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Decreasing Duration of Mechanical Restraint Episodes
by Increasing Registered Nurse Assessment and Surveillance
in an Acute Psychiatric Hospital

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University of
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Abstract

Background

Application of mechanical restraints is a high-risk emergency measure that requires psychiatric intensive care in order to assure patient safety and expedite release at the earliest opportunity. While current regulations require that trained staff continuously observe restrained individuals, assessment by a registered nurse is required only once an hour. This project builds on research that demonstrated a regulatory change requiring more frequent registered nurse assessments led to decreased duration of mechanical restraint episodes in an acute psychiatric hospital.

Purpose

The purpose of this project was to implement and evaluate a practice change that required increased frequency of registered nurse assessment and surveillance during mechanical restraint episodes.

Methods

The nursing department standard requirement for frequency of face-to-face registered nurse assessment and surveillance of patients during episodes of mechanical restraint was increased on pilot units from once every thirty minutes to continuous assessment and surveillance throughout the duration of the restraint application. Quantitative data was collected on hours of duration of restraint episodes on four pilot units for three months before and three months after the intervention and mean duration of episodes was compared before and after the practice change.

Results

Mean duration of episodes on pilot units decreased 44% in the three months post

intervention: 15% on adult units and 70% on the adolescent unit.

Conclusion and Recommendation

Increasing the frequency of registered nurse assessment and surveillance during mechanical restraint has been shown to decrease duration of restraint episodes. Nurses are encouraged to change practice standards for mechanical restraint, which is a high-risk emergency measure, to provide continuous psychiatric intensive care by a registered nurse.

Keywords: mechanical restraint, physical restraint, psychiatric patients

Decreasing Duration of Mechanical Restraint Episodes by Increasing Registered Nurse Assessment and Surveillance in an Acute Psychiatric Hospital

When patients in acute inpatient psychiatric hospitals attempt to harm themselves or others, they may be mechanically restrained. There is an abundance of evidence that mechanical restraint is a practice that poses significant physical and psychological risks for individuals who are restrained, interferes with the development of therapeutic relationships with healthcare providers and is not in line with the principles of trauma informed, recovery oriented care (Barnett, Stirling & Pandyan, 2012; SAMHSA, 2015). In spite of years of national media attention, stringent regulation and rhetoric about dangers, mechanical restraint continues to be used as an emergency measure of last resort for managing harmful behaviors in acute inpatient psychiatric hospitals.

Background

The Center for Medicaid and Medicare Services (CMS, 2018a.) defines physical restraint as any “manual method or physical or mechanical “device, material, or equipment attached to or adjacent to the resident’s body that the individual cannot remove easily which restricts freedom of movement or normal access to one’s body (Glossary ‘R,’ pg.1)”. Mechanical restraint involves the use of ties, straps, belts, wraps or other apparatus to immobilize an individual, while manual restraint involves holding an individual by using hands or body.

Physical restraint was routinely used to manage psychiatric patients for over three centuries (Masters, 2017), until increased recognition of patient’s rights and media reports of deaths of restrained patients (Weiss, 1998) focused scathing attention on this long-standing practice. Beginning around the turn of the 21st century, the National Association of State Mental Health Program Directors (NASMHPD, 2008) and the Substance Abuse and Mental Health

Services Administration (SAMSHA, 2015a), joined forces to spearhead a national movement to eliminate the use of restraint in healthcare facilities. A 2017 report to Congress by the Interdepartmental Serious Mental Illness Coordinating Committee (ISMICC, 2017) recommended strictly limiting or eliminating the use of restraint for people with severe mental illness. Increased regulatory pressure and litigation has failed, so far, to end the use of mechanical restraint. Even though patients may be harmed and nurses have negative feelings about the practice, mechanical restraint continues to be used as an emergency measure of last resort in acute inpatient psychiatric hospitals.

While current CMS (2006) regulations require continuous observation and monitoring of restrained individuals, this important assignment may be delegated to unlicensed workers. At New Hampshire Hospital (NHH), a 168 bed acute inpatient psychiatric facility, it has long been the practice of registered nurses to directly observe and monitor individuals during episodes of manual restraint. However, direct observation of mechanically restrained individuals was often delegated to mental health workers (MHW) with only a GED or high school diploma. While MHW's receive in-house training in basic first aid and cardiopulmonary resuscitation techniques, they do not have the knowledge and skills necessary to assess individuals for subtle signs of the physiological complications that may result from being physically restrained and cause sudden death. These complications include excited delirium and cardiac complications related to adrenal catecholamine rush and arrhythmias (Nadler-Moodie, 2009). Mental health workers may experience a sense of relief when an individual suddenly stops struggling against being restrained - unaware that this change, in combination with shallow, labored breathing, can be a sign of impending cardiopulmonary arrest. MHW's are trained to summon help from a registered nurse if they become concerned about a restrained individual, but they are not authorized to

release the individual from restraint until a nurse is present. Not only is a registered nurse more likely than a MHW to recognize signs that the individual is in physical distress, a registered nurse is also authorized and trained to determine whether or not the individual has met criteria and is ready for release from restraint. This determination requires skill in accurately assessing the probability that the individual will not resume whatever dangerous behavior resulted in the need for restraint.

This quality improvement project was the third Plan-Do-Study-Act (PDSA) cycle (Langley, Moen, Nolan, Nolan, Norman, Provost, 2009) in a four-year effort to decrease the use of mechanical restraint by increasing registered nurse assessment and surveillance (Figure A1). The nurse-driven project grew out of a literature search done by New Hampshire Hospital nurses in 2014, in preparation for revision of the American Psychiatric Nurses Association Position Paper and Standards of Practice for Seclusion and Restraint (APNA, 2018). After reviewing the literature, New Hampshire Hospital nurses developed an eLearning presentation titled “Seclusion and Restraint: Assessment and Risk Mitigation” that continues to be used as an educational resource for APNA members (2017). Analysis of evidence during this scholarly work led New Hampshire Hospital nurses to conclude that mechanical restraint is a high-risk emergency measure that is inherently dangerous and requires psychiatric intensive care by a registered nurse.

