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UNIVERSITY OF SAN DIEGO

Hahn School of Nursing and Health Science and

Beyster Institute for Nursing Research

PATIENT OUTCOMES ASSOCIATED WITH DELAYED RAPID
RESPONSE SYSTEM ACTIVATION: A RETROSPECTIVE
COMPARATIVE STUDY

by

Ricardo M. Padilla

A dissertation presented to the
FACULTY OF THE HAHN SCHOOL OF NURSING AND HEALTH SCIENCE
UNIVERSITY OF SAN DIEGO

In partial fulfillment of the
requirements for the degree
DOCTOR OF PHILOSOPHY IN NURSING

November 2018

Dissertation Committee:

Ann M. Mayo, DNSc, RN, FAAN, Chairperson

Linda D. Urden, DNSc, RN, CNS, NE-BC, FAAN

Kathleen M. Stacy, PhD, RN, APRN-CNS, CCNS

APPROVAL PAGE

UNIVERSITY OF SAN DIEGO

Hahn School of Nursing and Health Science

DOCTOR OF PHILOSOPHY IN NURSING

CANDIDATE'S NAME: Ricardo M. Padilla

TITLE OF DISSERTATION: Patient Outcomes Associated With Delayed Rapid
Response System Activation: A Retrospective
Comparative Study

DISSERTATION COMMITTEE:

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Abstract

Purpose: The purpose of the dissertation study was to determine the difference in survival and length of stay (LOS) between patients who experienced a delay in Rapid Response System (RRS) activation and those patients who had no delay.

Rationale: There is evidence to support that the RRS is often not activated in a timely manner potentially leading to negative patient outcomes.

Background: Delaying treatment for in-hospital clinical deterioration has been associated with Serious Adverse Events (SAEs), including increased mortality, protracted LOS during hospitalization, and significant increased financial costs. The RRS was created as a hospital-wide approach to prevent SAEs; however, there are often delays in activation of the system.

Findings: During the study period, 1,086 RRS activations occurred. Delayed RRS activations occurred in 325 cases and non-delayed RRS activations occurred in 766 cases. Eighty-five percent of patients survived hospitalization regardless of experiencing a delay or not. Delay in RRS activation was significantly associated with an increase in length of hospitalization and a higher likelihood of not surviving hospitalization.

Implications: Nurses play an important role in the early detection and intervention of clinical deterioration and are commonly the first health care providers to notice a change in a patient's condition. This study confirms that delayed RRS activation occurs frequently and exposes patients to increased LOS and mortality during hospitalization. Given these findings, targeting nursing interventions for early identification and timely activation of the RRS can improve patient outcomes.

Dedication

To my loving and supporting wife, Jessica: You have motivated me to reach all the way to the top; thank you for being my number one cheerleader. I know many people often congratulate me for all my accomplishments, but congratulations are also in order for you too. You have been my rock and the main support system for our beautiful family while I undertook this academic journey. These last 12 years together have been amazing and it is hard to believe that for 10 of those years, I have been in school. It is time for an extended school break!

To my children who have spent the majority of their lives wondering why daddy is spending so much time reading and working on the laptop; well, this is the final product. I hope that through my scholarly achievements, you too, will learn the importance of obtaining a higher education. Now, as future second-generation college students, I hope you continue this tradition and allow it to flourish for many generations to come.

To my mother for always pushing me to better myself from a young age: Through you, I learned the importance of education and how it can provide endless opportunities. This would not be possible without you.

To my family, friends, and family that has passed: You have all helped shape me to become the person I am today.

Lastly, I would also like thank and dedicate this work to a forever-young Josie King who lost her life at 18 months of age due to preventable medical errors in 2001. Josie's story started a campaign shaping patient safety and quality with many

implications of early identification and intervention of patients whose conditions worsen during hospitalization.

Acknowledgments

This journey would not have been possible without the sound mentorship I have received from my dissertation committee, Dr. Ann Mayo, Dr. Linda Urden, and Dr. Kathleen Stacy. It has been a wonderful pleasure working with all of you and words cannot begin to define the big “thanks” I owe you. Not only have we worked closely through this dissertation process, but we have been afforded the opportunity to publish together on this scholarly journey.

An overwhelming thank you is extended to my chairperson Dr. Ann Mayo for rolling up her sleeves and being in the thick of this with me. You have fostered a spirit of inquiry within me and as a result, I hope to one day provide guidance and mentorship to someone else at the level you have provided for me.

To all my fellow students, friends, colleagues, staff, and faculty at the University of San Diego Hahn School of Nursing, thank you for playing such a pivotal role at this time in my life. I first stepped foot on this campus during my 10th grade year of high school. I remember thinking, “gosh I would love to be a student here.” Life has a funny way of working out; through all the twists, turns, and forks in the road, I finally made it here.

Lastly, I would like to thank the nursing profession for giving me a venue to touch the lives of so many.

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Chapter One

Introduction

Patients admitted to the hospital believe they are entering a place of safety and that, should their condition deteriorate, they are in the best place for prompt and efficacious treatment (National Institute for Health and Clinical Excellence [NICE], 2007). Although this may be a common perception, literature has demonstrated inadequacies in managing patients in the hospital setting (Barco, Putnam, Riggs, & Bayne, 2011; Garvey, 2015; Institute of Medicine, 2001; Kohn, Corrigan, & Donaldson, 1999; Subbe & Welch, 2013).

