Hypertension Alert Tool: To Reduce Patient Presurgical Treatment Times

Taylar N. DeRosa

Under Supervision of

Tracey Willson

A DNP Project Manuscript
Submitted in Partial Fulfillment of the Requirements for the
Doctor of Nursing Practice Degree

School of Nursing, University of Maryland at Baltimore
May 2025

Author Note

Taylar N. DeRosa https://orcid.org/ 0009-0007-4226-2032

There have been no changes in author affiliation

We have no known conflict of interest to disclose.

Correspondence concerning this article should be addressed to Tracey Willson, Dept. of Nursing, 620 W Lexington St, Baltimore, MD 21201

Abstract

Problem: In Maryland, hypertension diagnoses rose from 24.5% in 2001 to 34.5% in 2021. Preoperative hypertension is often under-recognized, leading to surgical delays or cancellations, greater workflow demands, and financial losses from unused OR time. A community hospital affiliated with a large academic health system has seen more patients presenting with preoperative essential hypertension on surgery day. **Purpose:** This QIP aims to reduce delays in reporting hypertensive blood pressures and improve provider awareness in the preoperative unit. **Methods:** Experts in the field developed the Hypertension Alert Tool (HAT) to enhance hypertension recognition and response times. Printed on bright red paper, the HAT is completed by preoperative nurses and attached to the anesthesia consent form. It highlights blood pressure readings and includes treatment guidelines from the AHA and ASA. Nurses document initial and rechecked pressures and any day-of-surgery antihypertensive use. Literature supports that checklists, accessible resources, and chart alerts improve provider awareness and treatment times. Implementation involved 12 anesthesia providers and 30 nurses. HAT data is collected via nursing surveys. The tool is used for patients with systolic BP ≥170 mmHg or diastolic ≥100 mmHg. Nurses complete and document HAT use through a QR code survey; they also complete a survey if a qualifying patient does not receive a HAT. Anesthesia providers use HAT as a chart alert. Audits assess completion and proper use. **Results:** Results indicated that while the appropriate tool utilization for the qualifying population had varied, there was progress in HAT implementation, with positive trends observed in the latter weeks aside from week 8. **Conclusions:** Continued education and reinforcement, alongside further data collection, will be crucial to solidifying the tool's reliability and ensuring that it becomes an effective and sustainable intervention.

Keywords: Alert tool, Hypertension, Case delays, Guidelines

Hypertension Alert Tool: To Reduce Patient Presurgical Treatment Times

Problem Description

Surgical patients with known diagnosis of essential hypertension are presenting to the pre-operative area on the day of surgery with hypertensive blood pressures greater than 170 mm hg systolic or 100mmHG diastolic. Patients demonstrating this degree of hypertension risk increased intraoperative blood pressure lability and an increase in adverse outcomes if not recognized and treated (Gill, 2022). There can often be a delay in the recognition of preoperative hypertension, cascading into delays or cancellations of surgical cases. This issue creates an additional workflow for staff, patient, and caregiver burdens and a loss in finances due to unused operating room time. At the implementation site there were 5 collectively cancelled and delayed cases from the quarter of July 2023 to October 2023. A root cause analysis was conducted to determine potential causes in the case cancellations and delays, resulting in factors such as patient health conditions, delays in communication, absence of alert technologies, and provider knowledge variation (see Appendix A). From this, communication delays and alert technologies were identified as intervenable factors.

Available Knowledge and Specific Aims

The purpose of this quality improvement project is to reduce the delay of reporting hypertensive blood pressures among surgical patients to anesthesia providers in the preoperative setting by implementing a hypertension alert tool with guideline recommendations on treatment and ensuring it is correct utilization by the preoperative nursing staff. This was achieved by implementing the Hypertension Alert Tool (HAT), developed by experts in this field based on evidence-based practice guidelines. The HAT tool serves as a checklist along with the

recommended guidelines, which literature proves will help increase provider alertness and decrease patient treatment times (Mastrianni, 2021).

A literature review was conducted via the PubMed Database to determine applicable studies regarding the practice problem and intervention. Seven relevant articles were produced using search terms “preoperative hypertension” and “anesthesia management.” Three additional articles were obtained through the NIH database utilizing the search terms “chart alerts” and “provider awareness”. Obtained studies were mostly level II, and a quality grade of A/B on the Johns Hopkins Evidence Based Practice Model grading scale (Appendix F). Zhou, 2021 and Venkatesan, 2017, both identified that preoperative hypertension is related to an increase in postoperative cardiac events. Two studies concluded that the addition of a chart alert and the presence of treatment guidelines to hypertensive patients increases provider awareness and improves patient treatment (Spencer, 2021; Mastrianni, 2021). Additionally, providers interviewed after the implementation of chart alerts identified that the interactive chart alerts increased their awareness and improved their timeliness in practice (Mastrianni, 2021). A 2020 study demonstrated a significant reduction in the number of pre-operative cancellations due to hypertension alone between 2013 and 2018, attributed to the availability of hypertension treatment guidelines (Soni, 2020). Conclusively the evidence search supports the implementation of this quality improvement project.

Rationale

Preliminary data suggested that a change was needed to improve provider reporting hypertensive blood pressures in the preoperative unit. The widely used and cited PARIHS (Promoting Action on Research Implementation in Health Services) framework provided a successful process framework for the examination and facilitation of this quality improvement

project. It was chosen as the key features of this framework can be directly applied to the current and future development and implementation of the project, and it focuses heavily on the translation of knowledge into practice. (Kitson, 1998) The PARIHS framework focuses on the three main concepts of evidence, context, and facilitation (Kitson, 1998). This applied directly to the QIP as evidence discovery lead the project, and found evidence motivated the academic facilities staff to incorporate the HAT into their everyday practice.

Methods

The culture of the hosting facility was evaluated through site visits and the Organizational Culture Assessment Questionnaire (OCAQ), conducted with the unit leader involved in the project. As a branch of a large teaching hospital, the facility emphasizes core values such as discovery and excellence, and innovation, which supports improvement projects. A community-based hospital, it prioritizes excellent patient interactions to strengthen community relationships, with seamless surgical processes exemplifying excellence in care. These values support a positive attitude toward practice changes to enhance patient outcomes.

The preoperative unit is small and busy, with high patient volume in the mornings. Nursing staff typically manage two patients each, supported by techs, secretaries, and management. Staffing is generally adequate, with minimal use of temporary staff nurses, and vital sign machines readily available. Due to the dynamic workflow, direct interactions between nursing and anesthesia providers is often limited, making communication a challenge. As a result, the need for ease of communication was important in this setting. Utilizing a checklist is one such form of communication. Securing buy-in from both providers and nursing staff required highlighting the tool’s benefits.

The unit is experienced with evidence-based practice (EBP) and has committees to ensure adherence, holding quarterly meetings and providing resources. Providers also engage in the committee meetings. A unit leader completed the OCAQ survey to assess cultural strengths and challenges for implementing the HAT. Strong areas included managing change and goal achievement, while coordinated teamwork was identified as a weaker area, making it essential to involve all specialties in the HAT rollout. Emphasizing the tool's potential to enhance interdisciplinary communication supported its successful adoption.

Intervention

The initiative was implemented over a 14-week period in the Fall of 2024. In the months preceding project implementation, the QI Project Lead (QI-PL) mobilized an interdisciplinary team of invested stakeholders from the Peri-Op staff to plan the following structure and workflow change: development of the Hypertension Alert Tool (HAT) which combines the chart alert tool along with the current evidence-based guidelines for management of peri-operative hypertension. Education on the practice change was provided to approximately 14 anesthesia providers, two student anesthesia providers, 25 preop nurses, and two nurse managers. Once education is completed, the HAT was available in the Peri-operative unit at the central preoperative nursing station with a brightly colored sign. The HAT was printed on red paper by the QI-PL and the perioperative RNs will complete for all patients with severe Stage Two Hypertension, which is defined as systolic blood pressure > 160mmHG or diastolic blood pressure >90mmHG. The following data was documented regarding hypertension: patient's initial blood pressure reading, repeat blood pressure reading, and list of blood pressure medications the patient has taken within the past 24 hours. Once complete, the bright red HAT paper was attached to the anesthesia consent form to serve as the alert and reference for the

American Heart Association's and American Association of Anesthesiologists' recommendations for management of peri-operative hypertension, increasing provider awareness of the patient condition and reducing the time to treatment by providing guidelines and quick patient information necessary for treatment. Strategies to increase participation included poster advertisements distributed by the QI-PL, incentive raffles for participation, and frequent unit presence of the QI-PL, nurse champion, site representative, and supporting unit manager. Other positive impacts for implementation success included the minimal work burden of implementation, the prospective reward of improving patient outcomes, and the increase in communication that subsequently improves teamwork and inclusion for staff. Appendix M includes the plan for future sustainability.

Measures

The quality improvement project targeted three types of goals: structure, process, and outcome. The structure goal was the development and availability of the tool, the process goal consisted of correctly identifying patients and utilizing the tool with the feedback survey, and the outcome goal was the correct use of the tool and notifying the provider that the tool is complete.

The project outcome goals were evaluated over a 14- week period during the Fall 2024 semester. The project outcome goal: 100% of qualifying hypertensive patients will receive a correctly utilized HAT was the combined responsibility of nursing, the providers, the team lead, the unit lead, and the unit champion. Nursing and providers were responsible for utilizing the tool correctly, however the team lead, project lead, and unit champion were present for continuing education and offering support. Emails were sent out periodically to encourage participation. Tactics such as conducting audits throughout the implementation and providing helpful feedback were utilized until the project was concluded. After this, it was the

responsibility of the unit lead and unit champion to continue to encourage the sustainability of the HAT.