In the first PDSA cycle, the New Hampshire Hospital nursing department standard was changed on July 1, 2014 to require a registered nurse to assess mechanically restrained individuals every thirty minutes, instead of every hour. Analysis of data collected in Part 1, over a period of four years - two years before and two years after the change, showed that the hospital experienced a 34% decrease in hours of mechanical restraint per 1,000 hours of care. There was

also a 13% decrease in percent of patients mechanically restrained and a 23% decrease in mean duration of mechanical restraint episodes following the change. The decreases in hours of mechanical restraint ($t = 2.81$, DF 46, $p < .05$) and duration of mechanical restraint episodes ($t = 2.74$, DF 46, $p < .05$) were statistically significant. (Table B1).

In 2017, nurses on half of New Hampshire Hospital's units (C, H, J and APC- children under 14 years old) volunteered to participate in the pilot for a second PDSA quality improvement cycle. In the second change cycle, a registered nurse was required to continually and directly observe patients throughout the duration of mechanical restraint episodes. Data collected in Part 2, over a period of one year before and one year after the practice change, reflected that the percent of patients restrained and mean duration of mechanical restraint episodes increased across the hospital as a whole after the change (Appendix B). However, duration of restraint episodes decreased 12% on pilot units after the change, while duration of episodes increased 64% on the units that did not participate in the pilot. Duration of restraint episodes for children under age 14, in the pilot group, decreased 68%. The percent of patients restrained during this part of the project increased on all units except the pilot children's unit, where the percent of children restrained who were under the age of 14 years decreased 44%. The data from the first two parts of this project was used to inform nurses and provide a foundation for further testing of change, as part of an iterative Plan-Do-Study-Act (PDSA) quality improvement cycle (Langley, et al., 2009).

Problem Description

To provide the optimal level of safety and quality of care for individuals who must be physically restrained, intensive care by a registered nurse is required to mitigate risks and assure release at the earliest opportunity. New Hampshire Hospital's nursing department standard has,

for many years, required a registered nurse to remain continuously with individuals who are manually restrained. During mechanical restraint episodes, however, CMS regulations and hospital nursing standards allowed the delegation of continuous observation and monitoring of mechanically restrained individuals to unlicensed workers. These workers lack the skill and training to recognize subtle signs of physiological distress and are not authorized to release the individual from restraint when the earliest opportunity arises.

Current CMS regulations require a face-to-face assessment by a registered nurse just once every hour. Since 2014, New Hampshire Hospital's nursing department standard has required assessment by a registered nurse once every thirty minutes. While thirty minute assessments provide more frequent surveillance and an opportunity for earlier recognition of readiness for release than hourly assessments, neither of these standards provide the level of psychiatric intensive care needed by individuals who are so critically ill that they must be mechanically restrained.

The purpose of this project was to attempt to decrease the duration of mechanical restraint episodes by requiring continuous, direct observation by a registered nurse, who is trained to recognize the need for medical treatment and the individual's readiness for release at the earliest opportunity.

Review of Literature

In order to learn about efforts to reduce the use of mechanical restraint in psychiatric inpatient hospitals, a literature search using the following electronic databases was conducted: Medline Plus, Pubmed, CINAHL, Cochrane Library, ProQuest, PsychINFO and Google Scholar. Key search words included MeSH terms and Boolean operators "restraint, physical," "inpatient psychiatric," "hospitals, psychiatric," and "restraint reduction." Two subsets of physical restraint

-“manual restraint” and “mechanical restraint – were also included in the search. Studies included were published in the past five years, written in the English language and reported on the use of physical restraint in human adults, adolescents and children. A total of 4,695 articles about physical restraint were found, and these were screened for studies that described efforts to reduce the use of physical restraint. The number of applicable studies was further reduced to just seventeen when the following exclusion criteria related to settings were applied: long-term care and geriatric settings, correctional systems, home care, schools and programs for individuals with intellectual disability and/or mental retardation and no major mental illness. Specific outcome of interest was duration of physical restraint episodes.

The literature search produced a number of articles about when restraint is used, how it negatively impacts patients and staff and why it should not be used (Aguilera-Serrano et al., 2018; Barnett, Stirling & Pandyan, 2012; Gill, 2014; SAMHSA, 2015). Most studies of physical restraint are confounded by the implementation of multiple interventions at the same time and the simultaneous study of seclusion. Studies of specific strategies to decrease or eliminate the use of physical restraint are scarce. The search revealed broad categories of strategies (NASMHPD, 2017) to decrease the use of physical restraint through culture change and leadership. Other common themes are the use of policies and administrative oversight (Masters, 2017) and staff training (Ye et al., 2017; CPI, 2018). There is some evidence that having more registered nurses on duty and requiring more nurses to provide care during restraint episodes may decrease the likelihood that patients will be restrained (Staggs, et al, 2017). None of these studies, however, measured variables in relation to duration of restraint episodes.

According to the CMS (2018 b) Measures Inventory, the standardized CMS measure for reporting restraint use is hours of restraint per 1,000 patient hours (HBIPS-2). However, this

measure of usage is influenced by a multitude of factors that guide the nurse's decision to initiate the use of restraint (NASMHPD, 2017). Duration of restraint episodes is a more precise measure of the influence that direct observation by a registered nurse may have on the amount of time that an individual remains restrained, since the nurse's decision to end restraint is based upon the nurse's assessment of the individual's ability to refrain from harmful behavior.

Only one study was found that specifically explored the relationship between increased frequency of registered nurse assessments and duration of mechanical restraint episodes. In that study, conducted in an acute psychiatric hospital in Spain by Guzman-Parra, Garcia-Sanchez, Pino-Benitez, Alba-Vallejo, and Mayoral-Cleries, (2015), the mean duration of restraint episodes decreased significantly after new regulations required nurses to assess restrained individuals every fifteen minutes instead of every thirty minutes. According to the Effective Public Health Practice Project (EPHPP) (Thomas et al., 2004) quality assessment tool for quantitative studies, the quality of the evidence in the study is low. Limitations of the Guzman-Parra study include lack of a control group and data from only one unit for two time periods that were separated by seven years, where staff education about restraint practices took place. However, it does provide some evidence that policy change to increase the frequency of registered nurse assessments may lead to decreased duration of mechanical restraint.

The observation that almost twenty years of intense public and regulatory scrutiny has not led to elimination of mechanical restraint suggests that current methods for avoiding and preventing the practice are not effective. The literature review revealed that there is no strong evidence to support any one strategy for decreasing duration of mechanical restraint episodes. Given the importance of finding ways to reduce and eliminate the use of mechanical restraint in

acute inpatient psychiatric settings, more study of specific interventions aimed at decreasing duration of restraint events is needed.