Approximately 10% of patients admitted into the hospital setting experience a significant adverse event (SAE) such as cardiopulmonary arrest (CA) and unplanned intensive care unit admission (Hu, Wong, Correa, Li, & Deng, 2016). Furthermore, patients exposed to these types of SAEs can generate an additional cost exceeding \$100,000 during a single admission (Bonafide et al., 2014). Inpatients who suffer from a CA event often show signs of clinical deterioration several hours prior to arrest and an estimated 23,000 cases of in-hospital arrests are avoidable (Beaumont, Luettel, & Thomson, 2008; Smith et al., 2006).

Despite many advancements in hospital resuscitative efforts, patient outcomes remain dismal and emphasis has been placed on identifying and intervening on patients clinically deteriorating early on (Rozen & Butt, 2016). The Rapid Response System (RRS) model was created to attend to inpatient deterioration; however, there is debate surrounding their efficacy and many delays in activation resulting in negative patient outcomes. This research study will explore the phenomena of early identification and

intervention of clinical deterioration in the acute adult inpatient setting. The investigator will begin with performing a concept analysis of the term “clinical deterioration” and introduce an operational definition. Secondly, the investigator will present a systematic review of nurses’ perceived barriers to RRS activation. Lastly, the investigator will retrospectively explore patient outcomes associated with delayed RRS activation in the inpatient acute setting. This chapter will begin by describing the background and significance of the proposed study. The investigator will then present the purpose and research design, aims, theoretical perspectives, and methodology of the proposed study.

Background

The RRS, also known as Medical Emergency Teams (METs) or critical care outreach teams, were established to attend to inpatient deterioration serving as a critical care resource in the non-intensive care unit (ICU) setting. Due to several models of these teams existing, the first consensus conference on METs decided to unify the models under the term Rapid Response System (RRS) (DeVita, 2006). The RRS was designed to identify and intervene on patients exhibiting physiological instability with the goals of averting cardiopulmonary arrest and unplanned intensive care unit (ICU) admissions (Le Guen, Tobin, & Reid, 2015). In literature, the RRS system is described as having an afferent limb often termed the trigger of the activation and the efferent limb which is the responder (Rozen & Butt, 2016). The RRS responders are multidisciplinary critical care trained clinicians often composed of a registered nurse and respiratory therapist and in some structures a physician (Gallo de Moraes et al., 2018).

In the United States, the RRS was established from the 100,000 lives campaign. The 100,000 lives campaign was an initiative that took place over 18 months aimed to

improve health care quality and reduce preventable deaths (Berwick, Calkins, McCannon, & Hackbarth, 2006). Offering critical care outreach for clinical deterioration in situ was quickly adopted and the RRS gained support from stakeholders including the American Medical Association, American Nurses Association, Centers for Medicare & Medicaid Services, The Joint Commission (TJC), Agency for Healthcare Research and Quality (AHRQ), and the Association of American Medical Colleges (Gosfield & Reinertsen, 2005; Hammer et al., 2012; Sandrick, 2007). Furthermore, the need for RRSs coupled with TJC's criterion for National Patient Safety Goals requiring additional assistance from a specially trained individual(s) when a patient's condition is deteriorating (NPSG) (AHRQ, 2016; Mitchell, Schatz, & Francis, 2014). Although there was strong endorsement and widespread dissemination of the RRS, research has demonstrated mixed results.

RRSs have demonstrated to be a vital asset in healthcare organizations. However, are only effective when activated and nurses often fail to call for help when necessary (Astroth, Woith, Stapleton, Degitz, & Jenkins, 2013). Delay in RRS activation is associated with increased mortality and morbidity (Barwise et al., 2016; Boniatti et al., 2014; Chen et al., 2015; Gupta et al., 2017) and prolonged deterioration can increase 30-day mortality four-fold (Henriksen, Brabrand, & Lassen, 2014). A number of early RRS studies displayed success in reducing mortality, adverse events, cardiopulmonary arrests, and post-surgical length of hospital stay (Bellomo et al., 2004; Buist, Bernard, Nguyen, Moore, & Anderson, 2002; DeVita et al. 2004). Conversely, other early studies on RRSs state that there is insufficient evidence for improving patient outcomes, and no association with reduction in cardiac arrest or decrease in unplanned intensive care unit

admissions (Chan et al., 2008; MERIT Study Investigators, 2005; Winters, Pham, & Pronovost, 2006). Recent systematic reviews on the efficacy of RRSs presented significantly reduced cardiopulmonary arrest outside of the intensive-care-unit; however, did not show decreased hospital mortality (Chan, Jain, Nallmothu, Berg, & Sasson, 2010; Tirkkonen, Tamminen, & Skrifvars, 2017). Due to the mixed results presented from studies, the efficacy of RRSs are often questioned and further research is necessitated to explicate the need for RRSs (Benin et al., 2012; Chan et al., 2008; Williams, Newman, Jones, & Woodard, 2011).

Purpose and Study Designs

The purpose of this study was to add to the scientific body of knowledge on the early identification and intervention of clinical deterioration in the acute adult inpatient setting. A concept analysis on the term clinical deterioration was performed using the Walker & Avant (2011) eight step method of concept analysis. The results from this concept analysis on clinical deterioration identified defining attributes as dynamic state, decompensation and objective and subjective determination. Antecedents identified include clinical state, susceptibility, pathogenesis and adverse event. Increased mortality, resuscitation, implementation of higher level of care and prolonged hospital admission were the consequences identified. Defining attributes, antecedents and consequences identified led to an operational definition of clinical deterioration as a dynamic state experienced by a patient compromising hemodynamic stability, marked by physiological decompensation accompanied by subjective or objective findings. Performing a concept analysis on clinical deterioration is expected to contribute to further identification of

clinically modifiable risk factors and accompanying interventions to prevent clinical deterioration in the inpatient setting.