Data elements collected included: the patient's MRN number, initial blood pressure, if it was re- checked, if the HAT was utilized, and if the patient had received any preoperative instructions of blood pressure medication prior to the day of surgery. The measurements were obtained by the completion of REDCap survey titled *Nursing Survey* and were distributed via a QR code to nursing by the QI-PL (Appendix B). Additionally, the QI-PL visually audited the total number of HATs correctly filled out compared to the total number of patients that qualified for a HAT to create a numerical measurement value for appropriate use. Data was analyzed weekly by the QI-PL to assess implementation success and identify improvement areas.

To track the outcome goal of this project, several measurement variables were obtained. The initial structure goal was to develop the HAT and print copies by Week 2 and was the main responsibility of the project lead. The process goals identified by nursing included accurately determining which patients qualified for a HAT, promoting its use, and completing the survey to indicate whether the HAT was used. These goals were monitored through weekly audits conducted by the QL-PL. To help facilitate this goal, education reinforcement to ensure competency was provided, and there was small prize incentives for nursing to complete surveys such as entries to win a Starbucks gift card for post- tool use survey completed. Accountability was demonstrated by accepting feedback from nursing at this phase and improving useability where requested. At this time the project lead was also completing random chart audits to validate accuracy of data.

Analysis

Data was collected and placed into tables through REDCap software. These tables were then incorporated into excel documents and used to create a run chart and table of the compliance rates displayed as a percentage by week (Appendix K), and as the number of patients qualifying for the HAT and the number of patients receiving the HAT (Appendix L). Descriptive statistics were analyzed for the run chart, and the median was displayed as a comparison line on the chart. Weeks without data were demonstrated by dotted lines.

Ethical Considerations

The project lead has no paid employment or affiliation with the facility that will host the project. No conflicts of interest have been identified. Non-human Subject's Research determination from the Human Research Protections Office (HRPO) of the UMSOM was obtained prior to project implementation to ensure the project does not qualify as human research and the proposal is of QI nature. The project lead is compliant with all required CITI and HIPAA training. Site- specific privacy training has additionally been completed by the project lead Patient identifiers will be limited to the patients MRN number on the HAT and REDCap encrypted software survey, and HATs will be shredded after use. Patient charts were only accessed through secure, protected networks and at the facility site. The identity of all participants have been kept confidential throughout the project and into the presentation through limited collected identifiers, data encryption, and password protection.

Results

Throughout the fourteen weeks of implementation, compliance rates, which included correctly identifying which patient will receive the HAT, rechecking the patient's blood pressure, and attaching the HAT to the anesthesia consent form, fluctuated consistently. In week one, 50% compliance was recorded, but compliance improved to 100% by week six. The compliance

remained at 100% until week eight, when it fell to 0% but returned to 100% the following week with qualifying data (week ten). This could have been due to factors such including a lack of QIP team presence on the unit, implementation fatigue by nursing, and a smaller sample size than other weeks. Educational efforts and collaborative reinforcement through verbal communication and flyers contributed to increased HAT usage. Overall, the QIP resulted in a 75% compliance rate for correct HAT utilization, with 24 qualifying patients receiving a HAT chart alert.

The implementation of the HAT on the preoperative unit resulted in 34 qualifying patients presenting during the implementation period, and 25 qualifying patients receiving a correctly utilized HAT. When compared weekly, results indicated that while the appropriate tool utilization for the qualifying population (measured as compliance) had varied, there was some progress in HAT implementation, with positive trends observed in the latter weeks aside from week 8. There were no qualifying patients to receive the intervention during weeks seven, nine, and ten. (Appendix L). During these weeks, in person audits verified that there were no qualifying patients on the unit to receive the HAT. The ongoing educational interventions appeared to be effective, as evidenced by overall increased compliance in the latter weeks increased from the 50% recorded compliance during weeks one and four. Additional presence of the QI-PL through the second half of implementation had increased compliance by encouraging participation and reinforcing education. There is no data to conclude a special cause effect of increased tool utilization for qualifying patients from the increase in nursing's ability to identify appropriate patients and support from the project implementation team, as weekly data varied. Although data was not consistent, positive trends of compliance were noticed several times throughout implementation, and verbal reports of increased awareness of hypertension and it's negative consequences were reported by staff to the QIPL.

Discussion

The outcome goal: continued use of the alert tool to improve patient outcomes is tracked as a compliance rate for the HAT tool utilization. The PARIHS (Promoting Action on Research Implementation in Health Services) framework, focusing on the three main concepts of evidence, context, and facilitation, provides a successful process framework for the examination and facilitation of this quality improvement project (Kitson, 1998). The outcome data is collected by nursing completed surveys and analyzed as a run chart. Although data varies throughout the weeks, and compliance has not meet to set goal of 100%, there are still some positive trends observed and 5 weeks of 100% compliance documented.

The outcome goal: continued use of the alert tool to improve patient outcomes was created as the literature review identifies that checklist style chart alerts can increase provider awareness, reduce patient treatment times, and reduce surgical cancellations. As the literature has already proven these positive outcomes, this quality improvement project intends to implement a checklist – style chart alert into the selected setting, designed specifically for hypertensive preoperative patients, and measure success by the compliance of nursing to utilize this chart alert tool (Zhou, 2021, Venkatesan, 2017, Spencer, 2021, Mastrianni, 2021). The difference in measurement methods of this QIP, compliance with the proven intervention as opposed to patient outcomes from the proven intervention, does not allow direct comparison to the literature. Results indicate that while the appropriate tool utilization for the qualifying population (measured as compliance) has varied, there has still been significant progress in HAT implementation, with positive trends observed in the latter weeks aside from week 13. During weeks 7, 9, and 10, in person audits verify that there no qualifying patients on the unit to receive the HAT, limiting data. Although full compliance was not consistently achieved, literature

review suggests that even some tool utilization is associated with an increased recognition of patient hypertension, and enhanced notification of this risk to the providers.

Common cause variation was exemplified in the data as slight weekly fluctuations around the median of 75% aside from weeks 7-10. Special cause and effect were unable to be confirmed by the results as there were no large shifts, deviation, or fluctuations in the qualifying data. Educational interventions were effective and overcame initial barriers, evidenced by observed positive trends of increased compliance in the latter weeks from the 50% recorded compliance during week one. Trends were not consistent, and the lack of evidence from weeks 7 through 10 disrupt the trend of 100% compliance observed in weeks 5,6, and 11. By educating nurses and encouraging correct utilization, the staff was successfully able to identify qualifying patients for HAT use about 75% of the time with some weeks at 100%. Limitations included a limited implementation time of 14 weeks, self-reported data by nursing, and a limited patient sample size. Weaknesses included lack of intervention understanding in the early weeks of the tool usage, and the reliance on self-survey by the nursing staff for data collection. Surveys were collected anonymously to discourage any bias in the results. Sustainability may be limited by relying on staff members to remain accountable and print out the paper tools.

Conclusions

While the overall compliance rate of 75% with tool utilization demonstrates some progress, the fluctuating data and inability to confirm special cause effects suggest that further investigation and extended implementation periods are necessary to confirm long-term success. Despite these limitations, the positive trends observed in the latter weeks of the project, coupled with the minimal burden placed on nursing staff and the tool's ease of integration, support the potential for future implementation. Strengths of the project include the positive attitudes and

cooperation from the implementation team, and the periodic increases in the nurses' ability to correctly identify qualifying patients to receive the alert tool. Continued education and reinforcement, alongside further data collection, will be crucial to solidifying the tool's reliability and ensuring that it becomes an effective and sustainable intervention for surgical patients presenting with hypertension.

References

Balcı, E., Demir, Z. A., & Bahçecitapar, M. (2022). Management of renin-angiotensin-aldosterone inhibitors and other antihypertensives and their clinical effects on pre-anesthesia blood pressure. *Anesthesia and Pain Medicine*, *17*(1), 112–119. https://doi.org/10.17085/apm.21050

Burns, A. (n.d.). *Libguides: Cabarrus college of health sciences library: iowa model*. Retrieved March 11, 2024, from https://cabarruscollege.libguides.com/c.php?g=465666&p=5283295

Explore high blood pressure in maryland | ahr. (2024). America's Health Rankings. https://www.americashealthrankings.org/explore/measures/Hypertension/MD

Foëx, P., & Sear, J. W. (2021). Implications for perioperative practice of changes in guidelines on the management of hypertension: Challenges and opportunities. *British Journal of Anaesthesia*, *127*(3), 335–340. https://doi.org/10.1016/j.bja.2021.05.006

Gill, R., & Goldstein, S. (2024). Evaluation and management of perioperative hypertension. In *StatPearls*. StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK557830/

Hollmann, C., Fernandes, N. L., & Biccard, B. M. (2018). A systematic review of outcomes associated with withholding or continuing angiotensin-converting enzyme inhibitors and angiotensin receptor blockers before noncardiac surgery. *Anesthesia & Analgesia*, *127*(3), 678. https://doi.org/10.1213/ANE.0000000000002837

Kitson, A., Harvey, G., & McCormack, B. (1998). Enabling the implementation of evidence based practice: A conceptual framework. *BMJ Quality & Safety*, *7*(3), 149–158. https://doi.org/10.1136/qshc.7.3.149