Since physical restraint is already limited by regulations to be an emergency measure of last resort, it may never be possible to completely eliminate the practice. Staggs (2015) found that in spite of intensive reduction efforts, nationwide rates of physical restraint use remained relatively constant between the years 2007 and 2013. There was, however, a clinically significant decreasing trend in mean duration of physical restraint applications during that time period. Therefore, it is appropriate to focus quality improvement studies on methods to reduce the duration of physical restraint episodes.

Rationale

More study is needed to measure the influence of nurse assessment and surveillance on duration of mechanical restraint episodes. Direct observation, assessment and interaction with the restrained individual provide the best evidence to inform the registered nurse about whether or not release criteria have been met and it is safe to release the restrained individual. Release from restraint may be accomplished most expeditiously by a registered nurse who remains in the restrained individual's presence, continuously attuned to signs of readiness for release. Hence, the purpose of this project was to measure the change in mean duration of mechanical restraint episodes that occurred on pilot units after the nursing department standard was implemented to require mechanically restrained individuals to be continually and directly observed by a registered nurse during restraint episodes.

Theoretical Framework/Evidence Based Practice Model

A quality improvement project incorporated organizational change concepts developed by Lewin (1997) and Schein (1999). According to Lewin, change follows a three-stage model

that begins with becoming motivated to change (unfreezing), then changing what must be changed, and finally making the change permanent (refreezing) (Figure A2). Schein built upon Lewin's ideas to develop a more comprehensive model for changing culture, believing that organizational leaders influence the beliefs, values and underlying assumptions that form the culture of an organization. Successful change requires leaders to identify the actions and behaviors that fit their own beliefs, values and goals.

The dominant culture at New Hampshire Hospital has continued to support the necessity for the use of mechanical restraint as an emergency measure of last resort. This project attempted to influence that culture (unfreezing) and bring about a renewed effort to assure that when mechanical restraint is necessary, that it is used for as short a period of time as possible (moving/changing). Registered Nurses are in a position to take a leadership role in that effort, using their specialized skills and knowledge to assess the physical and mental status of the individual who is restrained, recognizing when release criteria has been met and determining when the individual is ready to be released.

New Hampshire Hospital nurses have a firm theoretical foundation to help them make these critical decisions. They practice within a collaborative, relationship-based nursing care delivery model (Figure A3) that is based on the dynamic nursing theory of Ida Jean Orlando (Allen & Vitale-Nolen, 2005). Orlando's theory (1990) set forth the idea that the nurse's function is to find out what the individual needs for help and try to assist the individual to meet that need. The collaborative relationship-based care delivery model focuses the nurse's attention on trying to make a human connection with the individual and developing a therapeutic relationship that is built upon trust. The registered nurse, then, is positioned to spend time with the individual who is experiencing crisis, identifying the problem that is fueling the crisis and helping to find an

interim resolution that is safe and acceptable to the nurse and the individual. While interacting with the restrained individual, the registered nurse bases assessment of the individual's readiness for release on attunement to and understanding of the meaning of the individual's verbalizations and behavior.

The relationship-based nursing care delivery model has helped New Hampshire Hospital to reduce the use of restraint in the past (Allen et al., 2006), and nurses continue to strive for a restraint-free environment (refreezing) by interacting with individuals in their care to develop mutual trust and build therapeutic relationships. Trust is an essential element in the registered nurse's decision about when to release an individual from restraint, and the more time a nurse spends observing and interacting with an individual, the more opportunity there is for the nurse to build trust in their assessment that an individual can or cannot be safely released.

Setting Barriers and Facilitators

The biggest challenge for the quality improvement project was to convince nurses that the anticipated strain on resources created by requiring increased nurse presence during mechanical restraint episodes is worthwhile. Support from nurse leaders has been found to be a critical element of success for any new project in a practice environment with limited resources (Aiken, Havens & Sloan, 2009). In an attempt to overcome objections and "unfreeze" current culture and ways of thinking, a consistent change message communicated throughout this quality improvement project. This message was, 'While providing this level of care may pose challenges related to resources and routine workflow, we are committed to the idea that there is nothing more important than assuring the highest level of care for those who are experiencing psychiatric crises that require restraint.'

The four pilot unit leaders who were invited to participate in the third phase of the quality improvement project had declined a similar invitation early in 2017. Results from the Part 2 pilot were presented to those leaders a year later, in an effort to convince them to participate in Part 3 of the project. Positive feedback from nurses on the first pilot units supported the transformational approach used to convince other nurses to undertake the practice change. Results from Part 2 showed that concerns that there would not be enough nurses available to directly observe patients were not founded. During the year after implementation of the practice change on Part 2 pilot units, there were only four reported instances where a registered nurse was unable to remain one-to-one with a restrained individual for the entire episode because there were not enough nurses available.

Cost-Benefit Analysis

Concerns related to costs associated with the requirement to assign a registered nurse to remain 1:1 with all restrained patients were allayed when a cost-benefit analysis determined that implementation of this improvement could result in increased annual costs of up to \$4,800. Nurses agreed that potential costs of medical care and litigation from just one injury to a patient during mechanical restraint would certainly exceed such a small cost increase, as would the physical and psychological benefits associated with earlier release from restraint.

Organizational Gap Analysis

Recognizing the need for psychiatric intensive care to be provided by a registered nurse during mechanical restraint episodes, New Hampshire Hospital nurses advocated for a change in nursing practice to narrow the gap between the current and desired states. Moving from the current state, where mental health workers may be assigned to continually monitor mechanically restrained individuals and a registered nurse is required to assess those individuals once every

thirty minutes, to the desired state, where a registered nurse provides continuous, direct observation for mechanically restrained individuals.

Hypotheses

In order to evaluate the project, the following hypothesis was proposed: The duration of mechanical restraint episodes on Part 3 pilot units (D, G, ISU and APC-Adolescents ages 14-18) will significantly decrease ($p, .05$) during the three-month period after the nursing standard of care for mechanical restraint is implemented to require continuous, direct observation by a registered nurse.

