7-6-2022

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Evaluation of an Updated Maternal Severe Hypertension Recognition and Response Protocol

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B.S.N., Maryville University, Saint Louis, MO, 2017

A Dissertation Submitted to The Graduate School at the University of Missouri-St. Louis
in partial fulfillment of the requirements for the degree
Doctor of Nursing Practice with an emphasis in Women's Health Nurse Practitioner

August 2022

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Abstract

Problem: Hypertensive disorders of pregnancy are a leading cause of morbidity and mortality. An area of concern is the lack of women and infant departments that have a standardized approach for treatment of severe hypertension congruent with the American College of Obstetricians and Gynecologists (ACOG) recommendations.

Methods: A department with approximately 4,000 deliveries per year was the site for this quality improvement project. A descriptive observational design was used to evaluate the effect of an updated protocol on treating hypertensive events within 30-60 minutes. The protocol was updated by a maternal fetal medicine physician and a certified nurse midwife. Data was evaluated 3 months prior to and 3 months after implementation of the updated protocol.

Results: One hundred fifty-five patients met eligibility criteria and participated in the project. The relationships between program change and meeting the time to treatment goal was significant, x^2 (1, $N = 155$) = 8.8, $p = 0.003$. Variables shown to not have a significant relationship between program change were the average number of blood pressure readings to normalize per patient, the number of times the repeat blood pressure was met, and magnesium utilization.

Implications for Practice: Implementation of the updated protocol increased knowledge to staff and clarified notification to the house provider along with decreasing the percentage of severe maternal hypertensive events not treated within 30-60 minutes over a 3-month period. Updating the maternal severe hypertension recognition and response protocol resulted in improved practice to align with ACOG guidelines.

Evaluation of an Updated Maternal Severe Hypertension Recognition and Response

Protocol

Hypertensive disorders of pregnancy are a leading cause of morbidity and mortality around the world (American College of Obstetricians and Gynecologists [ACOG], 2020). In the United States, hypertensive disorders account for 17% of maternal mortality, occurring in 12%-22% of pregnancies (Williams, 2019). Preeclampsia, a hypertensive disorder of pregnancy, costs $2.18 billion annually: women accounting for $1.03 billion and infants accounting for $1.15 billion (ACOG, 2020). Missouri is ranked 44th in the United States for maternal mortality with 40.7 deaths per 100,000 live births (Williams, 2019). In St. Louis County, Missouri, the rate of gestational hypertension is 1.2 to 1.4 times the nation's rate (Saint Louis County Department of Public Health, 2019). Between 2014 and 2018, gestational hypertension increased from 6.3% to 8.8% in St. Louis County (Saint Louis County Department of Public Health, 2019). Hypertensive disorders of pregnancy increase the risk for preeclampsia, eclampsia, stroke, premature birth, intrauterine growth restriction, low birth weight, placental abruption, renal failure, long-term cardiovascular morbidity, and death (Butwick et al., 2020; Saint Louis County Department of Public Health, 2019).

In 2017, the American College of Obstetricians and Gynecologists (ACOG) stated severe maternal hypertension is a medical emergency requiring antihypertensive treatment within 30-60 minutes (Williams, 2019). The implementation and utilization of evidence-based guidelines for the treatment of severe maternal hypertension in the antepartum, intrapartum, and postpartum periods is recommended in all hospitals with labor and delivery units and has shown to reduce substandard maternal and fetal

outcomes (Williams, 2019). In 2018, the Missouri Hospital Association (MHA) and the

Missouri Department of Health and Senior Services (DHSS) partnered with ACOG to

declare the Alliance for Innovation on Maternal Health's (AIM) *Severe Hypertension in*

Pregnancy Bundle, as a priority issue for Missouri (Missouri Hospital Association

[MHA], 2021). The Alliance for Innovation on Maternal Health is a safety and quality

improvement (QI) program driven by data. The Alliance for Innovation on Maternal

Health targets reducing maternal morbidity and mortality in the United States by

implementing standardized patient safety bundles (Missouri DHSS, 2021). The content of

the patient safety bundles is supported and promoted by ACOG (Williams, 2019).

Recommendations for hospitals in Missouri are to track and report data each

quarter to the MHA regarding maternal hypertension management (Missouri DHSS,

2021). The Alliance for Innovation on Maternal Health's patient safety bundle *Severe*

Hypertension in Pregnancy includes 4 categories: readiness, recognition and prevention,

response, and reporting/systems learning (Missouri DHSS, 2021). The first objective in

the readiness category is for labor and delivery units to develop an evidence-based

protocol including algorithms on "early warning signs, diagnostic criteria, and monitoring

and treatment of severe hypertension, preeclampsia, and eclampsia" (Williams, 2019, p.