Misra, S., Parida, S., Sahajanandan, R., Behera, B. K., Senthilnathan, M., Mariappan, R., & Chandy, T. T. (2022). The effect of continuing versus withholding angiotensin-converting enzyme inhibitors/angiotensin II receptor blockers on mortality and major adverse cardiovascular events in hypertensive patients undergoing elective non-cardiac surgery: Study protocol for a multi-centric open-label randomised controlled trial. *Trials*, *23*, 670. https://doi.org/10.1186/s13063-022-06616-y

Mohseni, S., Behnam-Roudsari, S., Tarbiat, M., Shaker, P., Shivaie, S., & Shafiee, M. A. (2022). Perioperative hypertension etiologies in patients undergoing noncardiac surgery in university health network hospitals–canada from 2015–2020. *Integrated Blood Pressure Control*, *15*, 23–32. https://doi.org/10.2147/IBPC.S347395

Ott, M. N. (n.d.). *Libguides: Nursing-johns hopkins evidence-based practice model: levels i, ii and iii*. Retrieved November 9, 2023, from https://bradley.libguides.com/jhebp/123

Roshanov, P. S., Rochwerg, B., Patel, A., Salehian, O., Duceppe, E., Belley-Côté, E. P., Guyatt, G. H., Sessler, D. I., Le Manach, Y., Borges, F. K., Tandon, V., Worster, A., Thompson, A., Koshy, M., Devereaux, B., Spencer, F. A., Sanders, R. D., Sloan, E. N., Morley, E. E., … Devereaux, P. J. (2017). Withholding *versus* continuing angiotensin-converting enzyme inhibitors or angiotensin ii receptor blockers before noncardiac surgery. *Anesthesiology*, *126*(1), 16–27. https://doi.org/10.1097/ALN.0000000000001404

Soni, S., Shah, S., Chaggar, R., Saini, R., James, E., Elliot, J., Stephens, J., McCormack, T., & Hartle, A. (2020). Surgical cancellation rates due to peri-operative hypertension: Implementation of multidisciplinary guidelines across primary and secondary care. *Anaesthesia*, *75*(10), 1314–1320. https://doi.org/10.1111/anae.15084

Spencer, N. M., Gabra, M., Bedell, S. M., Scott, D. M., & Rauk, P. (2021). Improving compliance with guidelines for hypertensive disorders of pregnancy through an electronic health record alert: A retrospective chart review. *Pregnancy Hypertension*, *25*, 1–6. https://doi.org/10.1016/j.preghy.2021.04.001

Tait, A., & Howell, S. J. (2021). Preoperative hypertension: Perioperative implications and management. *BJA Education*, *21*(11), 426–432. https://doi.org/10.1016/j.bjae.2021.07.002

Venkatesan, S., Myles, P. R., Manning, H. J., Mozid, A. M., Andersson, C., Jørgensen, M. E., Hardman, J. G., Moonesinghe, S. R., Foex, P., Mythen, M., Grocott, M. P. W., & Sanders, R. D. (2017). Cohort study of preoperative blood pressure and risk of 30-day mortality after elective non-cardiac surgery. *British Journal of Anaesthesia*, *119*(1), 65–77. https://doi.org/10.1093/bja/aex056

Zhou, Y., Liu, L., Fan, F., & Hong-Yun, Y. (2021). Relation between elevated first SBP from baseline (Delta sbp) and postoperative outcome. *Journal of Hypertension*, *39*(10), 1982–1990. https://doi.org/10.1097/HJH.0000000000002872

Table 1

Evidence Review Table

Citation #1 (hyperlink): Balcı, E., Demir, Z. A., & Bahçecitapar, M. (2022). Management of renin-angiotensin-aldosterone inhibitors and other antihypertensives and their clinical effects on pre-anesthesia blood pressure. *Anesthesia and Pain Medicine*, *17*(1), 112–119. https://doi.org/10.17085/apm.2105 Level: II					
Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**
The study aims to determine the effects of antihypertensive drug treatment strategies on preanesthetic operating room blood pressure measurements.	Cross-sectional, observational study	717 adult patients are included with various comorbidities. 383 patients who were normotensive based on baseline measurements and not under antihypertensive therapy were excluded from the analysis. Setting is in a tertiary hospital in Ankara, Turkey. Patients with SBP ≥ 140 and/or DBP ≥ 90 mmHg at basal measurements and/or patients receiving antihypertensive therapy were included in the study. These patients were divided into six groups according to	334 patients were divided into six groups according to the antihypertensive drug treatment. These six groups were examined in terms of preoperative baseline and pre-anesthesia blood pressure measurements. Patients took non-RAASI antihypertensive drugs until the morning of the operation, and patients using RAASI discontinued using RAASI 10–12 h before the operation. During the preoperative preparation, which is usually performed 2 weeks to 1 month before surgery at the hospital's outpatient clinics; SBP, DBP, and heart rate (HR) were taken as basal measurements. Blood pressure was measured using automatic blood pressure measurement machines.	When the whole study population was evaluated in general, pre-anesthetic blood pressure measurements were SBP 163.58 ± 24.43 mmHg, DBP 88.10 ± 12.41 mmHg, and mean blood pressure (MBP) 113.25 ± 14.63 mmHg. Pre-anesthesia SBP, DBP, MBP, and HR measurements were significantly higher than preoperative measurements in all groups (P < 0.001); however, DBP was not significantly different in group D. There was a significant	There was a significant difference in terms of pre-anesthesia SBP, DBP, MBP, and HR measurements between the groups (P = 0.046, 0.006, 0.004, and 0.023, respectively). In group none and group RAASI, pre-anesthesia measurements of SBP, DBP, and MBP were significantly higher than those in group BB (P = 0.006, 0.004, and 0.023, respectively). Group BB had the lowest pre-anesthesia SBP, DBP, and MBP. 24% of patients had high blood pressure precluding

		antihypertensive drug treatments: group none, group RAAS inhibitors (RAASI), group beta blockers (BB), group calcium channel blockers (CCB), group diuretics (D), and group combined (Co)	In the operating room, measurements were taken before induction. Patients with baseline hypertension or on antihypertensive therapy were included in the study and categorized into six groups based on their antihypertensive medication. Each measurement was three readings, and the highest values were recorded. Elective surgeries were postponed if pre-anesthesia blood pressure was too high according to guidelines.	difference in preoperative SBP, DBP, MBP, and HR measurements between the groups ($P < 0.001$, $P < 0.001$, $P = 0.001$, and $P = 0.032$, respectively). In group none, the preoperative measurements of SBP and DBP were significantly higher than those in the RAASI, BB, CCB, and Co groups, and the preoperative measurements of MBP were significantly higher than all other groups.	surgery, and patients using renin-angiotensin-aldosterone system inhibitors (RAASI) had higher pre-anesthesia systolic blood pressure than patients using other antihypertensive drugs. Patients who received beta-blockers were also observed to have the lowest pre-anesthesia systolic blood pressure, diastolic blood pressure, and mean blood pressure, compared to others. Conclusion: RAASI cannot provide optimal pre-anesthesia blood pressure and lead to an increase in the number of postponed surgeries, probably due to withdrawal of medication before the operation. Therefore, the preoperative discontinuation of RAASI should be

					reevaluated in future studies.

Citation #2 (hyperlink) Mohseni, S., Behnam-Roudsari, S., Tarbiat, M., Shaker, P., Shivaie, S., & Shafiee, M. A. (2022). Perioperative hypertension etiologies in patients undergoing noncardiac surgery in university health network hospitals–canada from 2015–2020. *Integrated Blood Pressure Control*, *15*, 23–32. https://doi.org/10.2147/IBPC.S347395
Level: II

Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**

The aim of the study was to explore common etiologies of hypertension during the perioperative period (pre, intra, and post-operation) in patients who underwent noncardiac surgeries in University Health Network (UHN) hospitals, Canada, from 2015 to 2020	Multi-center retrospective study	174 patients undergoing noncardiac surgeries who experienced perioperative hypertension in UHN hospitals, Canada, from 2015- 2020 All patients undergoing noncardiac surgery from 2015 to 2020 at UHN hospitals who experienced perioperative hypertension (pre, intra, post-operative hypertension) were included Pregnant women, pediatrics, patients who underwent radiological imaging with contrast before surgery, patients with incomplete data, and patients with a documented diagnosis of secondary hypertension before surgery were excluded from the study.	A chart review was conducted on patients who experienced hypertension in any of the perioperative phases (pre-, intra-, post-operative) were chosen according to the below criteria: Preoperative hypertension: Systolic Blood Pressure (SBP)≥ 130 OR Diastolic Blood Pressure (DBP) ≥80 Intraoperative hypertension: Low baseline BP (SBP, <90 mm Hg, or DBP, <50 mm Hg): >20% increase from the baseline Normal baseline BP (SBP, 90–129 mm Hg, and DBP, 50–79 mm Hg): >10% increase from the baseline OR BP>130/80 High baseline BP (SBP, ≥130 mm Hg, or DBP, ≥80 mm Hg): > 10% increase from the baseline OR SBP>160 Postoperative hypertension: the first 4 hours: >10% increase from the baseline BP 4–48 hours after surgery: SBP≥130, DBP≥8010 After selecting the patients and comprehensively reviewing their medical records, the causes of perioperative hypertension was evaluated by	The etiologies of perioperative hypertension in order of prevalence were poorly controlled hypertension (21.8%), excessive fluid therapy (19.5%), excessive vasopressor (18.4%), and medication withdrawal (13.7%). Regarding each period, the most common reasons were poorly controlled hypertension for pre (42.9%) and intraoperative period (22.7%) and fluid overload for the postoperative period (20.1%). A repeated-measures ANOVA with a Greenhouse-Geisser correction determined that systolic blood pressure was statistically significant between time points (F (1.9, 322.86) = 51.71, p < 0.001). Post	Poorly controlled hypertension is the most significant reason for perioperative hypertension in patients undergoing noncardiac surgeries. Apart from poorly controlled hypertension, as the main patient-related factor, in nearly half of patients, iatrogenic perioperative hypertension emerges because of excessive vasopressor or fluid replacement and poor management of chronic medication.

			classifying them into ten reasons. Intraoperative data included in the analysis were the type of surgery, type of anesthesia, blood transfusion, positive fluid balance, use of antihypertensive drugs, use of vasopressors, and the type of antihypertensive medication in the intraoperative phase. The data relating to the postoperative phase were intensive care unit (ICU) admission, LOS in ICU, LOS after surgery, and in-hospital mortality.	hoc tests using the Bonferroni correction revealed that systolic blood pressure increased from pre-operation (Mean = 151.11, sd = ±22.81) to Intra-operation (Mean= 178.05, sd = ±29.55) and then decreased in post-operation (Mean = 167.41, sd = ±21.27). The change in systolic blood pressure was not statistically between patients diagnosed with volume overload compared to those without volume overload.	