The second purpose of this study was to explore nurses' perceived barriers to RRS activation in the acute adult inpatient setting. This study was designed as a systematic review utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (Moher, Liberati, Tetzlaff, & Altman, 2009). Six search terms were used in the following electronic databases: Academic Search Premier, CINAHL, Healthsource: Nursing/Academic Edition, Medline, and PubMed. Limiters applied to search methods included years 2007 to 2018, full-text, scholarly (peer reviewed), and English language. This review was further limited to quantitative studies in the adult inpatient setting. The initial electronic database search yielded 149 articles. After duplicate exclusion, 87 article abstracts were reviewed for inclusion and eligibility yielding eight articles for use in this systematic review. Furthermore, themes to nurses' perceived barriers to RRS activation include RRS activator/responder interaction, physician influence, nurse education, and nurse experience.

The third purpose of this research study was to investigate patient outcomes associated with delayed RRS activation in the acute adult inpatient setting. Cases that experienced a delay in RRS activation were compared with cases that did not experience a delay. The specific aims of this databased study are as follows:

Aim I: To describe selected demographic characteristics (age, gender, hospital site); the independent variables (IV)—activating unit level of care (LOC), LOC status post RRS activation, trigger used for RRS activation, delay in RRS

activation; and dependent variables (DV)—patient outcome of length of stay (LOS) and survival to discharge.

Aim II: To describe the relationship between the following selected demographic characteristics: (1) activating unit LOC, LOC status post RRS activation, and trigger used for RRS activation with patient outcome of LOS, and (2) survival to discharge with receiving a delay in RRS activation.

Aim IIIa: To determine the amount of variance in LOS in cases attributed by receiving a delay in RRS activation.

Aim IIIb: To determine the likelihood of survival to discharge in cases attributed by receiving a delay in RRS activation.

Theoretical Models

This research study will be guided by the two theoretical models: The Human Factors Model of Situational Awareness (HFMSA) (Endsley, 1995) and the Dynamic Model of Situated Cognition (DMSC) (Shattuck & Miller, 2003).

Human Factors Model of Situational Awareness

HFMSA is a theoretical model based on dynamic human decision-making processes in various domains (Endsley, 1995). Figure 1 provides an illustration of situational awareness (SA) in the context of the overall decision-making process.

According to this model, a person's perception of the relevant environmental elements forms the basis of his/her SA leading to a decision, then elicits a performance of an action (Endsley, 1995). The three levels of SA are the foci of the model and will be used to inform this study.

Level 1 SA: Perception of the elements in the environment. The first step in achieving SA is to perceive the status, attributes, and dynamics of relevant elements in the environment (Endsley, 1995). Perception will be defined as a trigger used in RRS activation (IV) (e.g. altered mental status, low blood pressure, intuition).

Level 2 SA: Comprehension of the current situation. Based on the knowledge from Level 1, Level 2 goes beyond awareness of the elements and includes making an understanding of the environment (Endsley, 1995). In Level 2, patterns are formed with other elements allowing the decision-maker to form a holistic picture of the environment. Comprehension will be defined by predictor variables through the lenses of the DMSC model in the section preceding.

Level 3 SA: Projection of future status. The ability to project future actions of environmental elements forms Level 3, the highest level within SA (Endsley, 1995). In Level 3, knowledge of the status and dynamics of the elements and comprehension of the situation (both from Level 1 and Level 2) provides the necessary data to decide on the most favorable course of action (Endsley, 1995). In this study, projection of future status is the patient outcome of LOS and survival to discharge. (See Figure 1.)

Figure 1. Human Factors Model of Situational Awareness (Endsley, 1995).

Dynamic Model of Situated Cognition

The DMSC is a theoretical model emerged to illustrate the relationship between technological systems and the human perceptual cognitive processes (Shattuck & Miller, 2003). Figure 2 provides an illustration of the DMSC. Within situated cognition lays a dynamic environment where individuals intertwine tools, feedback mechanisms, and previous knowledge to make decisions and guide the formation of new knowledge (Shattuck & Miller, 2003). There are classes of information called lenses within the DMSC, which influence a decision-maker's action (Shattuck & Miller, 2003). The lenses used to inform this study are Individual States and Traits, Social Factors, and the Local Context.

Individual states and traits. Individual states and traits represent characteristics of an individual that affect decision-making (Shattuck & Miller, 2003). Demographic characteristics will represent this lens and include gender (IV) and age (IV).

Social factors. Social factors include group influences. These factors can range from small group to large group dynamics including cultural differences amongst groups (Shattuck & Miller, 2003). Unit level of care (IV) and campus site (IV) will represent this lens.

The local context. The local context is influenced by the data the decision-maker will use to attend within the environment (Shattuck & Miller, 2003). Delay in RRS activation (IV) and upgrade in level of care (IV) will represent this lens. (See Figure 2.)

Figure 2. Dynamic Model of Situated Cognition (Shattuck & Miller, 2003).

Research Conceptual Framework

A research conceptual framework is a representation of study variables and their projected relationships. Figure 3 illustrates a research conceptual framework guided by theoretical underpinnings of the HFMSA and DMSC. The framework follows the pathway levels of SA starting with perception, which is cued by RRS activation trigger (IV). Comprehension within SA includes many contextual factors surrounding decision-making and the lenses of the DMSC will encompass these phenomena. The specific lenses used are Individual States and Traits, Social Factors, and Local Context. Figure 3 illustrates the conceptual framework of independent variables guided by the theory of HFMSA and the lenses of DMSC. In the third level of SA projection of future status takes place based on a decision which is the patient outcome. (See Figure 3.)