17). An objective in the response category is for hospitals with labor and delivery units to

develop a standardized protocol with escalation policies for treatment so there is minimal

variation across providers (Williams, 2019).

The percentage of severe maternal hypertensive events not treated within 30-60

minutes in a women and infant's department in a suburban hospital in Missouri is 53%.

The purpose of this QI project is to evaluate the implementation of an updated maternal

severe hypertension recognition and response protocol. The aim of this proposed project is to determine whether the updated protocol will reduce the percentage of severe maternal hypertensive events not treated within 30-60 minutes in a women and infant's department by 3% over a 3-month period. Primary outcome measures of interest include the percentage of severe maternal hypertensive events treated within 30-60 minutes and the percentage of severe maternal hypertensive events followed by repeat blood pressure measurements per an updated protocol. A study question was formulated to guide literature review: What is the effect of the implementation of an updated maternal severe hypertension recognition and response protocol in a women and infant's department on treating severe maternal hypertensive events within 30-60 minutes?

Literature Review

A search of literature was carried out to find the current evidence and research on the implementation of a maternal severe hypertension recognition and response protocol in a women and infant's department based on ACOG guidelines. The Cochrane Database of Systematic Reviews, the Agency for Healthcare Research and Quality (AHRQ), Medline (EBSCO), Cumulative Index of Nursing and Allied Health Literature (CINAHL), and Google Scholar databases were investigated. The key search terms *severe maternal hypertension* AND *treatment* AND *protocol* were used which led to 2,302 results. Search settings were refined by selecting full text, peer reviewed journals, and journals written in English, from 1/1/2016 to 08/30/2021. Studies prior to 2016 were excluded. Pregnant women and women within 6 weeks postpartum were selected as inclusion criteria. Exclusion criteria were non-pregnant women, patients with an exacerbation of chronic hypertension, and patients greater than 6 weeks postpartum.

Articles were reviewed and duplicates were excluded, resulting in 253 articles. The

articles were reviewed for correct inclusion and exclusion criteria and hospital setting

with 5 articles selected for final inclusion.

Research findings revealed poor maternal outcomes related to non-compliance

with following evidence-based recommendations through standardized protocols,

algorithms, and safety bundles. Studies in this literature review are peer-reviewed, quality

improvement projects using prospective and retrospective chart reviews, a pilot study

using random sampling, and a retrospective cohort study. Common themes from the

studies are the need for a standardized approach to managing and treating severe maternal

hypertension according to ACOG guidelines.

The use of a protocol in hospitals with labor and delivery units may reduce the

time from onset of severe maternal hypertension to treatment, and improve maternal

morbidity. Miller et al. (2020) analyzed nurses' compliance with an evidence-based

nurse-initiated protocol on the management of severe-range high blood pressure. The

primary outcome measure of this prospective QI project was the amount of time from

when a treatable severe-range high blood pressure was taken to blood pressure control.

Secondary outcome measures included use of the correct medication and the time interval

repeat blood pressures were taken. Data was collected five months prior to

implementation of the protocol and five months after implementation. The time from a

treatable severe-range high blood pressure reading to treatment decreased from 25

minutes (24% compliance) to 11 minutes (60.6% compliance) post-implementation

(Miller et al., 2020). Compliance was considered when treatment was given within 15

minutes. The implementation of the evidence-based nurse-initiated maternal severe

hypertension protocol decreased the average amount of time treatment was initiated and blood pressure control was reestablished.

O'Brien et al. (2018) evaluated the adherence of a newly created protocol on a labor and delivery unit. The protocol was adapted from ACOG recommendations to ensure timely treatment of severe-range blood pressures using antihypertensive medication. A QI project using retrospective chart review was carried out in April to June of 2015. Results found prior to implementation; no nurse who administered intravenous labetalol adhered to the entire protocol. While 58.6% of nurses complied with treating participants with intravenous labetalol aligning with the protocol, only 3.5% of participants had a repeat blood pressure taken within five minutes (O'Brien et al., 2018). While labetalol was given when appropriate, protocol compliance was poor. Non-adherence was thought to be attributed to poor communication during nurse hand offs and conflicting protocols.