Citation #3 (hyperlink) Venkatesan, S., Myles, P. R., Manning, H. J., Mozid, A. M., Andersson, C., Jørgensen, M. E., Hardman, J. G., Moonesinghe, S. R., Foex, P., Mythen, M., Grocott, M. P. W., & Sanders, R. D. (2017). Cohort study of preoperative blood pressure and risk of 30-day mortality after elective non-cardiac surgery. *British Journal of Anaesthesia, 119*(1), 65–77. https://doi.org/10.1093/bja/aex056 Level: II					
Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**

To determine the relationship between preoperative BP and 30-day mortality after elective non-cardiac surgery	Cohort Study	A total of 251,567 adults were included from primary care data from the UK Clinical Practice Research Datalink (2004–13)	Statistical "cut-offs" were identified where the odds of mortality increased relative to reference values using restricted cubic splines analysis of BP as a continuous measure. Sensitivity analyses were conducted based on the timing of BP measurement to mitigate confounding factors. SBP and DBP were modeled separately as continuous variables using unadjusted and adjusted restricted cubic spline regression analyses. Logistic regression models were constructed, adjusting for covariates associated with postoperative mortality. Reference values were chosen based on population modes. Model fit was assessed using the Hosemer-Lemeshow test. Thresholds for risk were determined when 95% confidence intervals did not overlap with 1. Interaction tests were performed to assess the relationship between BP and patient age and heart failure. Subgroup analysis was conducted based on age groups. Analysis was carried out using Stata software.	A total of 251 567 adults were included, with 589 (0.23%) deaths within 30 days of surgery. After adjustment for all risk factors, preoperative low BP was consistently associated with statistically significant increases in the odds ratio (OR) of postoperative mortality. Statistically significant risk thresholds started at a preoperative systolic pressure of 119 mm Hg (adjusted OR 1.02 [95% confidence interval (CI) 1.01–1.02]) compared with the reference (120 mm Hg) and diastolic pressure of 63 mm Hg [OR 1.24 (95% CI 1.03–1.49)] compared with the reference (80 mm Hg). As BP decreased, the OR of mortality risk increased.	The study identified a significant dose-dependent association between low preoperative BP values and increased postoperative mortality in the elderly. In the whole population, elevated diastolic, not systolic, BP was associated with increased mortality.

				Subgroup analysis demonstrated that the risk associated with low BP was confined to the elderly. Adjusted analyses identified that diastolic hypertension was associated with increased postoperative mortality in the whole cohort	

Citation #4 (hyperlink) Soni, S., Shah, S., Chaggar, R., Saini, R., James, E., Elliot, J., Stephens, J., McCormack, T., & Hartle, A. (2020). Surgical cancellation rates due to peri-operative hypertension: Implementation of multidisciplinary guidelines across primary and secondary care. *Anaesthesia*, *75*(10), 1314–1320. https://doi.org/10.1111/anae.15084
Level: III

Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**

The aim was to quantify the number of operations cancelled due to hypertension alone and to assess impact of the guidelines on cancellation rates.	. Non-Experimental Study	Two large prospective, multicenter service evaluations were performed, assessing clinical practice over a 1 month period during October 2013 and then again in November 2018. They evaluated all patients undergoing elective surgery across six hospital trusts within north-west London Patients aged 18 years and over were eligible for inclusion. Patients undergoing emergency, cardiac, renal, endocrine, vascular, neurosurgical and obstetric surgery were not included as their underlying pathology may contribute directly to the management of their hypertension. N=7673	The initial survey was undertaken during the entire month of October 2013. In keeping with local policy, patients were either pre-assessed in a pre-operative assessment clinic or assessed for theatre on the day of surgery by their anesthetist. Anonymized data were collected for patients whose procedures were cancelled or postponed due to hypertension alone including age, the type of operation and surgical specialty. Initial blood pressure and repeated measurements were recorded. They also collected information about whether any further action was taken (e.g. whether the patient's procedure was cancelled or postponed , whether the patient was referred back to their GP or to an inpatient specialty and whether the patient received any antihypertensive treatment). This process was repeated in November 2018 and compared	All six hospital Trusts collected patient data and more than 7000 patients were screened in each of the two service evaluations. During October 2013, a total of 105 (1.37% (95%CI 0.69–2.11%)) patients had their procedure cancelled due to hypertension alone whereas during November 2018, 38 patients (0.54% (95%CI 0.20–0.92%)) had their procedures cancelled ($p < 0.001$). There was also a reduction in patients referred back to primary care for hypertension management, suggesting improved hypertension management in the primary care setting. These findings indicate that guideline implementation has positively impacted clinical practice	It demonstrated a significant reduction in the number of pre-operative cancellations due to hypertension alone between 2013 and 2018, which is likely attributable to the publication of the Association/BHS guidelines in 2016. The guidelines set out to reduce the number of cancellations of elective surgery due to hypertension alone, improve detection of significant hypertension before elective surgery and reduce the number of patients referred back to primary care for the management of hypertension. The aim of the study was supported.

				and reduced the burden of cancellations on patients and healthcare services.	

Citation #5 (hyperlink) Roshanov, P. S., Rochwerg, B., Patel, A., Salehian, O., Duceppe, E., Belley-Côté, E. P., Guyatt, G. H., Sessler, D. I., Le Manach, Y., Borges, F. K., Tandon, V., Worster, A., Thompson, A., Koshy, M., Devereaux, B., Spencer, F. A., Sanders, R. D., Sloan, E. N., Morley, E. E., … Devereaux, P. J. (2017). Withholding *versus* continuing angiotensin-converting enzyme inhibitors or angiotensin ii receptor blockers before noncardiac surgery. *Anesthesiology*, *126*(1), 16–27. https://doi.org/10.1097/ALN.0000000000001404 Level: II

Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**

To better understand the effect on cardiovascular outcomes of withholding angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers in chronic users before noncardiac surgery	International cohort study	14,687 patients (including 4,802 angiotensin-converting enzyme inhibitor/angiotensin II receptor blocker users) at least 45 yr old who had in-patient noncardiac surgery from 2007 to 2011	Among patients who used ACEI/ARBs within 7 days before surgery (baseline users), outcomes were compared between those who continued taking ACEI/ARBs within 24 hours before surgery and those who did not. Multivariable modified Poisson regression was used to adjust for potential confounders, including patient characteristics, preoperative use of medications, continuation or withholding of medications on the day of surgery, and type/timing of surgery. Center effects were also considered. Continuous variables were modeled using restricted cubic spline functions. The study did not assess the effects of withholding ACEI/ARBs or other medications after surgery due to limitations in data capturing postoperative medication timing. They also investigated whether the effect of withholding or continuing ACEI/ARBs on the primary outcome differed across various levels of preoperative systolic blood pressure (sBP).	Among all antihypertensive medication users, 1,794 (26.2%) had at least one of these medications withheld on the day of surgery. Typically, only one antihypertensive agent was withheld (79.3% of patients), even in patients taking multiple agents at baseline. Patients with lower preoperative blood pressure were more likely to have their medications withheld on the day of surgery. Patients in whom ACEI/ARBs were withheld (n = 1,245; 25.9%) were largely similar to those in whom ACEI/ARBs were continued but were less likely to have very high preoperative blood pressure, less likely to undergo major urogenital	This international prospective cohort study suggests that withholding ACEI/ARBs on the day of a noncardiac surgery may reduce the risk of perioperative death, stroke, or myocardial injury in patients who take these medications chronically. A large randomized trial is needed to confirm this finding. In the interim, clinicians should consider recommending that patients withhold ACEI/ARBs 24 h before surgery

				surgery, and more likely to undergo major general and urgent or emergency surgery. Withholding ACEI/ARBs on the day of surgery was associated with an 18% reduction in the relative risk of the composite outcome of death, stroke, or MINS (adjusted relative risk [aRR], 0.82; 95% CI, 0.70 to 0.96; *P* = 0.01) with the results qualitatively consistent across the component outcomes.	
Citation #6 (hyperlink) Hollmann, C., Fernandes, N. L., & Biccard, B. M. (2018). A systematic review of outcomes associated with withholding or continuing angiotensin-converting enzyme inhibitors and angiotensin receptor blockers before noncardiac surgery. *Anesthesia & Analgesia*, *127*(3), 678. https://doi.org/10.1213/ANE.0000000000002837 Level:II					
Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**