Figure 3: Conceptual framework of independent variables

Methods

Design

Retrospective comparative cohort analysis investigating patient outcomes associated with delayed RRS activation in the inpatient acute setting.

Setting

The study sites included four tertiary care hospitals located on two campuses within a comprehensive academic healthcare system in the western United States. The hospitals have a combined inpatient capacity greater than 800 beds, average daily census of approximately 500 patients, and approximately 300 RRS activations per month. There were approximately 38,000 inpatient admissions between both campuses during the study period. Campus #1 serves as the core clinical teaching site for the medical school and is a major tertiary care facility to the community providing specialties such as a Regional Burn Center and a Level 1 Trauma Center. Campus #2 houses the other three tertiary hospitals and offers a Comprehensive Cardiovascular Center, advanced surgical care, high-risk obstetrics with a Level III Neonatal Intensive Care Unit, and highly specialized oncology care.

Sample

The investigator will conduct a retrospective analysis of RRS cases on all inpatient admissions starting from January 1, 2017 to January 1, 2018. RRS cases will be obtained from the Rapid Response Team (RRT)/Code Blue committee and reviewed for inclusion criteria. Delayed RRS activation of greater than one hour in presence of clinical deterioration qualifies as inclusion for this study.

Data Sources

Data sources will be accessed from electronic variance reports and the patients' electronic medical records (EMR). Every RRS activation is documented in an electronic variance report and data are collected by the RRT/Code blue committee at the study site. This dataset will contain the following variables: trigger used for RRS activation, unit level of care, upgrade in level of care, and delay in RRS activation. Furthermore, EMRs will be accessed for the following variables: demographic variables, LOS, and survival to discharge.

Data Access

The RRT/Code blue committee data analyst will extract all RRS activation cases from January 1, 2017 to January 1, 2018 and will provide a database in the form of an excel spreadsheet. These cases will be then reviewed across EMRs for inclusion of delayed RRS activation. Data will be collected by the primary investigator and the research assistant.

Data Analysis Plan

Data analysis will be listed below by aim:

Aim I: Descriptive statistics and frequencies for all variables.

Aim II: Pearson's correlation coefficient for continuous and interval level variables and chi square between categorical variables.

Aim IIIa: Multiple linear regression will determine the amount of variance in LOS attributed by delay in RRS activation.

Aim IIIb: Survival analysis using cox regression to determine the likelihood of not surviving hospitalization attributed by delayed RRS activation.

Protection of Human Subjects

The Institutional Review Board was consulted at both the researcher's university (University of San Diego) and at the study site. Cases will be de-identified and data kept confidential. De-identified data will be downloaded from the study site EMRs for analysis onto the investigator's password-protected computer.

Study Limitations

All cases will be reviewed for delayed RRS activation, however, the reason for the delay will not be present. To assess RRS activation barriers, further research targeting nurses from delayed activation cases may help determine modifiable risk factors in the inpatient setting. Furthermore, cases will be dependent on RRS activation; patients who have clinical deterioration without RRS activation will not be included in this study. Intervention from clinicians may also be present prior to RRS activation, however, this will not be included in the analysis. Admitting diagnosis will be the only diagnosis used in this study and other co-morbidities will not be taken into account when assessing morbidity and mortality. The study site recently added an additional hospital within the health system that could potentially pose an interaction effect between some of the independent variables and research outcomes. This confounder could have a potential effect on the study due to having limited resources on both campuses secondary to staffing shortages and amount of overtime worked by registered nurses.

Study Implications

This study will inform implications for early utilization of the RRS in the presence of clinical deterioration in the acute inpatient setting. It is hypothesized that early activation of the RRS will decrease ICU admissions, code activations, LOS, and survival to discharge. By investigating patient outcomes associated to delayed RRS activation, there is potential to improve nurse-work environments, educational opportunities for multidisciplinary collaboration, future identification of barriers to RRS activation, and decrease the length of time of clinical deterioration for patients in non-critical-care settings.

Summary

In summary, there has been overwhelming evidence of inadequacies in managing patients in the hospital setting. Patients who endure SAE during hospitalization often exhibit signs of clinical deterioration hours preceding these events. RRSs were established to attend to clinical deterioration in the non-ICU setting, however, they are only effective when promptly activated by nurses. Delayed RRS activation is associated with increased morbidity, mortality, and protracted length of hospitalization. This research study will explore the phenomena of early identification and intervention of clinical deterioration in the acute adult inpatient setting. The investigator will first present a concept analysis of clinical deterioration. Secondly, a systematic review will be presented exploring nurses' perceived barriers to RRS activation. Lastly, the final purpose of this study will retrospectively compare patient outcomes associated with delayed RRS activation. The Human Factors Model of Situational Awareness and the Dynamic Model of Situated Cognition will theoretically underpin the proposed study

explaining contextual factors and decision-making processes associated with patient outcomes from delayed RRS activation.

Chapter Two

Clinical Deterioration: A Concept Analysis

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Formatted for the Journal of Clinical Nursing (JCN)

Manuscript Summary

A prerequisite to beginning stages of research often involves characterizing phenomena and concept clarification. Prior to investigating patient outcomes exposed to prolonged clinical deterioration, the investigator wanted to perform an analysis of this concept. Clinical deterioration is a term used in clinical practice frequently, however it is often difficult to define and can potentially cause variations in practice. The methodology for this concept analysis utilized the Walker and Avant eight step method. As an outcome of this dissertation, this concept analysis was published in the April 2018 edition of the Journal of Clinical Nursing (JCN).