A retrospective cohort study was carried out to assess whether implementation of a semiautonomous treatment algorithm according to ACOG guidelines would improve compliance of treating severe maternal hypertension in a timely manner (Martin et al., 2021). The algorithm included guidelines for when to repeat vital signs, blood pressure readings to report to a provider, and preferred method of treatment. The study was carried out from January 2017 to March 2020. Data was collected before implementation, during implementation, and after implementation. A total of 959 participants were treated for severe maternal hypertension during this period. Only 36.5% of participants received antihypertensive medication within 15 minutes before implementation, 45.8% during implementation, and 55.6% after implementation (Martin et al., 2021). Treatment was

initiated within 30 minutes in 65.9% of participants before implementation, 77.8% during

implementation, and 79% after implementation. There was no significant difference in

compliance with treatment within 60 minutes between the three phases. Implementation

of a treatment algorithm reduced the overall amount of time between the onset of

confirmed severe maternal hypertension and the first dose of antihypertensive medication

per ACOG guidelines (Martin et al., 2021).

Investigators sought to evaluate whether the implementation of a standardized

approach for treatment of severe maternal hypertension would reduce maternal

morbidity. Shields et al. (2017) conducted a prospective quality improvement project to

determine whether a standardized approach would increase nurses' compliance to

following evidence-based recommendations. Compliance was noted by the number of

patients who received antihypertensive medication, received magnesium sulfate if

needed, and had a postpartum follow-up appointment within 2 weeks if they had a

diagnosis of a hypertensive disorder of pregnancy or 1 week if they were treated with

antihypertensive medication while admitted at the hospital (Shields et al., 2017). The

study was done from January 2015 to June 2016 at 23 hospitals, with a total of 2,304

participants who met severe maternal hypertension criteria. The participating hospitals

were given recommendations for the management of maternal hypertension by the

California Maternal Quality Care Collaborative (CMQCC) and ACOG guidelines.

Findings showed compliance with the recommendations for treatment was only 50.5%

before implementation and greater than 90% after implementation (Shields et al., 2017).

Compliance with intravenous medication use increased by 33.2% and magnesium sulfate

use increased by 10.8% after implementation. The number of participants diagnosed with

eclampsia decreased by 42.6% and severe maternal morbidity declined by 16.7%

showing a significant improvement in maternal morbidity (Shields et al., 2017).

Other investigators created and evaluated the implementation of a Hypertension in

Pregnancy safety bundle created using evidence-based guidelines to standardize the

treatment of hypertensive disorders of pregnancy in a labor and delivery unit (Taylor et

al., 2020). A pilot study using random sampling found severe-range blood pressures

treated within 60 minutes increased by 19.4% after implementation (Taylor et al., 2020).

Patients with a diagnosis of hypertension discharged from the hospital with a new

prescription for antihypertensive medication increased by 20.3% and patients who

received education on hypertensive disorders of pregnancy prior to discharge improved

by 73% (Taylor et al., 2020). The Hypertension in Pregnancy safety bundle improved

standardization of care and improved urgency to recognize and treat severe-range blood

pressure.

The evidence-based practice (EBP) framework chosen to guide this proposed

project is the Define, Measure, Analyze, Improve, and Control (DMAIC) model, which

represents the five phases. The model is a data-driven quality framework utilized to

improve processes (American Society for Quality, 2021). The process includes defining

the problem, measuring process performance, analyzing the process, improving the

process, and controlling the improved process for future users. The DMAIC framework

will be used to clearly document and explain each step in the process so implementation

of a similar protocol can be replicated in other hospitals with women and infant

departments and achieve comparable results.

This QI project focuses on the need to implement an evidence-based protocol to

manage and treat severe maternal hypertension within 30-60 minutes per ACOG

recommendations (ACOG, 2020). Several research studies revealed the detrimental

impacts of untreated or delayed treatment on maternal and fetal well-being, however,

little research has been conducted regarding a specific protocol to implement to increase

nurses' compliance of treating severe maternal hypertension. Gaps in the literature

include lack of nurses' and providers' education on the new protocols, incomplete patient

documentation in the electronic medical record (EMR), and the protocol and order set on

severe maternal hypertension were not aligned. Recommendations from the literature are

to implement an evidence-based protocol, algorithm, standardized approach, and/or

safety bundle to improve nurses' compliance with following up to date recommendations.

This QI project will utilize the DMAIC model to provide a framework to improve

processes in a women and infant's department in a suburban hospital in Missouri.