The aim of this meta-analysis was to determine whether continuation or withholding ACE-I or ARB therapy in the perioperative period is associated with mortality and major morbidity.	Meta-Analysis Review included the following study designs: randomized controlled trials (RCTs) or observational studies in which patients in both treatment arms were on chronic ACE-I/ARB therapy before surgery. Case reports and case–control studies were excluded	25 studies were retrieved, of which 9 fulfilled the inclusion criteria: 5 were randomized control trials, and 4 were cohort studies. These studies included a total of 6022 patients on chronic ACE-I/ARB therapy before noncardiac surgery.	A meta-analysis was conducted using Review Manager Version 5.3 (The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark, 2014). A comprehensive search of MEDLINE (PubMed), CINAHL (EBSCO host), ProQuest, Cochrane database, Scopus, and Web of Science was conducted on December 6, 2016. We included adult patients >18 years of age on chronic ACE-I or ARB therapy who underwent noncardiac surgery in which ACE-I or ARB was either withheld or continued on the morning of surgery. Primary outcomes included all-cause mortality and major cardiac events (MACE). Secondary outcomes included the risk of congestive heart failure, acute kidney injury, stroke, intraoperative/postoperative hypotension, and the length of hospital stay .	The main findings in this meta-analysis are that there is no difference in mortality, MACE, CHF, AKI, or CVA between patients withholding or continuing chronic ACE-I/ARB therapy before surgery in the published literature. However, the total sample size remains small and is underpowered for all these outcomes. Concerning intraoperative hypotension, this meta-analysis demonstrated that continuing ACE-I/ARBs on the morning of surgery is associated with approximately 30% relative risk increase in hypotension (and an absolute risk increase of 6.5%, from 23.4% to 29.9%), but not postoperative hypotension. No difference in LOS was demonstrated between the groups Pooled	It confirms previous observations that continuation of ACE-I/ARBs is associated with intraoperative hypotension; however, it was unable to demonstrate an association between perioperative ACE-I/ARB administration and mortality or MACE. Furthermore, it remains unclear whether this intraoperative hypotension is associated with major postoperative patient morbidity and whether perioperative ACE-I/ARB therapy is associated with major morbidity, independent of any associated hypotension. Finally, the influence of pharmacogenomics on outcomes associated with perioperative ACE-I/ARB remains unanswered. A large

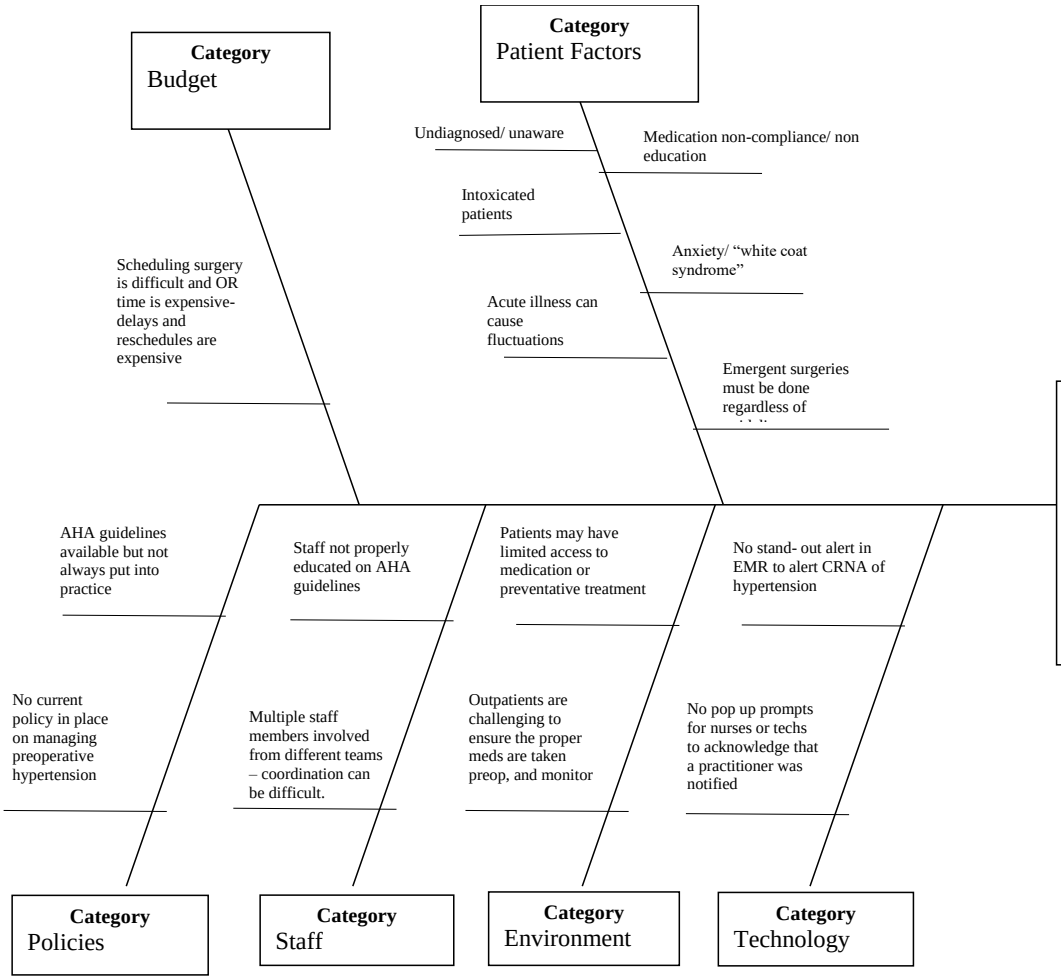
				dichotomous outcomes were reported as odds ratios (ORs) and 95% confidence intervals (CIs). Heterogeneity between studies was assessed using the I^2 statistic, which describes the percentage of variation across studies that is due to heterogeneity and not chance. We considered an I^2 test of >25% to represent significant heterogeneity. 2 sensitivity analyses were conducted: a sensitivity analysis of RCTs only for the outcomes of mortality, MACE, and intraoperative and postoperative hypotension; and a second sensitivity analysis of studies assessing major noncardiac surgery alone	randomized trial is needed to address these questions.
Citation #7 (hyperlink) Zhou, Y., Liu, L., Fan, F., & Hong-Yun, Y. (2021). Relation between elevated first SBP from baseline (Delta sbp) and postoperative outcome. *Journal of Hypertension*, *39*(10), 1982–1990. https://doi.org/10.1097/HJH.0000000000002872 Level: II					

Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
The hypothesis is that there is a possible threshold of delta SBP over which the risk of postoperative cardiac complications increases significantly. The study aimed to investigate the relationship between delta SBP (the difference between first operating room blood pressure and baseline blood pressure) and the development of a postoperative major adverse cardiac event (MACE) during elective noncardiac surgeries and to identify an optimal threshold that predicts the differential risks of MACE.	single-center retrospective cohort study	Peking University First Hospital, inpatients from adults (age ≥18 years old) who underwent elective noncardiac surgery between 1 January 2012, and 31 December 2018. 91 233 elective noncardiac surgeries were screened, and ultimately a total of 55 563 surgery were analyzed The median age was 68 years old, 44.7% men, the mean BMI was 24.4±3.7 kg/m^2, mostly ASA class II and III. The most common surgery was the digestive tract (42.9%) and genital/urinary surgery (24.8%), with a median operation duration of 89 (52–154 interquartile range, IQR) minutes, and the median delta SBP was 14 (from 20 to 60) mmHg	They evaluated the relationship between the delta SBP (the difference between first operating room blood pressure and baseline blood pressure) and the development of postoperative major adverse cardiac events (MACEs) in patients with normal baseline blood pressure. Multivariate logistic regression before and after propensity score weighting was performed to adjust for perioperative variables, and the minimum *P* value approach was used to identify the possible threshold of delta SBP that independently indicated the risk of MACE.	Of the 55 563 surgeries, in 4.1%, postoperative MACE occurred. The threshold for the delta SBP was 49 mmHg. The adjusted odds ratio for MACE before and after propensity score weighting for the delta SBP threshold was 1.35 (95% CI, 1.11--1.59); *P* less than 0.001 and 1.28 (1.03–1.60); *P*=0.028, respectively. Patients with higher delta SBP had a longer hospitalization (4 vs. 3 days; *P*<0.001). The logistic regression showed that in addition to old age, extreme BMI, smoking, cancer or major surgery, intraoperative hypotension, and blood transfusion were all risk	Delta SBP contributed to the elevated risk over and beyond the SBP at rest in patients who underwent elective noncardiac surgery. A rise of SBP of more than 49 mmHg from baseline in the operating room was significantly associated with an increased risk of postoperative MACE.

				factors	

Appendix A

Root Cause Analysis



Common categories:

- Procedures
- Policies
- Environment
- Equipment
- Technology
- Budget
- Leadership
- Staff

Appendix B

Hypertension Alert Tool (HAT)

(FRONT)

HYPERTENSION ALERT!

Patients INITIAL BP: _____

(if BP > than 160mmhg/ 100mmhg please recheck in 5 mins)

Rechecked BP: _____

Has the patient taken any blood pressure medications in the past 24hrs? _____

(BACK)

Suggestions for Preoperative Hypertension Treatment:

SBP ≤ 170 *or* DBP ≤100: Mild hypertension predicts perioperative swings in BP but can usually be managed safely with appropriate administration of anesthetics, analgesics, and antihypertensives.