Specific Aim

The specific aim for this quality improvement project was to provide the optimal level of care and safety for individuals who, in emergencies, must be mechanically restrained at New Hampshire Hospital. The objective of the project was to change the nursing standard of care during mechanical restraint episodes from registered nurse assessment once every thirty minutes to direct and continuous observation by a registered nurse during the entire episode of restraint. The desired outcome for the project was a 25% overall decrease in hours of restraint per episode on units D, G, ISU and APC (Adolescents 14-18 years of age) by August 31, 2018. This benchmark was determined based on the results from Part 1 of the quality improvement project, where a 23% overall decrease in duration was experienced and data from the first few months on the pilot units in Part 2.

Methods

Design

The design of the project was a quality improvement process, using a Plan-Do-Study-Act strategy (AHRQ, n.d.), that involved changing the requirements for registered nurse practice

during episodes of mechanical restraint on Part 3 pilot units (D, G, ISU and APC (Adolescents-14-18 years of age). In the Plan phase, stakeholders and nurses were informed about results of two previous PDSA cycles in this three-part quality improvement project. Buy-in was sought for the next “Do” cycle. Pre-intervention plans included presenting results from Part 1 and Part 2 of this quality improvement project to the Chief Nursing Officer (CNO) and unit nurse leaders. With support from the nursing leadership team, the hospital’s research manager and the investigator’s academic advisor, a study proposal was made to the DHHS Committee for the Protection of Human Subjects (CPHS). When CPHS determined that this study was exempt, nurses on Part 3 pilot units (D, G, ISU and APC-Adolescents 14-18 years old) were notified of the pending practice change via email and direct communications in advance of the start date (June 1, 2018).

Implementation

On June 1, 2018, the second group of New Hampshire Hospital units (D, G, ISU and APC (Adolescents 14-18 years of age) joined the previous pilot units (C, H, J and APC-Children under age 14). All units were now participating in a pilot project to raise the standard of care by requiring a registered nurse to directly observe mechanically restrained individuals throughout the duration of restraint episodes.

Setting

The project took place at New Hampshire Hospital, a state-funded, 168-bed acute psychiatric hospital located in Concord, New Hampshire. The population served by the hospital ranges from individuals as young as four years through those at the end of their lifespan. Most patients are admitted under New Hampshire’s Involuntary Emergency Admission law, and must “be in such mental condition as a result of mental illness to pose a likelihood of danger to

himself or others ((NH RSA 135-C: 27, 2010, pg. 1)”. During the Study phase of the project, quantitative data on duration of mechanical restraint episodes was collected in the routine manner on all units, beginning three months before and ending three months after the proposed change, which was implemented on June 1, 2018.

Measure

The measure chosen to evaluate project outcomes was hours per episode of restraint (duration). The mean duration per episode, in hours, was calculated by dividing the number of hours of mechanical restraint for each month by the number of mechanical restraint episodes for each month in the study period. Hours of mechanical restraint attributed to manual holds were not counted, since a registered nurse already remained face-to-face with individuals during these events.

Data Collection

The data were collected from March 1, 2018 to August 31, 2018. The registered nurse involved in the emergency restraint measure manually recorded the start and end times of each episode of mechanical restraint on the Personal Safety Emergency and Physician Intervention Orders form as part of normal operating procedure. The data is retrieved from the forms every night by nurses on the 11P-7A shift and entered into New Hampshire Hospital’s Netsmart Avatar electronic health record. This routine data collection method has been in place for several years and provides the organization with data on all episodes of restraint. Crystal reports available in Avatar provided a summary, by date range and unit, of the number of episodes and the number of hours of mechanical restraint.

Data from the Avatar reports was aggregated and cleaned each month. The process entailed running an AVATAR crystal report (“Negative Time Report”) that identifies any data

entry errors in the start and stop times that are used to determine duration of episodes. Corrected duration times were entered into the Microsoft Excel spreadsheet for each unit. The start and stop times of restraint interventions were verified by cross-referencing with data found on reports of personal safety emergencies.

Data Analysis

Data was analyzed to evaluate the change in mean duration of episodes during the study period. Statistical calculations were made and verified using JMP, MedCalc and Social Science Statistics software. Mean durations of mechanical restraint episodes on Part 3 pilot units (D, G, ISU and APC-Adolescents 14-18 years of age) for the pre-intervention period occurring between March 1 and May 31, 2018 were compared with mean durations of episodes occurring during the post-intervention period between June 1 and August 31, 2018.

Pre and post comparisons of mean duration of restraint episodes were calculated all units, the first group of pilot units (C, H, J & APC < 14 years), and for children under 14. Changes in mean hours of duration post-intervention are reported as a percentage of pre-intervention mean hours of duration. Analysis included calculating the differences between means to determine whether or not any changes in mean duration of mechanical restraint episodes were statistically significant. These calculations included standard deviations from the mean and *t*-tests at a 95% confidence interval.

Human Subjects

Approval was obtained from the State of New Hampshire DHHS Committee for the Protection of Human Subjects prior to initiating the DNP project. The IRB had previously approved Parts 1 and 2 of this project as an exempt study #1020212, titled “Increased Registered Nurse Surveillance in Relation to Frequency & Duration of Physical Restraint Episodes” in

February 2017. A request to amend and modify the study to include this new PDSA cycle as the third part of this same project was submitted and approved.

The information collected as part of evaluating the impact of this project did not include any potential patient or nurse identifiers. The risk to patients participating in this project was no different from the risks of patients receiving standard care. All standards of care during mechanical restraint episodes were met. There were no ethical considerations and no conflicts of interest.

Results

During the three months after implementation of the change in Part 3, there were six reports of situations where a registered nurse was unable to remain continuously with restrained individuals. All but one of those reported situations occurred during the first week after implementation of the change. Two reports were for a situation that required two individuals to be restrained at the same time. Two other reports indicated that the registered nurse was able to stay with the restrained individual for at least half of the episode, when they were compelled by emergent needs of other patients to delegate monitoring to an unlicensed worker. Nurses reported that they worked collaboratively with colleagues and supervisors in their efforts to meet the practice standard.

Duration of mechanical restraint episodes on pilot units (D, G, I & APC-14 to 18 years) decreased a total of 44%, from a mean of 2.80 to a mean of 1.56, in the three months after registered nurses began staying 1:1 with mechanically restrained individuals (Figure A4). Duration decreased 15% on adult pilot units (D, G & I) and 70% on the adolescent unit (APC 14-18 years) in the three months after the intervention. During the same three month study period, duration of restraint episodes decreased 30% on the Part 2 pilot units, 100% on the APC

children's unit to zero restraint use and 33% on all units combined (Table B3). The results were analyzed using paired *t*-tests to compare the differences in pre and post intervention means, however the differences in Part 3 of the study were not significant (Table B4).