Citation

Padilla, R. M., & Mayo, A. M. (2018). Clinical deterioration: A concept analysis. *Journal of Clinical Nursing*, 27(7/8), 1360–1368. doi:10.1111/jocn.14238.

Abstract

Objective: To present an analysis on the concept of clinical deterioration.

Background: Hospitalized patients who endure cardiopulmonary arrest and unplanned intensive care unit admissions exhibit physiological signs preceding these events. A barrier to recognizing and responding to clinical deterioration stems from variations among health care clinicians.

Design: Concept analysis.

Methods: Walker and Avant eight step method of concept analysis

Results: Defining attributes identified included dynamic state, decompensation, and objective and subjective determination. Antecedents identified include clinical state, susceptibility, pathogenesis, and adverse event. Consequences identified include, increased mortality, resuscitation, implementation of higher level of care, and prolonged hospital admission. Attributes, antecedents, and consequences identified led to an operational definition of clinical deterioration as a dynamic state experienced by a patient compromising hemodynamic stability, marked by physiological decompensation accompanied by subject or objective findings.

Conclusions: Variation in the uniformity of the concept of clinical deterioration causes a gap in knowledge and necessitated clarification of this phenomenon in nursing research. Conducting preliminary work in concept clarification of clinical deterioration can lead to assessing modifiable risk factors and intervening prior to critical situations arise in the inpatient setting.

Implications: It is anticipated that this concept analysis on clinical deterioration will lead to the future identification of clinically modifiable risk factors and accompanying interventions to prevent clinical deterioration in the adult inpatient setting.

Keywords: clinical deterioration, concept analysis, instability, inpatient, resuscitation, failure to rescue, early warning signs, decompensation

Chapter Three

Nurses' Perceptions of Barriers to Rapid Response System Activation:

A Systematic Review

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Manuscript Summary

In this manuscript, the writer aimed to further investigate factors associated with patients being exposed to prolonged clinical deterioration and nurses perceived barriers to activating the rapid response system. In performing a literature review the writer found no other systematic review on nurses' perceived barriers to RRS activation. The aim of this manuscript was to perform a systematic review of nurses perceived barriers to RRS activation utilizing the preferred reporting items for systematic reviews and meta-analysis (PRISMA) checklist. As an outcome of this dissertation, this systematic was published in the September 2018 edition of the Dimensions of Critical Care Nursing.

Citation

Padilla, R. M., Urden, L. D., & Stacy, K. M. (2018). Nurses perceptions of barriers to rapid response system activation: A systematic review. *Dimensions of Critical Care Nursing*, 37(5), 259-271. doi: 10.1097/DCC.0000000000000318.

Abstract

Background: Rapid Response Systems (RRS) were designed to identify and intervene on patients exhibiting physiological instability in the non-critical-care setting however are not always effectively activated by nurses.

Objective: The objective of this systematic review was to explore nurses' perceived barriers to rapid response system activation in the acute adult inpatient setting.

Method: Systematic review utilizing the preferred reporting items for systematic reviews and meta-analysis (PRISMA) checklist. The following terms were searched: "barriers to rapid response team activation," "barriers to RRT activation," "barriers to medical emergency team activation," "barriers to MET activation," and "barriers to rapid response system activation." Electronic databases accessed include Academic Search Premier, CINAHL, Healthsource: Nursing/Academic Edition, Medline, and PubMed. Limiters applied to search methods included: years 2007 – current, full-text, scholarly (peer reviewed), and English language. Systematic review was further limited to quantitative studies in the adult inpatient setting.

Results: Initial electronic database search yielded 149 articles. After duplicate exclusion, 87 article title and abstracts were thoroughly reviewed for inclusion. Twenty-six full-text articles were reviewed for eligibility and a total of 8 articles were used for this systematic review. Nurses perceived barriers to RRS activation included themes: RRS activator/responder interaction, physician influence, nurse education, and nurse experience

Discussion: Nurses play a vital role in patient care by providing around the clock surveillance and are the frontline for early detection and prompt intervention should a

patient's condition deteriorate. Inconsistent RRS activation has been associated with negative patient outcomes. Exploring nurse perceived barriers to RRS activation can contribute to further identification of clinically modifiable risk factors and accompanying interventions potentially decreasing patient mortality.

Chapter Four

Patient Survival and Length of Stay Associated with Delayed

Rapid Response System Activation

Ricardo M. PADILLA

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Formatted for the American Journal of Critical Care (AJCC)

Manuscript Summary

In this retrospective comparative database manuscript, the writer aimed to further explore patient outcomes associated with rapid response system activation (RRS). Specifically, the writer wanted to investigate patient survival and length of stay during hospitalization associated with delayed RRS activation. During the study period, two groups were compared: cases which received a delay in RRS activation and cases that did not receive a delay. This manuscript has been submitted to the American Journal of Critical Care and is currently under review.

Citation

Padilla, R. M., & Mayo, A. M. (2018). Patient survival and length of stay associated with delayed rapid response system activation. *American Journal of Critical Care*.
Manuscript submitted for publication.

Abstract

Background Delaying treatment to in-hospital clinical deterioration has been associated with Serious Adverse Events (SAEs), including increased mortality, protracted length of stay (LOS) during hospitalization, also imposing significant financial implications. The Rapid Response System (RRS) was created as a hospital-wide approach to prevent SAEs; however, there is often delays in activation of the system.