SBP ≥ 180 or DBP ≥ 110 *and* the patient HAS NOT taken their antihypertensives that morning: Their home medications should be given with a sip of water, or a comparable intravenous antihypertensive should be administered. A small dose of an anxiolytic such as midazolam could be administered as well. Changing the order of cases should be considered to afford these agents time to work prior to inducing anesthesia. **

SBP ≥ 180 or DBP ≥ 110 with NO prior history of HTN *or* they have history and HAS taken their BP medications the DOS: Elective surgery should be postponed until BP is better controlled. *

SBP ≥ 200: Elective surgery should be canceled. ***

**The 2017 American College of Cardiology/American Heart Association guidelines label SBP of 180 as hypertensive crisis, so a decision to proceed with surgery with SBP of 180 mm Hg should be made with caution, considering the patient's overall state of health and urgency of the procedure.*

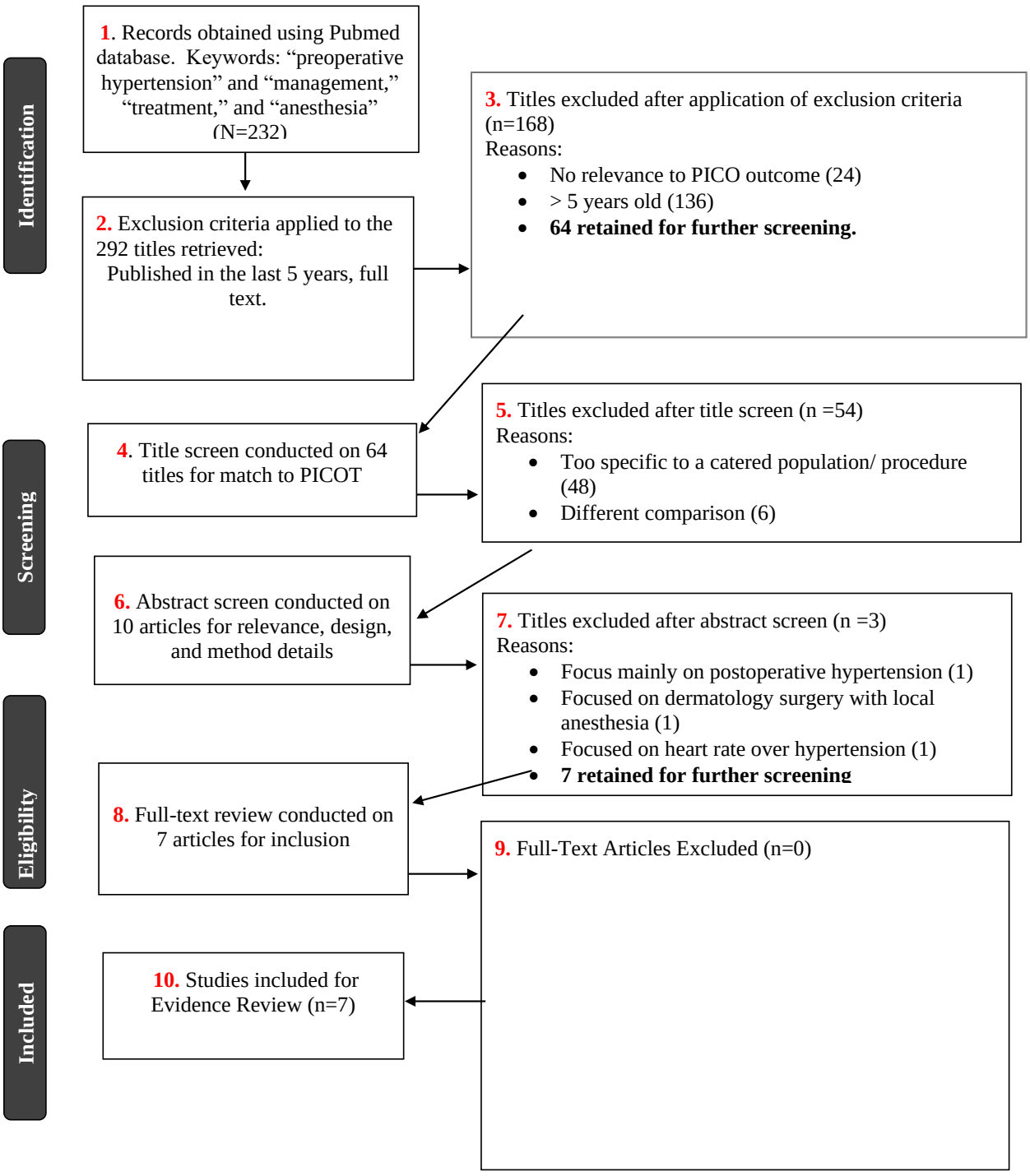
*** DBP ≥ 110 is itself a risk factor for cardiovascular complications. It has been associated with ECG changes of myocardial ischemia, especially if blood pressure drops to <50% of awake MAP and isolated diastolic HTN is associated with increased risk of both CHF and death in the general population.*

**** A large retrospective study has shown that patients who receive anesthesia with an SBP of 200 mm Hg have twice the risk of a postoperative rise in troponin, and twice the risk of death, compared with patients with lower BP.*

Appendix C

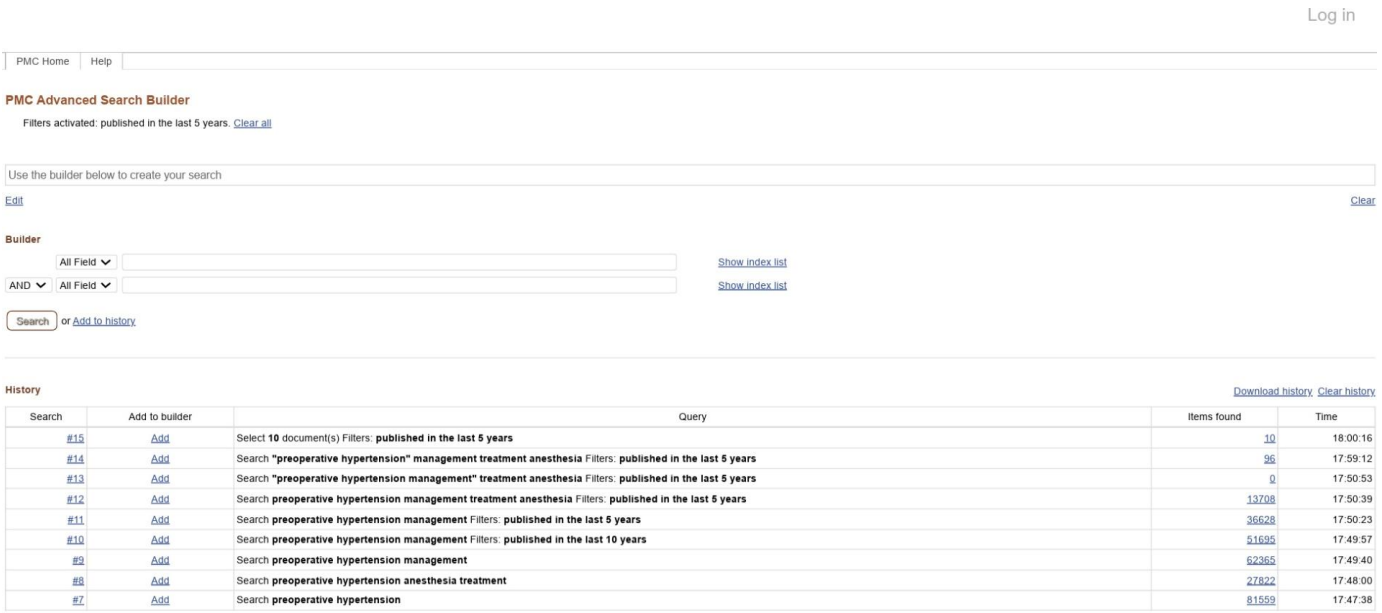
PRISMA Search Flow Diagram

PRISMA Search Flow Diagram



Appendix D

Pub Med Database Search



Log in

PMC Home | Help

PMC Advanced Search Builder

Filters activated: published in the last 5 years. Clear all

Use the builder below to create your search

Edit Clear

Builder

All Field — Show index list

AND — All Field — Show index list

Search or Add to history

History Download history Clear history

Search	Add to builder	Query	Items found	Time
#15	Add	Select **10** document(s) Filters: **published in the last 5 years**	10	18:00:16
#14	Add	Search **"preoperative hypertension" management treatment anesthesia** Filters: **published in the last 5 years**	96	17:59:12
#13	Add	Search **"preoperative hypertension management" treatment anesthesia** Filters: **published in the last 5 years**	0	17:50:53
#12	Add	Search **preoperative hypertension management treatment anesthesia** Filters: **published in the last 5 years**	13708	17:50:39
#11	Add	Search **preoperative hypertension management** Filters: **published in the last 5 years**	36628	17:50:23
#10	Add	Search **preoperative hypertension management** Filters: **published in the last 10 years**	51695	17:49:57
#9	Add	Search **preoperative hypertension management**	62365	17:49:40
#8	Add	Search **preoperative hypertension anesthesia treatment**	27822	17:48:00
#7	Add	Search **preoperative hypertension**	81559	17:47:38