Comparison of mean duration of restraint episodes over the entire course of the three-part quality improvement project reveals that there was an overall 30% decrease in the duration of restraint episodes at NHH- from a mean duration of 2.15 hours in 2012-2013, before the project began, to 1.51 hours from 2014-2018, after the project began (Figure A5). This overall change in duration of restraint episodes was found to be statistically significant at $p < .05$ (Table B5).

Discussion

Increasing the frequency of registered nurse surveillance and assessment of individuals who were mechanically restrained decreased the duration of restraint episodes in an acute psychiatric hospital. Results from the third Plan, Do, Study, Act (PDSA) cycle (IHI, 2018) add to what was learned in Parts 1 and 2.

In Part 1 of the study, duration of restraint decreased significantly after the nursing standard was changed to require thirty-minute assessments instead of sixty-minute assessments. In Part 2, duration of restraint episodes decreased on units that piloted having a registered nurse stay continuously with restrained individuals, while duration of episodes decreased on non-pilot units. In Part 3, duration of restraint episodes decreased on the second group of units that piloted having a registered nurse stay continuously with restrained individuals. There were no statistically significant differences in duration of episodes found in Part 2 or Part 3. The lack of statistical significance may have been due to the small number of hours and relatively large standard deviations from the mean. Although the Part 3 results did not support the hypothesis through statistical significance, they were clinically significant. Overall results of the three-part

quality improvement project were statistically significant and provide evidence that supports changing practice standards to require increased assessment and surveillance by a registered nurse during mechanical restraint.

The results of this quality improvement project are similar to those of Guzman-Parra et.al (2015), who found that restraint duration decreased significantly after a mandatory regulatory protocol increased the required time for assessment by a nurse from every 30 minutes to every fifteen minutes.

The overall decrease occurred in spite of significant challenges and organizational changes. Throughout the project, nurses expressed concerns that availability of registered nurse staffing resources would not support the requirement for having a registered nurse remain 1:1 with all restrained individuals. The results demonstrated that the practice change was possible without changing staffing patterns.

Organizational changes that may have influenced restraint use in Part 2 and 3 of this quality improvement project included an unusually high turnover of doctors and nurse practitioners. In June of 2016, more than two-thirds of NHH's experienced staff psychiatrists and psychiatric nurse practitioners resigned due to a labor dispute and the process of hiring new staff of clinicians took over a year. This high turnover may have created variability in the level of diagnostic expertise and proficiency in prescribing medications that are important elements of treatment plans for managing anxiety, agitation and aggression that can lead to the use of restraint.

The project demonstrates the value of increased registered nurse presence during emergencies that require the use of mechanical restraint. Psychiatric intensive care by a registered nurse expedites an end to restraint episodes, while providing increased patient safety.

The Act phase of this quality improvement project involved the process of “refreezing” change by presenting the results from all three parts of this quality improvement study to hospital nurses and other stakeholders. During these presentations, nurses talked about how it was sometimes really difficult to manage the new standard, yet they *had* managed, through cooperative effort and new ways of prioritizing tasks. One nurse said she wasn’t surprised that duration of episodes decreased once a registered nurse had to remain continuously with a patient. She explained that when a nurse left the room where a patient was restrained it was easy to get distracted and hard to get back to assess whether or not the patient was ready for release.

Evidence supporting the hypothesis that duration of mechanical restraint episodes decreased after the frequency of registered nurse assessment and surveillance was increased led nurse leaders to permanently change the New Hampshire Hospital Nursing Department standard to require that a registered nurse continually and directly observe individuals who are mechanically restrained.

The requirement for increased registered nurse presence during mechanical restraint is not always easy for nurses to manage. Knowing that people have died while being restrained, however, has helped nurses to overcome challenges in order to provide the best care. Nurses at New Hampshire Hospital can’t remember any deaths that were attributed to the use of restraints and that is fortunate. While hoping that this trend continues, nurses are doing everything in their power to make sure that the lives of patients don’t rely on good fortune. Like ensuring that patients who are experiencing psychiatric emergencies get the highest level of care. Nurses have modified their workflow and prioritized psychiatric intensive care for

individuals who are so ill that they must be physically restrained and this is making a positive difference.

Limitations

Findings of this study may not be generalizable to other settings because the results were limited to one inpatient hospital with only a three-month data collection period. Results may have been influenced by pre-implementation discussions about the dangers of restraint that occurred as part of the change process. Differences between pre and post intervention means may not reflect the fact that some nurses on non-pilot units changed their practices to remain 1:1 with restrained individuals before their units officially joined the project. Another possible confounder is that some nurses may not have remained 1:1 continuously with restrained individuals, but did not report it through a variance report.

Conclusions

The duration of mechanical restraint episodes in an acute psychiatric hospital decreased as the frequency of registered nurse surveillance and assessment of individuals who are restrained increased. Even though statistical significance was not found in all phases of this project, the overall results were clinically and statistically significant. Registered nurses have adapted their workflow to provide psychiatric intensive care by remaining 1:1 with individuals who are experiencing psychiatric crises that require the use of mechanical restraint. They have demonstrated their commitment to safe and quality care by working collaboratively with colleagues and supervisors in order to exceed regulatory requirements and reach for standards of excellence.

Mechanical restraint is a practice that results when treatment fails; therefore, the ultimate goal is elimination of the practice. When restraint is necessary, nurses are responsible for doing

everything possible to help individuals get through their times of crisis so they may be released from restraint. This means assuring that individuals who must be mechanically restrained receive focused, intentional care from a registered nurse. Nurses have the power to change their standards of practice to reflect what they know, believe and value. New Hampshire Hospital nurses know that mechanical restraint is dangerous, believe that it requires intensive nursing care and value the registered nurse's knowledge and skill set. Nurses have learned that increasing the frequency of registered nurse assessment and surveillance has decreased duration of mechanical restraint episodes in an acute psychiatric hospital. Other healthcare organizations are encouraged to implement similar changes and study related outcomes as part of further PDSA cycles of quality improvement. Further evidence may help to bring about regulatory changes that will require psychiatric intensive care by a registered nurse for all individuals who are physically restrained.