Objectives The objective of this study was to investigate the difference in survival and LOS between patients who experienced a delay in RRS activation with patients that had no delay.

Methods A retrospective comparative study investigated all adult inpatients who experienced an RRS activation from January 1, 2017 through January 1, 2018. Patients that experienced a delay in RRS activation were compared to patients without delay. Descriptive statistics and measures for strength of association were performed for all variables of interest. Inferential statistics were performed to investigate associated outcomes between delayed RRS activation with length of stay and patient survival.

Results During the study period 1,086 RRS activations occurred. Delayed RRS activations occurred in 325 cases and non-delayed RRS activations occurred in 766 cases. Eighty-five percent of patients survived hospitalization regardless of experiencing a delay or not. Delay in activation was significantly associated with an increase in length of hospitalization and also a higher likelihood of not surviving hospitalization.

Conclusion This study demonstrates that delayed RRS activation occurs frequently and exposes patients to higher mortality and longer length of hospitalization. Providing timely activation of the RRS has potential to increase survivability during hospitalization.

Chapter Five

Discussion of Findings

The four preceding chapters of this dissertation represent the unfolding of the learnings, findings, and outcomes of this dissertation process. The purpose of this chapter is to provide an integrated discussion of all four.

Chapter One provided a review of the literature and background of the establishment of the RRS within the hospital setting. Moreover, Chapter One introduced the research design and methodology along with the research aims and the conceptual framework utilized to guide this dissertation research.

Chapter Two highlighted the beginning of this research topical area and presented a concept analysis of clinical deterioration utilizing the Walker and Avant (2011) method of concept analysis. As an outcome of this dissertation, this concept analysis was published in the April 2018 edition of the *Journal of Clinical Nursing* (Padilla & Mayo, 2018).

Chapter Three further explored reasons for patients being exposed to prolonged clinical deterioration and barriers to activation of the RRS. In Chapter Three, this investigator performed a systematic review of nurses' perceptions to barriers of activating the RRS. As a second outcome of this dissertation, this systematic review was published in the September 2018 edition of the *Dimensions of Critical Care Nursing* (Padilla, Urden, & Stacy, 2018).

Chapter Four presented findings of a retrospective comparative study performed to investigate patient outcomes associated with delayed RRS activation, addressing the

research aims from Chapter One. Chapter Four has been submitted for publication in the American Journal of Critical Care and currently under review.

Chapter Five will begin with a discussion, in the context of the completed study, of how the Human Factors Model of Situational Awareness and the Dynamic Model of Situated Cognition supported the research study. Finally, this chapter will provide a synthesis of chapters one through four, nursing implications, and recommendations for future research.

Research Study Conceptualization

This research study was guided by two theoretical models: The Human Factors Model of Situational Awareness (HFMSA) (Endsley, 1995) and the Dynamic Model of Situated Cognition (DMSC) (Shattuck & Miller, 2003). The HFMSA is a theoretical model based on the dynamic human decision-making process in various environments (Endsley, 1995) and the DMSC is a theoretical model utilizing previous knowledge and experiences to make decisions and guide the formation of new knowledge (Shattuck & Miller, 2003). Both of these models highlight factors associated with decision-making and arriving at an actual decision. In the context of this study, the decision is to delay RRS activation. Specifically, the three levels of SA from the HFMSA and three lenses from the DMSC were used to guide the selection of study variables culminating in the research conceptual framework for this dissertation research. Figure 1 displays the HFMSA in Chapter 1 using the independent variables (IV) and dependent variables (DV) derived from the three levels of SA and three lenses of the DMSC.

Three levels of SA. The three levels of SA in the HFMSA were supported by these research findings. In level one, the perception of data, or in this case, the RRS

activation trigger (IV), shared a very significant relationship with receiving a delay in RRS activation. This concept is also supported in literature. A recent systematic review (Padilla et al., 2018) summarized that nurses reported being unclear about activating the RRS when a patient was deteriorating clinically but presenting with normal vital signs (Basgshaw et al., 2010) or when a patient fulfilled activation criteria but looked well (Douglas et al., 2016; Jackson, Penprase, & Grobbel, 2016; Radeschi et al, 2015). Therefore, there is variation in the perception of what constitutes a deteriorating patient and this can lead to a delay in activating the RRS. Some components of level 2 SA, comprehension, were found to be supported by this study and will be discussed in the next section investigating the three lenses of DMSC.

Level 3 SA, projection, was also found to be supported by these research findings. Projection of future status was investigated by examining survival to discharge (DV) and length of stay (DV). This study found the decision to delay an RRS activation was highly significantly associated with not surviving hospitalization and increased length of stay further warranting timely activation of the system. Other studies also have also demonstrated this phenomenon (Barwise et al., 2016; Chen et al., 2015).

Three lenses of DMSC. The three lenses of the DMSC, also used to guide this research, were (1) individual states and traits, (2) social factors, and (3) the local context. In the model, the individual states and traits are considered characteristics (Shattuck & Miller, 2003). The demographic study variables of gender (IV) and age (IV) represented this lens. This study found that neither of these variables in this lens were associated with receiving a delay in RRS activations. This finding is also supported by other studies

showing no relationship between delayed RRS activation and these variables (Barwise et al., 2016; Boniatti et al., 2014).