Methods

Design

This QI project used a descriptive observational design. Quantitative data was

collected regarding the number of times patients required treatment for a hypertensive

event (systolic blood pressure greater than or equal to 160 mm Hg, diastolic blood

pressure greater than or equal to 110 mm Hg, or both that was persistent for 15 minutes

or more) and whether the nurse followed the updated maternal severe hypertension

recognition and response protocol algorithm. Data was collected by retrospective chart

review starting three months prior to the implementation start date of August 2, 2021

(May 2, 2021 through August 1, 2021). Data was also collected three months after the

implementation was started (August 2, 2021 through November 2, 2021).

Setting

This project occurred in a women and infant's department with approximately 4,000 deliveries per year. This department is part of a Magnet® recognized health care organization with approximately 225 employees located in a suburban hospital in a Midwestern state.

Sample

This project used a convenience sample of pregnant women and women within 6 weeks postpartum ages 18 years and older in the antepartum, intrapartum, and postpartum periods. Non-pregnant women, patients with an exacerbation of chronic hypertension, and patients greater than 6 weeks postpartum were excluded. All medical records of patients in triage, antepartum, labor and delivery, and mother/baby from May 2, 2021 through November 2, 2021 were included in pre and post implementation analysis.

Approval Process

Formal, written approval was obtained from the participating hospital's Institutional Review Board Administrator and from the University of Missouri- St. Louis Institutional Review Board prior to project initiation. The risk to individuals involved in the project were no greater than what is normally involved in their care. Benefits included timely recognition and treatment of severe hypertension potentially preventing maternal morbidity and mortality.

Procedures

The QI project was led by the Doctor of Nursing Practice (DNP) candidate. The maternal severe hypertension recognition and response protocol was reviewed and updated through collaboration with a maternal fetal medicine physician and a certified

nurse midwife (CNM) to align with ACOG recommendations. A maternal severe

hypertension protocol was already in place, but updated to include an algorithm that

clearly shows what steps to take when managing and treating maternal severe

hypertension. The updated protocol also states nurses are to notify the hospitalist of the

severe hypertensive event who will notify the attending provider. The previous protocol

was unclear on whether to notify the hospitalist or attending provider and whose

responsibility it was to update the attending provider. The updated protocol was

implemented on August 2, 2021 by replacing the old protocol with the updated protocol

in the hospital's policy guide. Staff were notified of this change during morning huddles.

A women's health nurse practitioner (WHNP) quality specialist educated staff on the

updated protocol and our department's compliance rates at monthly staff meetings

starting on September 20, 2021. Staff were also required to complete an online

educational course on hypertension in pregnancy through a program called Relias by

September 26, 2021.

  A retrospective chart review was conducted to evaluate data from May 2, 2021 to

August 1, 2021 (3 months prior to implementation of the updated protocol) and August 2,

2021 to November 2, 2021 (3 months after implementation of the updated protocol). At

the conclusion of the predetermined timeframe, data was requested from the CNM and

WHNP who have access to the data and analysis was performed by the primary

investigator (PI) using descriptive statistics.

  The Centers for Disease Control and Prevention's (CDC) framework for program

evaluation was used as evaluative measures for this project. The CDC's six steps of

evaluating a program include engaging stakeholders, describing the program, focusing

evaluation design, gathering credible evidence, justifying conclusions, and ensuring use

and sharing lessons (CDC, 2017). The four groups of evaluation standards are utility,

feasibility, propriety, and accuracy.

Data Collection/Analysis

A retrospective chart review was conducted to gather data on the number of times

patients required treatment for a hypertensive event (systolic blood pressure greater than

or equal to 160 mm Hg, diastolic blood pressure greater than or equal to 110 mm Hg, or

both that was persistent for 15 minutes or more) and whether the nurse followed the

updated protocol steps: number of times patients were treated with an antihypertensive

medication and number of times repeat blood pressures were taken within the appropriate

timeframe according to the updated protocol, from May 2, 2021 through November 2,

2021. Data was also collected on whether the patient received magnesium sulfate.

Data was collected by the CNM and NP and given to the PI in an Excel

spreadsheet. Data was de-identified by covering patient names and medical record

numbers with a black box in Excel. The data was stored within the CNM's and NP's

hospital-owned laptop with a protected password and only shared with the PI after

January 2022.

Aligning with the AIM data reporting measures for the treatment of severe

hypertension, numerators and denominators were used to help report compliance with the

updated maternal severe hypertension recognition and response protocol. The numerator

is represented by the number "1" if the patient was treated with an antihypertensive

medication. The numerator is represented by the number "0" if the patient was not treated

with an antihypertensive medication. The denominator is represented by the number "1"

if the patient should have been treated with an antihypertensive medication per the

updated protocol.