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Appendix A. Figures

Figure A1. Three PDSA Cycles

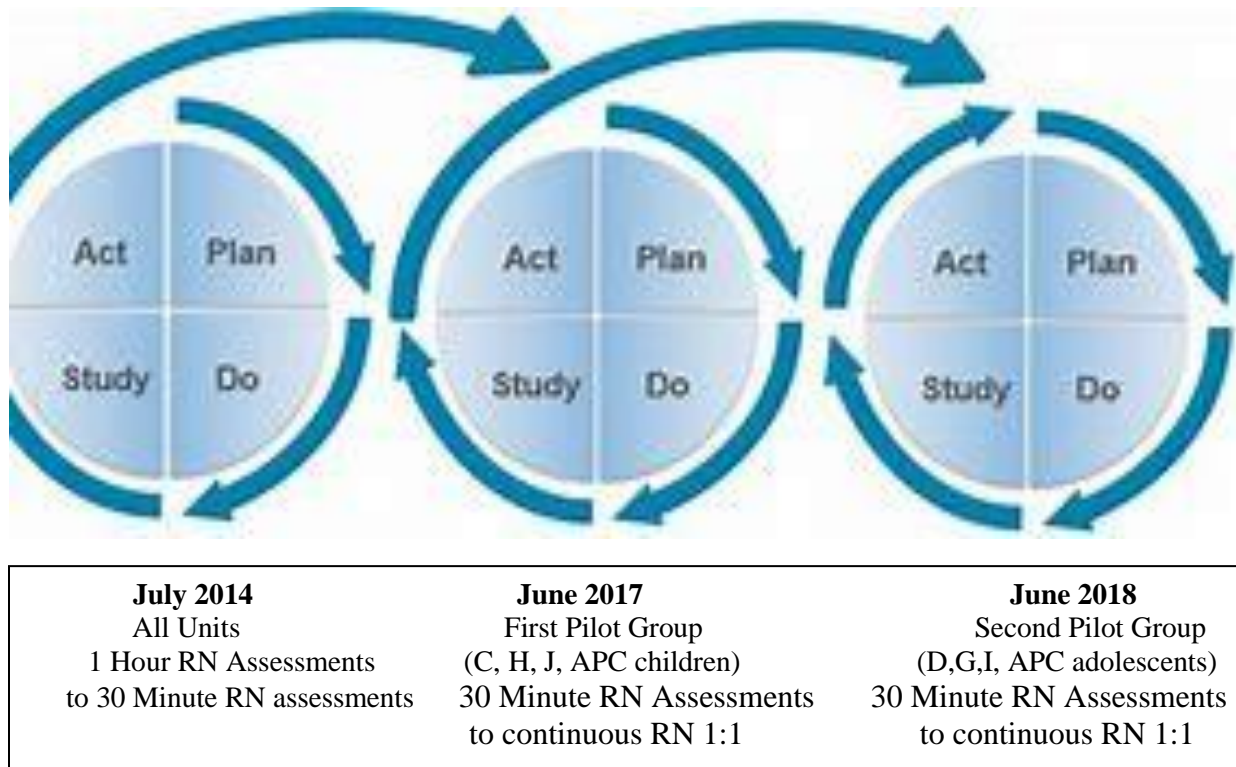


Figure A2. Lewin's Model of Change

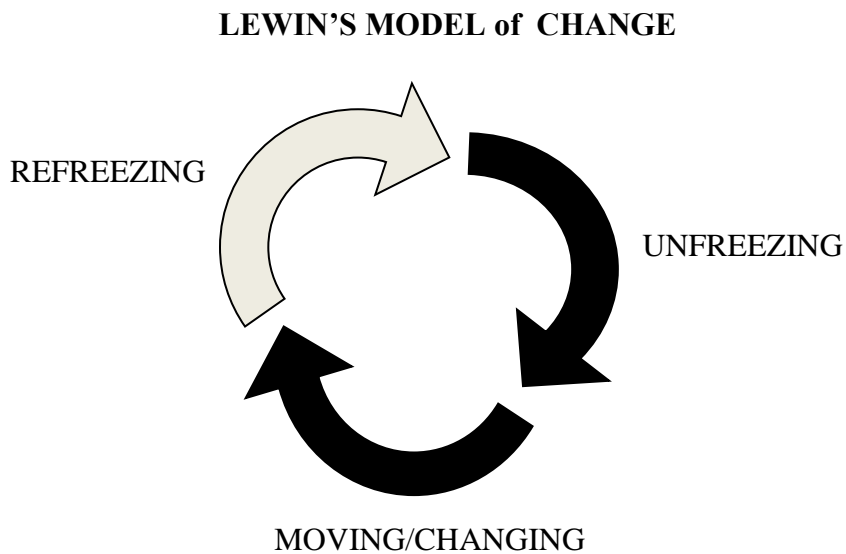


Figure A3. New Hampshire Hospital Nurse’s Collaborative Relationship-Based Nursing Model