The next lens, social factors, was represented in this study as unit level of care (IV) and campus site (IV). Each of these variables was found to be highly associated with receiving a delay in RRS activation. Other studies have demonstrated that social-cultural dynamics have acted as facilitators or barriers to effect utilization of the RRS in (Astroth, Woith, Jenkins, & Hesson-McInnis, 2017; Jenkins, Astroth, & Woith, 2015).

Additionally, unit level-of-care has also been associated with receiving a delay in RRS activation in other studies (Barwise et al., 2016; Tirkkonen et al., 2013). This study and others, therefore, support the idea that social factors should be taken into consideration when designing rapid response systems.

The final lens, the local context, influences the data the decision-maker attends to within the environment (Shattuck & Miller, 2003). In this study, the patient's current status was conceptualized to influence the decision-maker and was represented by the variable of requiring an upgrade in level of care (IV). In this study, requiring an upgrade in level of care was highly associated with receiving a delay in RRS activation. This finding was also demonstrated in other studies examining delayed RRS activation and therefore should continue to remain a variable of interest, especially in interventional research (Boniatti et al., 2014; Chen et al., 2015).

Chapter Two Summary

Concept clarification is an important step in characterizing phenomena in nursing science and is often a prerequisite to beginning basic research (Toftthagen & Fagerstrom, 2010). Prior to investigating patient outcomes exposed to clinical deterioration, the

investigator wanted to perform an analysis of this concept. The term “clinical deterioration” is a concept frequently used in practice; however, is difficult to define (Bell-Gordon, Gigliotti, & Mitchell, 2014). The investigator utilized the Walker & Avant (2011) method of concept analysis.

The results from this concept analysis of clinical deterioration identified defining attributes as dynamic state, decompensation, and objective and subjective determination. Antecedents identified included clinical state, susceptibility, pathogenesis, and adverse event. Increased mortality, resuscitation, implementation of higher level of care, and prolonged hospital admission were the consequences identified. Defining attributes, antecedents, and consequences identified led to an operational definition of clinical deterioration as a dynamic state experienced by a patient compromising hemodynamic stability marked by physiological decompensation and accompanied by subjective or objective findings. Additionally, while performing this concept analysis, the investigator found that a barrier to recognizing and responding to clinical deterioration stems from variations as to what constitutes a deteriorating patient (Jones, Mitchell, Hillman, & Story, 2013; Thompson et al., 2009).

Chapter Three Summary

After performing the concept analysis aforementioned, the investigator wanted to further investigate barriers to calling for assistance when a patient is experiencing signs of clinical deterioration. While performing a thorough literature review of barriers to RRS activation, the investigator found no systematic review synthesizing this evidence in nursing research. The investigator decided to perform a systematic review exploring nurses’ perceived barriers to RRS activation in the acute adult inpatient setting. This

study was designed as a systematic review utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (Moher et al., 2009).

A thorough initial electronic database search was performed and yielded 149 articles. After exclusion, eight articles were used for this systematic review. In summary, the main finding from this systematic review found themes to nurses' perceived barriers to RRS activation as RRS activator/responder interaction, physician influence, nurse education, and nurse experience.

Chapter Four Synthesis of Study Results

Delaying treatment in the context of in-hospital patient clinical deterioration has been associated with Serious Adverse Events (SAEs), increased mortality (Chen et al., 2015; Tirkkonen et al., 2013), protracted hospital LOS (Barwise et al., 2016), and increased costs (Bonafide et al., 2014). Furthermore, factors associated with underutilization of the RRS and recent research suggest that delaying RRS activation is associated with poor patient outcomes (Barwise et al., 2016; Chen et al., 2015). This retrospective comparative databased-study further explored these phenomena and the findings from this study added to this body of evidence and confirms that delay in RRS activation decreases survivability of hospitalization and increases length of stay. The findings for each research aim will be discussed below.

Research Aim I: Descriptive frequencies were used for all variables in the first aim. During the study period a total of 1,086 RRS activations were included for analysis. By comparison, delayed RRS activations occurred in 322 cases (29.7%) versus non-delayed RRS activations occurring in 764 cases (70.3%). The mean age was roughly the same for both groups (60 years old) and both groups consisted of approximately 60%

males. More RRS activations were made from Campus 2 (54.8%) and majority of activations were made from a Progressive Care Unit (PCU) level of care (69.8%). Additionally, more than half (57%) of patients who received an RRS activation stayed in the same LOC and approximately a quarter (25.8%) upgraded to the ICU. Roughly half (46%) of all activation calls fell under the cardiovascular trigger.

Research Aim II: All variables were explored to examine relationships including obtaining a delayed RRS activation. Pearson's correlation coefficient for continuous variables and chi square between categorical variables was used for examining relationships. In this analysis, the hospital site ($p = 0.01$) and activating unit level of care ($p = 0.003$) demonstrated significant associations with receiving a delay in RRS activation. Level-of-care status post-RRS activation showed a highly significant association with receiving a delay in activation ($p = 0.001$) with most of the delayed RRS calls (77%) being activated from the PCU level of care. Furthermore, mean length of stay was significantly higher for patients who received a delay in activation the RRS (32.4 days compared to 19.2 days; $p < .001$).

Research Aim III: While approximately 85% of the patients survived regardless of whether they experienced a delayed or non-delayed RRS activation, a chi square analysis determined a highly significant relationship between delayed activation and survival to discharge ($p < 0.001$). In the cases that did not survive hospitalization, 63.1% experienced a delay in activation. The survival analysis demonstrated that cases with a delayed RRS activation were approximately three times more likely of not surviving hospitalization (hazard ratio = 2.70, 95% CI, 1.96-3.71; $p < 0.001$) compared to cases without delay. Additionally, an increased length of hospitalization was highly significant

($F(1,1084) = 74.23$, $p = < 0.001$) in cases that experienced a delay in RRS activation.