To gain a better understanding of the effectiveness of the updated protocol,

descriptive statistics was conducted using Statistical Package for the Social Sciences

(SPSS). Since descriptive statistics showed some relationships between variables, an

independent samples T test was also performed.

Results

The sample size was 155 ($n = 155$). The sample included 100% female

participants ($n = 155$) and 100% of the women were 18 years of age or older ($n = 155$).

See Table 1. An independent samples t-test found that the average number of blood

pressure readings to normalize per patient did not decrease from before the program

change ($M = 4.78$, SD $= 8.21$) to after the program change ($M = 4.44$, SD $= 4.31$), $t(153)$

$= 0.335$, $p = 0.738$. See Table 2.

A chi square test of independence was performed to examine the relation between

program change and whether the time to treatment goal was met. The relationship was

significant, x^2 (1, $N = 155$) $= 8.8$, $p = 0.003$. See Table 3. Before the program change, the

time to treatment goal was met 54.9% of the time ($n = 123$). After the program change,

the time to treatment goal was met 67.7% of the time ($n = 197$). In alignment with the

AIM data reporting measures for the treatment of severe hypertension, the time to

treatment goal was met 123 out of 224 opportunities before the program change and the

time to treatment goal was met 197 out of 291 opportunities after the program change.

See Table 4 and Figure 1.

A chi square test of independence was also performed to examine the relationship between program change and the number of times the repeat blood pressure goal was met and between program change and magnesium utilization. Neither variable was significant. See Table 3.

Discussion

The aim of this project was to determine whether the updated protocol would reduce the percentage of severe maternal hypertensive events not treated within 30-60 minutes in a women and infant's department by 3% over a 3-month period. This project was able to reduce the percentage of severe maternal hypertensive events not treated within 30-60 minutes on this unit by 12.8% over a 3-month period. Findings are congruent with current research recommending the implementation of a maternal severe hypertension recognition and response protocol algorithm according to ACOG guidelines, to reduce the percentage of severe maternal hypertensive events not treated within 30-60 minutes (Martin et al., 2021; O'Brien et al., 2018; Shields et al., 2017).

A primary outcome measure of this project was the percentage of severe maternal hypertensive events treated within 30-60 minutes. The relationship between the percentage of severe maternal hypertensive events treated within 30-60 minutes and program change was found to be significant ($p = 0.003$), with 54.9% treated before the program change and 67.7% treated after the program change.

This success may be contributed to educating nurses on the updated protocol, educating on the importance of treating severe maternal hypertension, and being transparent with the nurses' compliance of treating severe maternal hypertension. Education occurred during morning huddles, staff meetings, and with an online

educational course required for nurses on the unit. Further, these findings may be significant since the protocol update involved initial notification of the house provider who would then update the primary provider which facilitated timely treatment. It is recommended that this continues in future practice. A recommendation for future study is to evaluate whether there is a superior teaching method and what education is most important to focus on.

The other primary outcome of this project was the percentage of severe maternal hypertensive events followed by repeat blood pressure measurements per an updated protocol. The relationship between the percentage of severe maternal hypertensive events followed by repeat blood pressure measurements per the updated protocol and program change was not statistically significant, with 49.8% of repeat blood pressure goals met before the program change and 55.1% of repeat blood pressure goals met after the program change ($p = 0.16$). Other data that was analyzed and shown to not have a significant relationship between program change were the number of blood pressure readings required to normalize per patient and whether magnesium was administered when indicated. The average number of blood pressure readings required to normalize a patient's blood pressure was 4.78 before the program change and 4.44 after the program change ($p = 0.738$). Magnesium was administered 41.5% of the time before the program change and 41.3% of the time after the program change ($p = 0.972$).

A limitation to this project included nurses' resistance and hesitation to the updated protocol. Experienced nurses may have felt more apprehensive to follow the updated protocol since they have been treating severe maternal hypertension for so long with the old protocol. Some nurses disagreed with the updated protocol and thought the

number of times repeat blood pressure readings should be taken was too frequent. The

most important recommendation for future DMAIC models is to educate staff, including

the providers and nurses treating and caring for this population, on the updated protocol.

Both nurses and providers should be educated on ACOG's current guidelines on

treatment with antihypertensive medications, magnesium utilization, and on the unit's

updated protocol. Before another implementation of a DMAIC model, consideration

should be made for nurses and providers to be tested on their understanding of the subject

to ensure competency before the program change takes place.

