria who transferred to higher level of care or converted into Code Blue (n = 13). Table 19 displays this difference.

Table 19

Variable of Temperature > 100.4

	N	Minimum Minutes from documented criteria to RRT Call	Maximum Minutes from documented criteria to RRT Call	Mean time in minutes	Standard Deviation
All RRT Patients	26	0	222	28.76	52.02
RRT Patients who transferred to higher level of care or turned into a Code Blue	13	7	222	111.15	85.18

Discussion

This study sought to answer the question: Are there statistically significant differences between medical-surgical adult inpatients who required Rapid Response Team Intervention and those who did not for demographic characteristics and selected clinical parameters? If statistically significant differences were noted, this could inform a proactive tool and protocol for identifying patients at risk for deterioration. RRTs may be more effective in preventing transfers to high levels of care and inpatient mortality if criteria were acted upon immediately. The literature review for this study did not reveal any studies that examined the time frame prior to the call of RRT to determine the timeliness of summoning the team, although Chan et al. (2010) did report wide variation in activation (use of) RRT among hospitals. Perhaps the reason RRT

has not been found to be successful is because the known criteria are not being acted upon immediately. One solution for this delay would be a tool that was an automated “push out” when data meeting RRT criteria was entered into the EMR. This automated tool would be an automated “push out” to the RRT which includes a critical-care trained RN at the hospital. The new protocol would require the RRT nurse who receives the automated alert on their wireless device to respond and assess the patient as soon as possible. Timelier assessment by the RRT Nurse could keep the patient at Roy’s Compensatory Level and prevent deterioration to Compromised Level. Medical-surgical patients in this sample could have benefitted from the critical-care trained RN assessing the patient soon after the first documentation of RRT criteria was recorded.

The findings of this study regarding the RRT patients and the “time from documentation of RRT criteria to the time of RRT call” suggest that there is opportunity for improvement. The delay between documentation of RRT criteria and actual RRT activation suggest that not all nurses were acting quickly when patients met RRT criteria. This is congruent with a qualitative study presented at the 2013 American Nurses Credentialing Center Magnet® Conference. This qualitative study involving 32 nurses found that nurses fell into two categories in activating a RRT: “Blink” were nurses who “had an immediate response” and “Think” were nurses who “expressed internal tension in deciding to call or not to call the RRT as they generally gathered more information” (Bartos, 2013). As related to the Theoretical Framework of Roy’s Adaptation Model, the “goal of nursing care is to foster successful adaptation” (Masters, 2011); this goal may be impeded by delaying interventions. The nurse’s ability to aid the patient in successful adaptation and prevent deterioration to Roy’s Compromised Level, could improve with timely

interventions. Prior to implementation of an automated tool, this information can be shared with RRT nurses to formulate a plan to scan vital signs for values that would trigger an RRT.

For this sample, the RRT patients were more likely to be: older patients, positive for a history of cardiac disease, positive for a history of psychiatric/mental illness, have respiratory medications including inhalers and steroids as an active medication on their eMAR, or have medication to treat psychiatric/mental illness as an active medication on their eMAR. This does give a profile of patients who are more at risk: those with chronic conditions such as cardiac or psychiatric/mental illnesses, with medications to treat chronic respiratory illnesses and psychiatric illnesses. This information can inform a protocol of proactive rounding through use of discriminate lists in the EMR based on these findings.

Three independent predictor variables were chosen based on personal communication about practices of proactive RRT rounding at a local hospital: ED admission within 8 hours of RRT, CCU transfer within 8 hours of RRT if patient had been extubated in previous 24 hours, or CCU length of stay greater than 7 days prior to RRT. As only 4% of the 135 patients met the ED admission criteria (n=6) and none of the 135 RRT patients met the CCU transfer/length of stay criteria, it would suggest that these criteria for proactive rounding by the RRT may not be the best use of their time and skill set for this study's population. This finding is congruent with literature regarding proactive rounding of recently transferred ICU patients at a large academic center; which also found no statistically significant improvement with proactive rounding based on patient transfers (Butcher et al., 2013).

Limitations

One limitation of the study was that it was conducted at one acute care non-profit community hospital located in an affluent area of the United States. This patient population tended to be highly educated, well insured and health care literate.

Another limitation was that only patient variables were examined. Research suggests that new graduate nurses may be less adept at recognizing changes in patient condition, thereby leading to delay in treatment (Purling & King, 2012). A future study could include the “years of experience of the nurse caring for the patient at the time of RRT” as one of the variables collected.

With regard to the delays in care, the study did not include qualitative information from the primary nurses as to their thinking processes in the collection of assessment data and the subsequent decision to call the RRT.

Another limitation for the study is sample size. The descriptive variable of “language other than English” was found to have a p value of .054; with a larger sample size, this variable may be found to reach statistical significance. Patients who do not speak English may have higher likelihood of RRTI.

Implications for Nursing Practice and Conclusion

These findings suggest that perhaps the earlier intervention based on documentation of RRT criteria could improve patient care. One method for improving timeliness would be to create a tool and protocol that automates the calling of the RRT. A message would be automatically sent through the wireless system from the EMR to the communication device of the critical-care trained RRT nurse. The study hospital will be implementing a new EMR in November 2015, and utilizes a wireless communication device worn by all clinical staff that can

receive messages from the EMR. This technologic tool and protocol could be implemented soon after the new EMR implementation. This EMR system is a clear leader in the industry and this type of automated calling of the RRT could be done in other hospitals. Hospitals would need to collaborate with EMR vendors to explore possibilities within an organization's infrastructure.

Prior to an automated tool, the information from this study regarding vital sign criteria documented but not triggering a call will be shared with the RRT nurses. These nurses can use the current EMR to scan for vital sign changes. The findings regarding co-morbid conditions and medication profiles can be used to create discriminate lists in the current EMR, which can then create a proactive rounding list for the RRT nurses.

Additionally, the information regarding criteria more likely to result in transfer to a higher level of care (low systolic blood pressure, low oxygen saturation) and the greatest delays associated with "Temperature > 100.4" could be useful to the RRT members. When responding to patients due to these specific criteria, the RRT can be more aware of the potential for transfer or further deterioration.

Recommendations for Further Study

Suggestions for future study include replication in different acute care settings within California (for example: teaching hospitals, county hospitals, for-profit organizations) as well as outside California. Due to the fact that California remains the only state with mandated 24/7 nurse-to-patient ratios, the comparison to hospitals outside of California will include the limitation of unequal staffing models.

A variable for future study would be to include the experience level in years of the primary nurse caring for the patient at the time of the RRT call.

Finally, if the automated calling of an RRT is actualized, re-examining the time of documentation of an RRT criteria and time of response of the team to evaluate the effectiveness of this new process could be studied. This process outcome of timely response could then be examined in comparison to outcome of RRT and outcome of hospitalization. The research question would then be: Does an automated RRT call reduce the transfers of medical-surgical patients to higher level of care and decrease in-hospital mortality?

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