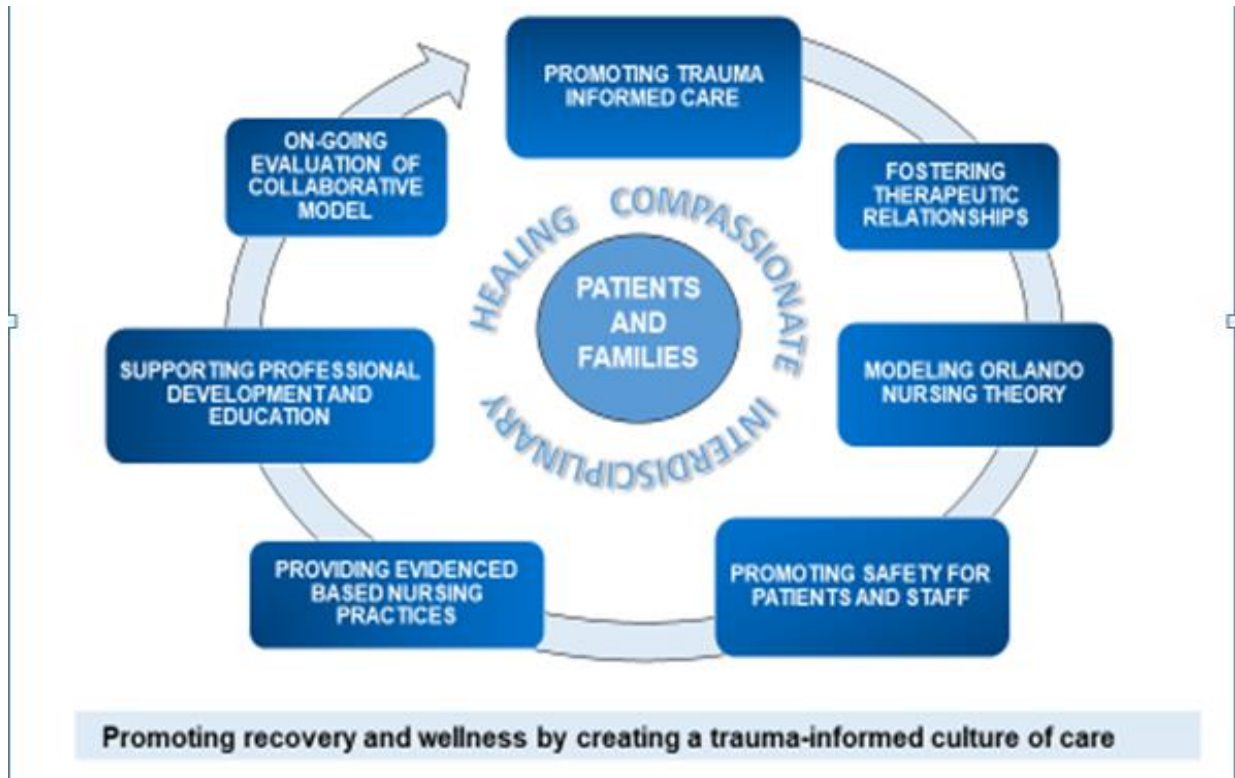


Figure A4: Mean Duration of Episodes of Restraint, Part 3 Pre and Post Intervention

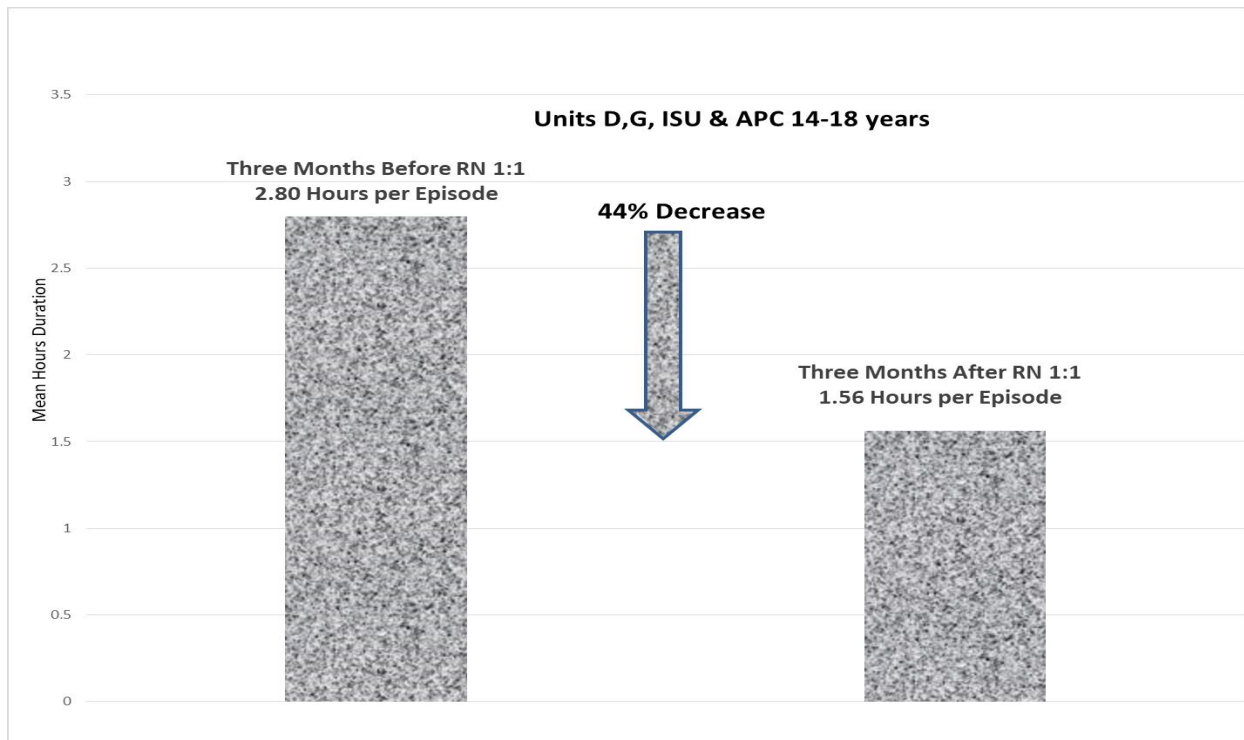
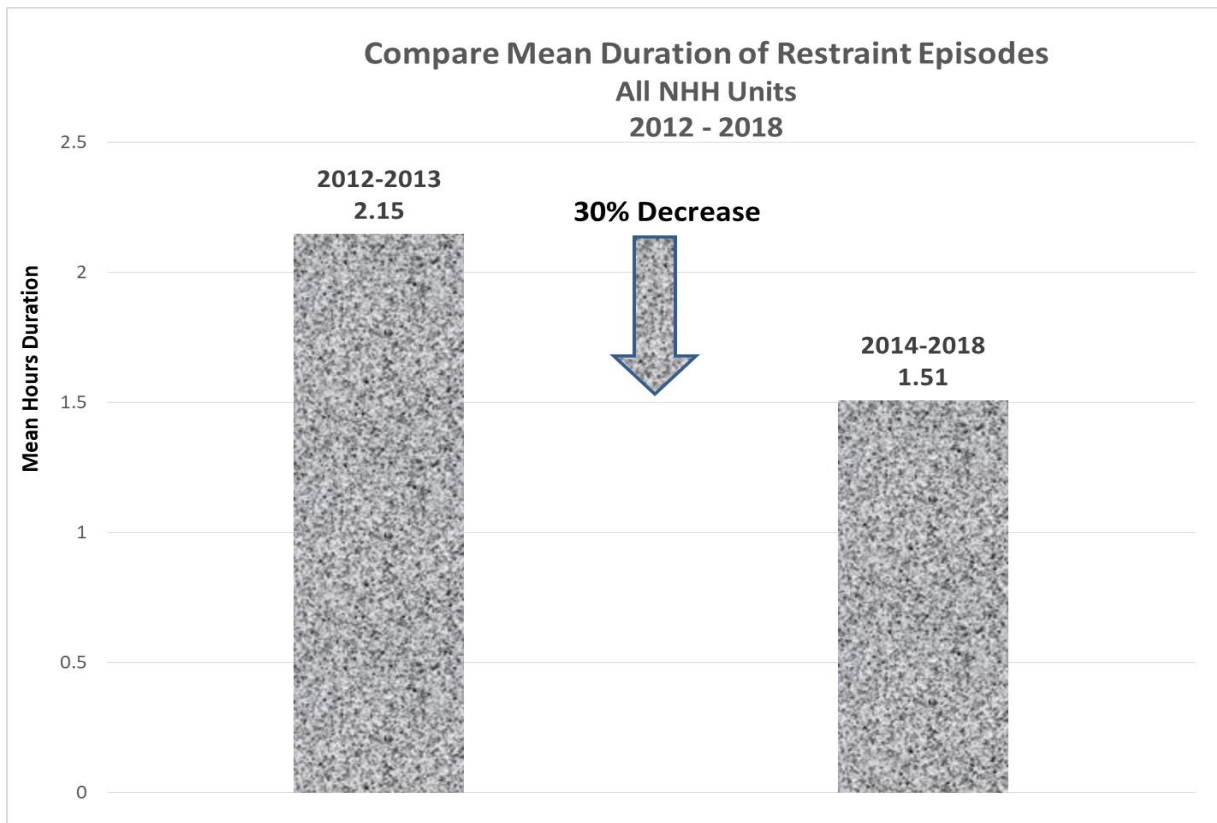