Appendix E

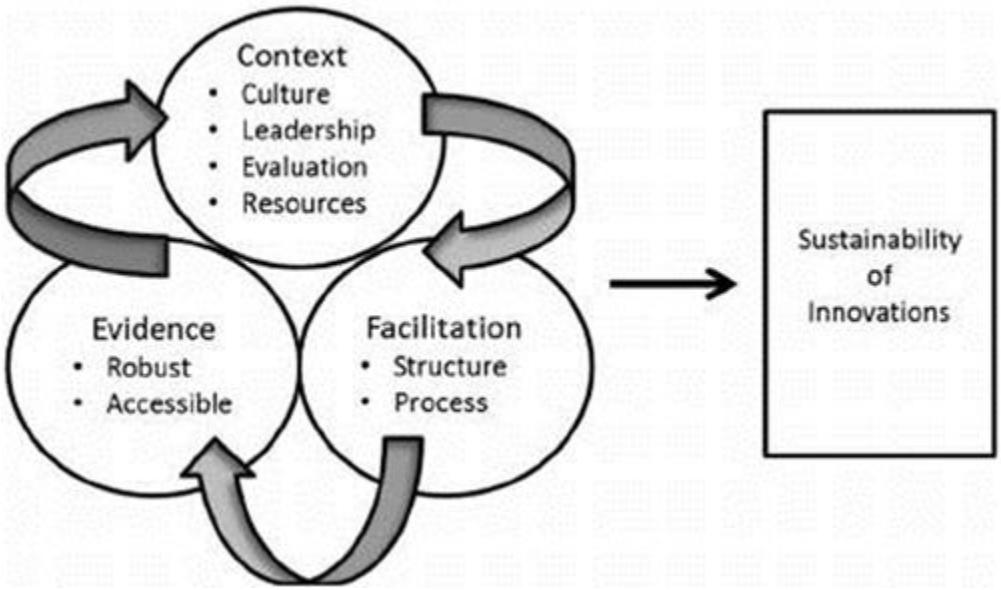
University of Maryland School of Nursing Evidence Synthesis Template

Project Title: Preoperative Hypertension Management			
PICOT: Can we reduce intraoperative adverse events and the use of vasopressors among preoperatively hypertensive patients by 5% through education and utilization of current best practice preoperative treatment recommendations via a resource tool compared the absence of a resource tool within 6 months?			
JHNEBP Model Level	**Total Number of Sources**	**Author and Quality Rating of each study**	**Synthesis of Findings**
Level 1 Experimental study · Randomized Controlled Trial (RCT) · Systematic review of RCTs with or without meta-analysis	0		
Level II Quasi-experimental studies · Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis	6	Balcı, E.: Cross-sectional, observational study **B** Mohseni, S.: Multi- center retrospective study **A** Venkatesan, S.: Cohort Study **A** Roshanov, P.: Cohort Study **C** Hollmann, C.: Metaanalysis **C** Zhou, Y.: Retrospective cohort study **A**	Zhou and Venkatesan both identified Increased preoperative SBP is related to an increase in postoperative cardiac events. Mohseni identified that the most common cause of preoperative hypertension is poorly controlled baseline hypertension. Roshanov and Hollman both identified that ACE-I/ARBS administration are associated with intraoperative hypotension if not held, and Balci emphasized that utilizing ACE-I/ARBS for HTN control and then holding it the day of surgery to reduce the risk of hypotension actually increased the patient risk for hypertension and post operative complications.
Level III Non-experimental study · Systematic review of a combination of RCTs, quasi-experimental, and non-experimental studies, or non-experimental studies only, with or without meta-analysis · Qualitative study or systematic review of	1	Soni, S.: Non-experimental study **A**	It demonstrated a significant reduction in the number of pre-operative cancellations due to hypertension alone between 2013 and 2018. This is attributed to the publication of preoperative hypertension case management

qualitative studies with or without meta-synthesis			guidelines to providers.
Level IV Opinion of respected authorities and/or reports of nationally recognized expert committees/consensus panels based on scientific evidence	0		
Level V Evidence obtained from literature reviews, quality improvement, program evaluation, financial evaluation, or case reports · Opinion of nationally recognized expert(s) based on experiential evidence	0		
Overall Quality Rating w/rational and Recommendation: B; Good evidence to include practice change			
Recommendations Based on Evidence Synthesis • Strong, compelling evidence, consistent results: solid indication for a practice change. • Good and consistent evidence – practice change • Good but conflicting evidence: questionable indication for practice change; consider risk/benefit analysis • Little or no evidence: no indication for practice change			

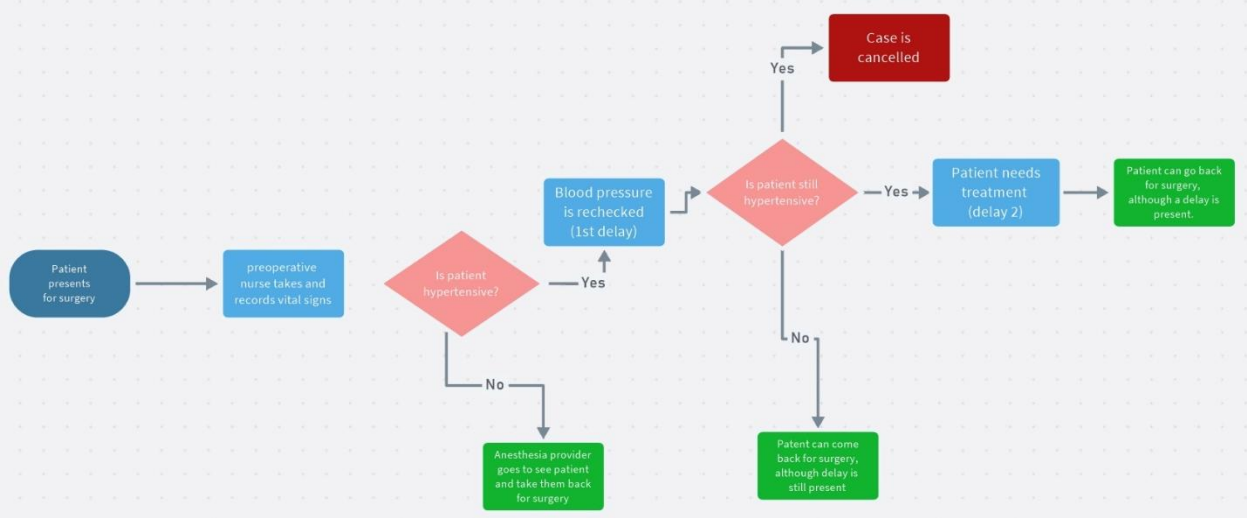
Appendix F

PARIHS Framework Diagram



Appendix G

Process Map



Appendix H

REDCap Nursing Survey

Nursing Usage

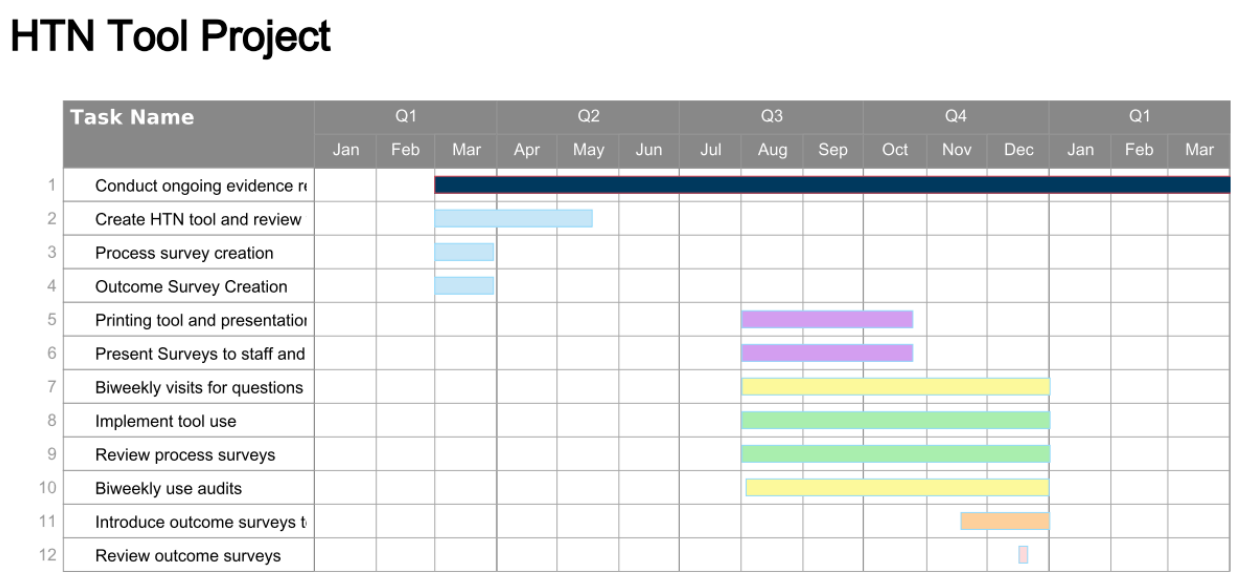
Please complete the survey below.

Thank you!