Importantly, the adjusted R square demonstrated that 6% of all variability regarding length of hospitalization can be explained by experiencing a delay in RRS activation.

Implications for Nursing Practice

By providing continuous surveillance of their patients, nurses play an important role in the early detection and intervention of clinical deterioration. Furthermore, nurses are commonly the first healthcare provider to notice changes in a patient's condition (Aiken et al., 2002; Padilla, et al., 2018). Even though nurses play a frontline provider role, they often fail to activate the RRS in a timely manner. This study not only confirms that delayed RRS activation occurs frequently (approximately 30% of cases), but also is highly associated with high mortality and an increase LOS during hospitalization. These findings not only support the need for the RRS but also the importance of early identification and timely activation of the RRS. Efforts targeted at ensuring prompt recognition of CD and timely activation of the RRS are necessitated should a patient's condition worsen during hospitalization.

Including additional focused training for nursing professionals could help identify adverse clinical scenarios early on. For example, other studies investigated incorporating additional resuscitative programs among nurses increased timely utilization of the RRS (Pantazopoulos et al., 2014; Radeschi et al., 2015). Furthermore, providing simulated-based education on clinical scenarios improves nursing knowledge in the recognition of clinical deterioration potentially leading to prompt activation of the RRS (Bell-Gordon et al., 2014). Additionally, establishing a multidisciplinary RRS quality review process such

as committee may help identify negative patient outcomes related to delays and provide focused training and education influencing early activation (Jackson et al., 2016).

Along with providing ongoing RRS educational programs, fostering a supportive RRS environment can help mitigate barriers encouraging a timely activation (Astroth et al., 2017). A recent systematic review found that improving the interaction between RRS activator and responder plays a crucial role in the in timely activation of the RRS (Padilla et al., 2018). This can be accomplished by instituting a collegial RRS that not only responds to critical situations but offers non-punitive ongoing unit-based feedback to nurses and promotes positive relationships between team members (Bagshaw et al., 2010; Padilla et al., 2018).

Future Research

The findings from this dissertation study indicate a need for further research into this phenomenon in nursing science. Research aimed at investigating barriers to activation of the RRS could provide a direct benefit to prompt activation of the RRS. Development of instruments to measure this construct can demonstrate considerable promise in identifying barriers to a nurse's activation of the RRS. An example of this is the development of the instrument named the Rapid Response Team Facilitators and Barriers Survey (RRT-FBS) (Jenkins et al., 2015). The RRT-FBS was developed from themes identified qualitatively (Astroth et al., 2013), piloted (Jenkins et al., 2015), and refined and tested quantitatively (Astroth et al., 2017). The RRT-FBS shows promise with Cronbach's alphas for subscales ranging from 0.770-0.897.

Another topical area for further research that can potentially decrease the incident of delayed RRS activation is the impact of using an Early Warning Score (EWS) system

in conjunction with an RRS. An EWS is a clinical prediction model that uses a patient's measured vital signs and other physiological parameters to identify the likelihood of deterioration (Gerry et al., 2017). An EWS can add another layer of early detection to the RRS, helping identify high-risk patients before they clinically deteriorate (Duncan, McMullin, & Mills, 2012). Coincidentally, a recent systematic review by of 36 articles Jensen, Skar, and Tveit (2018) found that using an EWS with the RRS is beneficial; however, it is contradictory with nurses' decision-making, necessitating further research.

Conclusion

There is substantial literature demonstrating that patient care is often mismanaged upon entering the hospital setting. Furthermore, approximately 10% of patients admitted experience a preventable SAE such as cardiac arrest (Hu et al., 2016). The RRS was introduced to intervene with patients exhibiting clinical deterioration with the goal of preventing further deterioration leading to CA. The RRSs received strong endorsement in the hospital setting nationwide; however, there is debate surrounding their efficacy and the many delays in activation resulting in negative patient outcomes. Findings from this concept analysis, systematic review, and database retrospective study will add to the scientific body of knowledge on the importance of timely activation of the RRS. Specifically, this dissertation research demonstrated that RRS activation delay occurs frequently and is associated with increased mortality and longer hospitalization. Given these findings, the nurses' role is instrumental in early identification and intervention should their patient exhibit a worsened clinical state.

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Appendix A: University of San Diego Institutional Review Board

Apr 11, 2018 10:17 AM PDT

Ricardo Padilla
Hahn School of Nursing & Health Science

Re: Expedited - Initial - IRB-2018-404, Patient outcomes associated with delayed rapid response team activation: A retrospective comparative study

Dear Ricardo Padilla:

The Institutional Review Board has rendered the decision below for IRB-2018-404, Patient outcomes associated with delayed rapid response team activation: A retrospective comparative study.

Decision: Approved

Selected Category: 5. Research involving materials (data, documents, records, or specimens) that have been collected, or will be collected solely for nonresearch purposes (such as medical treatment or diagnosis).

Findings: None

Research Notes:

Internal Notes:

Note: We send IRB correspondence regarding student research to the faculty advisor, who bears the ultimate responsibility for the conduct of the research. We request that the faculty advisor share this correspondence with the student researcher.

The next deadline for submitting project proposals to the Provost's Office for full review is N/A. You may submit a project proposal for expedited or exempt review at any time.

Sincerely,

Dr. Thomas R. Herrinton
Administrator, Institutional Review Board

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