Figure A5. Mean Duration of Restraint Episodes, 2012-2018



Appendix B. Tables

Table B1: Part 1 Results

Comparison of Means <i>t</i> -tests	Pre- 1 Hour RN Assessments July 2012-June 2014	Post- 30'' RN Assessments July 2014-June 2016	% Change
Hours Restraint per 1,000 hours care All Units	Mean .57 (SD .08) n=24	Mean .37 (SD .04) n=24	-34%
Difference	.196		
Standard Error	.070		
95% CI	.0552 to .3368		
<i>t</i> -statistic	2.807		
DF	46		
Significance level	$p = 0.0074$ *result is significant at $p < .05$		
Effect Size	Cohen's $d = 3.162$		
Percent of Patients Restrained per 1,000 hours care All Units	Mean 4.6 (SD 3.96) n=24	Mean 4.0 (SD 4.15) n=24	-13%
Difference	-0.630		
Standard Error	1.171		
95% CI	-2.9869 to 1.7269		
<i>t</i> -statistic	-0.538		
DF	46		
Significance level	$p = 0.5931$ result is not significant at $p < .05$		
Hours Duration per Restraint Episode All Units	Mean 2.15 (SD .46) n=24	Mean 1.65 (SD .33) n=24	-23%
Difference	-0.497		
Standard Error	1.181		
95% CI	-0.8616 to -0.1324		
<i>t</i> -statistic	2.738		
DF	46		
Significance level	$p = 0.00438$ *result is significant at $p < .05$		
Effect Size	Cohen's $d = 1.249$		

Table B2: Part 2 Results

Comparison of Means	Pre RN 1:1 June '16 thru May '17 n=12	Post RN 1:1 June '17 thru May '18 n=12	
Location	Mean Hours	Mean Hours	Change
All Units	1.06	1.57	+48%
Adults	.91	1.3	+42%
APC1 Child <14	1.01	.33	-68%
APC2 Adol.14-18	1.02	1.46	+44%
CHJAPC1 Pilot Units	.95	.83	-12%
DGISUAPC2	.92	1.56	+64%
Location	Percent Restrained	Percent Restrained	Change
All Units	2.84%	3.15%	+11%
Adults	1.14	1.64	+43%
APC1 Child <14	4.94	2.78	-44%
APC2 Adol.14-18	9.22	9.57	+3%
CHJAPC1 Pilot Units	1.45	1.49	+3%
DGISUAPC2	2.42	2.44	+1%

Table B3: Part 3 Results

Comparison of Means	Pre RN 1:1 March '18 thru May '18 n=3	Post RN 1:1 June '18 thru Aug '18 n=3	
Location	Mean Hours	Mean Hours	Change +/-
DGIAPC2 All Pilot Units	2.80 (SD 0.90)	1.56 (SD 0.28)	-44%
D, G & I Adult Pilot Units	2.14 (SD 1.15)	2.00 (SD 1.14)	-15%
APC2 Adol. 14-18 Pilot Unit	3.20 (SD 1.10)	0.95 (SD 0.03)	-70%
APC1 Child <14	.26	0	-100%
APC All	2.85	.95	-67%
Adults All	2.81	1.98	-30%
CHJAPC1	3.31	2.31	-30%
All Units	2.82 (SD 0.72)	1.90 (SD 0.63)	-33%

Table B4: Part 3 Analysis of Results - Pilot Units

Comparison of Means <i>t</i> -test	
DGIAPC2 All Pilot Units	
Difference	-1.240
Standard Error	0.934
95% CI	-3.8323 to 1.3523
<i>t</i> -statistic	-1.328
DF 4	4
Significance level	$p = 0.2549$ results not significant at $p < .05$
APC2 Adol. 14-18 Pilot Unit	
Difference	-2.250
Standard Error	0.890
95% CI	-4.7211 to .2211
<i>t</i> -statistic	-2.528
DF 4	4
Significance level	$p = 0.0648$ results not significant at $p < .05$

Table B5: Overall Decrease in Duration Parts 1-3 2012-2018

Comparison of Means <i>t</i> -test	Pre- 1 Hour RN Assessments July 2012-June 2014	Post- Increased RN Assessments July 2014-August 2018	% Change
Hours Duration per Restraint Episode All Units	Mean 2.15 (SD .46) n=24 DF =23	Mean 1.51 (SD .43) n=50 DF = 49	-30%
Difference	-0.64		
Standard Error	0.11		
95% CI	.4223 to .8577		
<i>t</i> -statistic	-3.89		
Significance level	$p = 0.000111$ *result is significant at $p < .05$		
Effect Size	Cohen's $d = 1.44$		