1)	What is the patient's MRN?	_____
2)	What was the patient's FIRST preoperative blood pressure?	_____
3)	Was the patient's blood pressure rechecked?	◯ Yes ◯ No
4)	Was the Hypertension Alert Tool utilized?	◯ Yes ◯ No
5)	Was the patient given pre-operative instructions on taking/ withholding any blood pressure medications?	◯ Yes ◯ No
6)	Did the patient follow these instructions?	◯ Yes ◯ No

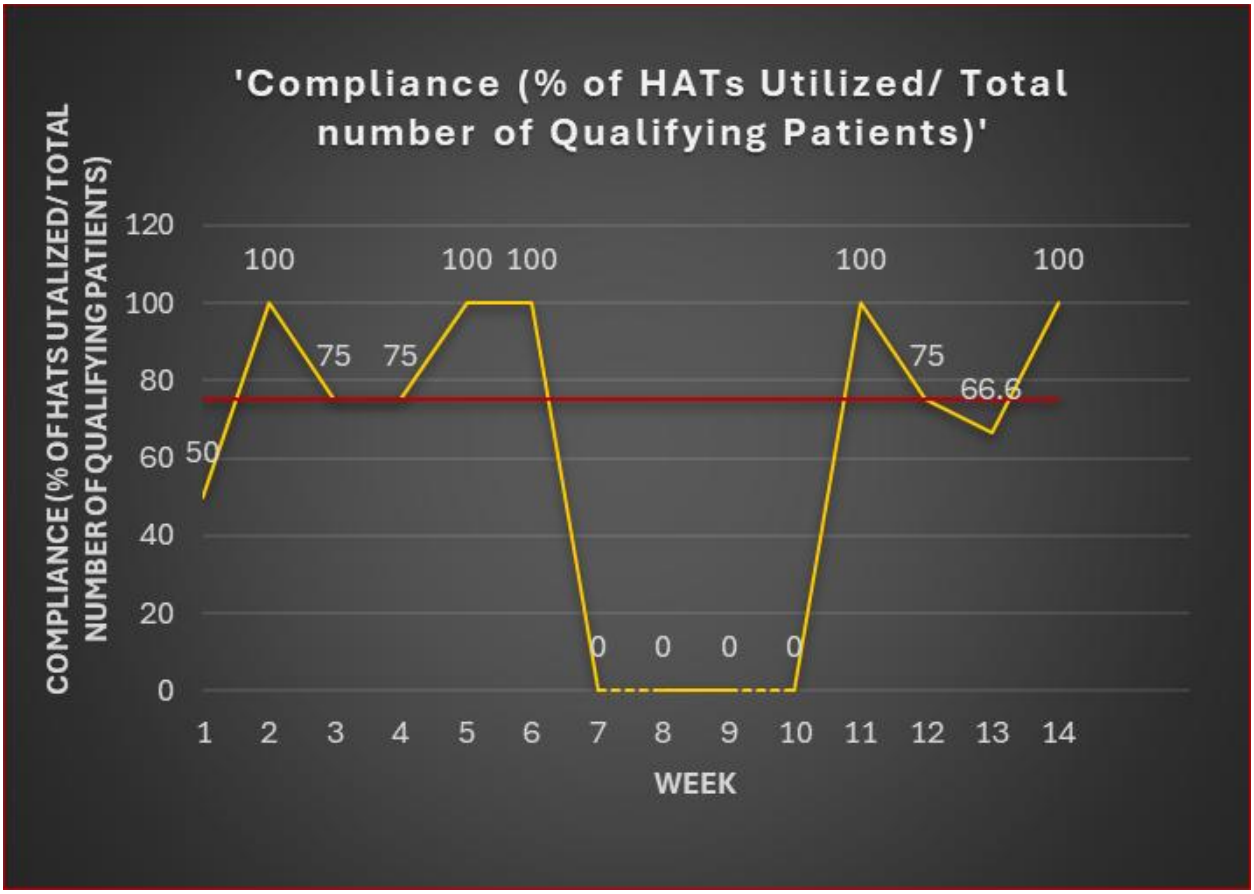
Appendix J

Gantt Chart of Goals



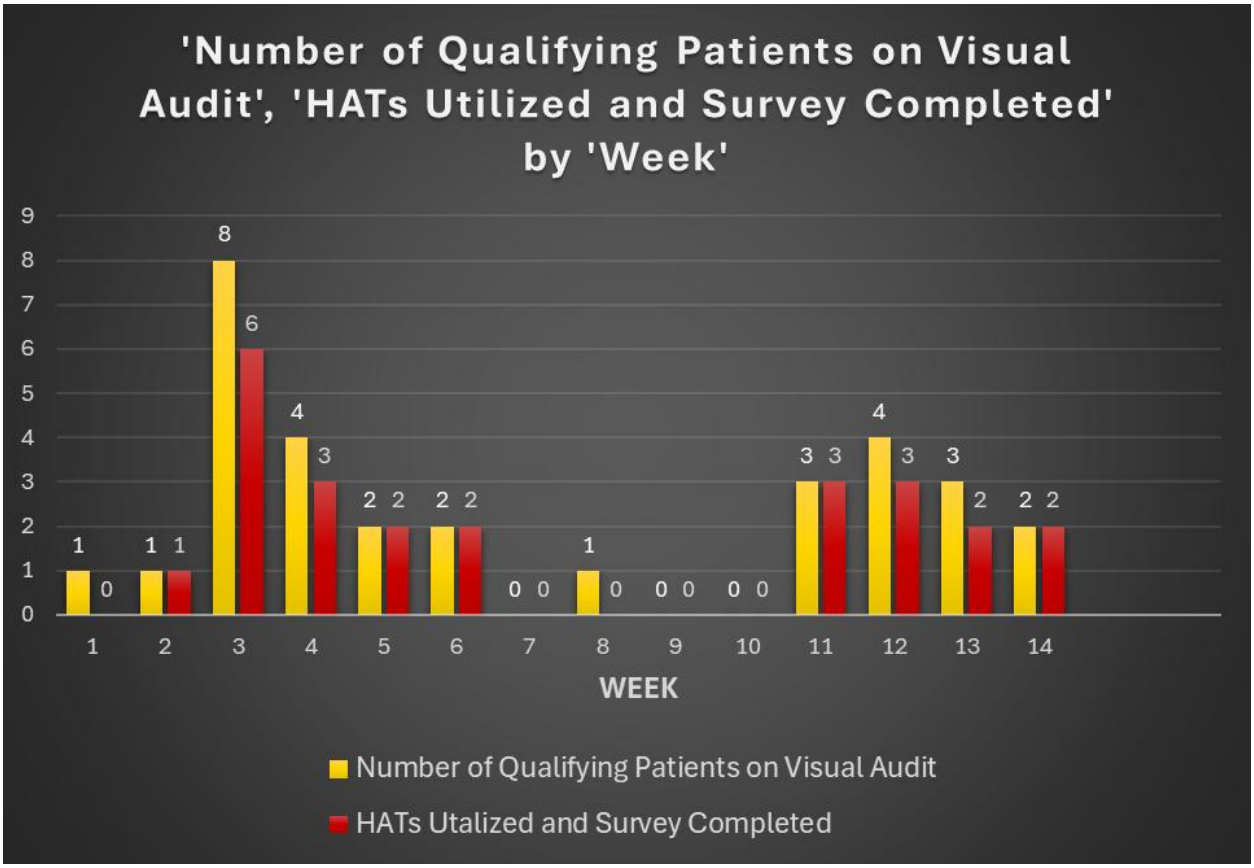
Appendix K

Run Chart of Outcome Goal



Appendix L

Weekly Patient Totals Chart



Appendix M

Sustainability Worksheet

Sustainability Planning Worksheet

This worksheet offers five areas (which conveniently spell MOCHA) for your team to consider when planning for the long-term sustainability of your improvement effort. Use the questions below to help you plan for success.

Areas for Consideration	Notes
Measurement • What will we continue to measure? • What will we stop measuring? • What will we do if we see a negative signal (i.e., special cause variation)?	We will continue to measure the patient's blood pressure and recheck it if they are hypertensive. We will also continue to use the HAT. We will stop regularly measuring the compliance percentage. If there is a decline in chart alert use we will begin to track compliance again and determine factors that are causing nurses to discontinue the use of the chart alert to evaluate for improvement.
Ownership • Who will own the new standard work? ○ Is he or she engaged and onboard with the improvement?	The new standard work will be a shared responsibility by the preoperative nursing staff, the anesthesia staff, and management. These members are all involved in the implementation, and the chief of anesthesia and nurse manager are both invested and engaged in the implementation, reviewing the project and making adjustments.
Communication and Training • How will we communicate about the change and who will be the messengers? • How will we support individuals in the new "right way"? • What type of training will we use?	Chage at the end of the implementation will be communicated in person, by flyer, and by email to ensure all staff is made aware. Education will be provided to preoperative nursing and anesthesia staff. Support will be provided by thorough education and availability to answer questions during the transition. Training will not be complicated, and the education flyers and instructive emails will be provided to the preoperative nursing manager to utilize for new employees moving forward.

Hardwiring the Change
• How will we make it hard to do the wrong thing and easy to do the right thing?
  ○ Can we reduce reliance on human memory?
• How will we standardize?
  ○ Do we need new documentation and resources?
	Disseminating the information on how the HAT improves patient outcomes and provider care can help nursing do the right thing and continue the usage. The continuation of having the tools available will be a transferred responsibility to the unit secretary who is already familiar with the procedure of printing and placing them on the unit. This will ensure they are continually available and easy to access. No new documentation or resources will be necessary; however education reminders should be sent out if a decline in use is recognized.

Assessment of Workload
• Are our changes increasing the overall workload to the system?
  ○ If so, how can we decrease the workload?
  ○ If not, how will we communicate about what is changing and not changing?
	The changes implemented are altering the workflow of the unit minimally. the largest workload increase is the requirement of filling out the surveys to track compliance which will not be used after the implementation ends. The decrease in workload will be communicated to nursing in the form of email, flyers, and in person notification as this aspect only affects their role.