Conclusion

Prior to implementing an updated severe maternal hypertensive protocol, the

women and infant's department utilized a protocol not completely congruent with ACOG

recommendations, continued education on severe maternal hypertension was very

limited, and the protocol was not clear on who the nurse should notify of a patient's

severe hypertensive event. By implementing the updated protocol, providing more

education, and clearly stating that the house provider should be notified first, the

percentage of severe maternal hypertensive events not treated within 30-60 minutes on

this unit was reduced by 12.8% over a 3-month period. This women and infant's

department is planning on continuing to utilize the updated protocol, however ACOG

guidelines should be routinely assessed for any changes. Future study should focus on the

importance of educating staff on the updated protocol, educating on the importance of

recognizing and treating severe maternal hypertension, and continuing to update staff on

how well they are complying with the protocol algorithm to maintain and sustain change.

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Appendix

Table 1

Demographic Characteristics of Participants (*n* = 155)

Characteristics	*n*	*%*
Gender		
Female	155	100%
Male	0	0%
Age		
>/= 18 years	155	100%
<18 years	0	0%

Table 2

Mean and Standard Deviation of the Number of Blood Pressure Readings to Normalize

per Patient

Variable	Before Program Change	After Program Change	*p*
BP Readings	4.78 (8.207)	4.44 (4.314)	.738

Note. Standard deviation is presented in parenthesis. BP Readings = Number of Blood

Pressure Readings to Normalize per Patient. Output obtained using *IBM SPSS Statistics*

for Windows, version 27.0

Table 3

Frequencies and Chi-Square Results of Study Variables (N = 155)

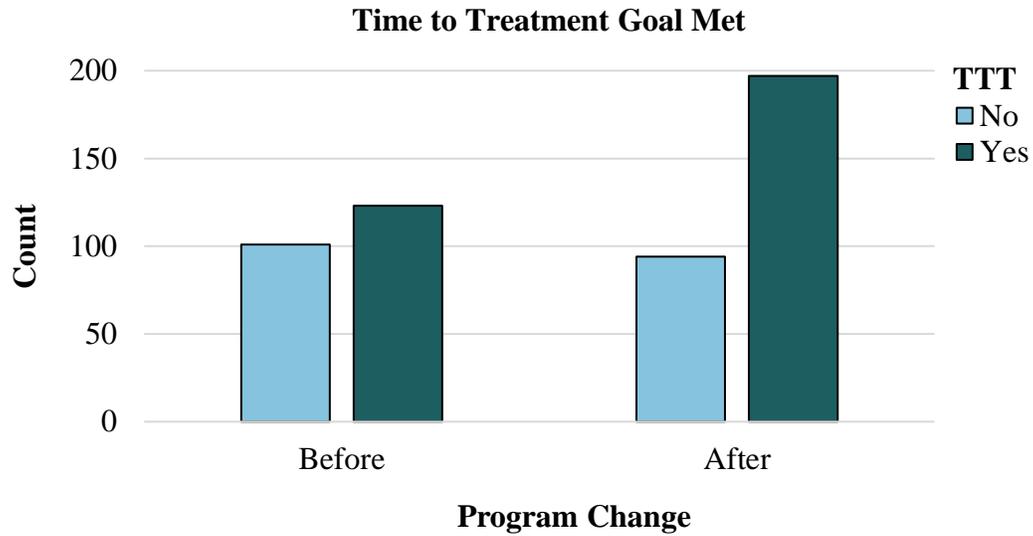| Variable	Before Program Change		After Program Change		χ^2
	n	%	*n*	%	
TTT	123	54.9	197	67.7	8.796*
Repeat BP	155	49.8	220	55.1	1.969
Mag	27	41.5	33	41.3	.001

Note. TTT = Time to Treatment Goal Met; Repeat BP = Repeat Blood Pressure Goal

Met; Mag = Magnesium utilized. Output obtained using *IBM SPSS Statistics for*

Windows, version 27.0

*p < .05

Table 4

Numerators and Denominators of Time to Treatment Goal Met

Program Change	Before	After
Numerator	123	197
Denominator	224	291
Percentage	54.9	67.7

Note. Numerators represent the number of patients treated with an antihypertensive

medication. Denominators represent the number of patients who should be treated with

an antihypertensive medication per the updated protocol. Time to Treatment Goal is met

if persistent severe range blood pressure is treated within 60 minutes. Output obtained

using *IBM SPSS Statistics for Windows, version 27.0*