UNDIAGNOSED HYPERTENSION

IN RURAL HEALTHCARE

by

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ABSTRACT

Hypertension is a disease that affects numerous people worldwide. It often goes undiagnosed, causing an increased risk of cardiovascular events. This project aimed to reduce the number of patients with undiagnosed hypertension within the observed population. This project occurred within a network of clinics associated with a 25-bed critical access hospital in rural Western Montana. Participants included clinic staff, physicians, nurse practitioners, physician assistants, registered nurses, licensed practical nurses, medical assistants, and a licensed clinical social worker.

The Plan-Do-Check-Act was used as the framework for this quality improvement (QI) project. Hypertension was defined using the 2017 American College of Cardiology and American Heart Association Clinical Practice Guidelines. The Electronic Medical Record system was used to identify out-of-range blood pressures in the last 2 years and add these patients to a registry. Clinical personnel performed chart reviews to eliminate patients who did not meet the criteria defined by the stakeholders. EHR message functionality alerted providers offering to schedule patients for an office visit to rule in or out hypertension. The identified patients were contacted by a licensed clinical social worker and invited to schedule an appointment with a provider to address the possibility of undiagnosed hypertension.

The final numbers were assessed 6 weeks after the undiagnosed hypertension project implementation. The multistep PDCA process resulted in a significant reduction in the overall number of potentially undiagnosed hypertensive patients. The initial data collection produced 3,617 patients between the ages of 18 and 85, and the last revealed only 1,210 patients that met the criteria. The most significant decrease in number was seen in the 56–65 age group, dropping from 700 to 188 patients.

This quality improvement project aimed to identify potentially undiagnosed hypertensive patients and establish a system to assess those patients by a provider. This project accomplished that objective. This quality improvement project was structured on innovative research, a trusted conceptual framework, and current practice guidelines. If the quality improvement team were to extend this project, the next step would be implementing clinical practice guidelines and monitoring hypertension outcomes within the patient population.

CHAPTER ONE

UNDIAGNOSED HYPERTENSION IN RURAL HEALTHCARE LITERATURE REVIEW

Background and Introduction

Noncommunicable diseases account for 74% of all deaths worldwide. Cardiovascular disease and hypertension are among the most prevalent, accounting for 43.7% of all yearly deaths (World Health Organization, 2022). The 2017 American College of Cardiology and American Heart Association (ACC/AHA) Clinical Practice Guidelines defines stage I hypertension as a systolic blood pressure of 130–139 or a diastolic blood pressure of 80–89 mm Hg (Whelton et al., 2018). Between 2017 and 2018, it was estimated that 45% of adults in the US had hypertension, and that rate increased with age. By age 60, approximately three-quarters of adults had hypertension (Ostchega et al., 2020). Hypertension is responsible for more cardiovascular deaths than any other modifiable risk factor. Additionally, hypertension is second only to cigarette smoking as a preventable cause of death in the United States (Whelton et al., 2018). While evidence supports that prevention is the key to treating hypertension and cardiovascular disease, many persons are living with undiagnosed hypertension.

While hypertension awareness has been steadily improving since the 1960s, there is still a vast population of undiagnosed hypertensive people (Whelton et al., 2018). Roughly 11 million U.S. adults with average access to healthcare have undiagnosed hypertension, placing them at heightened risk for cardiovascular events (Ciemins et al., 2018). This number has likely increased with the change to the 2017 ACC/AHA Clinical Practice Guidelines, which lowered

the systolic and diastolic numbers required to meet stage I hypertension. The ACC/AHA states providers are to use the averages of two or more blood pressure readings attained on two or more occasions to diagnose hypertension. Preferably, patients would provide twice-daily blood pressure readings over a 2-week period to be evaluated during the visit (Whelton et al., 2018).

Clinical practice guidelines are valuable tools used in managing chronic illnesses. The 2017 ACC/AHA Clinical Practice Guidelines is now the most commonly used standard for preventing and managing hypertension nationally and worldwide (Mancia & Corrao, 2018). Previous guidelines for managing hypertension are available but not frequently used by healthcare providers. Mahdavi and associates (2020) report, when the switch occurred from the JNC8 Clinical Practice Guidelines for treating hypertension to the 2017 ACC/AHA, they observed a drastic increase in the occurrence and steep decline in the awareness, treatment, and control of hypertension. The 2017 ACC/AHA document was assessed by two official reviewers nominated by the ACC and AHA; one reviewer from each of the following AGS, ABC, APhA, ASH, NMA, PCNA, ASPC, ACPM, and AAPA, and 38 individual content reviewers (Whelton et al., 2018).

Patient registries are healthcare informatics tools used in healthcare to manage various data types. Patient registries provide ways to organize and collect information about a population with a particular condition or illness and are used to enhance the knowledge of the disease and treatments (The Pediatric Pulmonary Hypertension Network Registry, 2015). Researchers Øie and associates (2018) explain that patient registries are created to manage and monitor healthcare data. This information can assist in accurately diagnosing a particular patient population (Øie et al., 2019).

Purpose/Objective

This systematic literature review aimed to identify the prevalence and effects of hypertension and undiagnosed hypertension, define clinical practice guidelines and their functions, and define patient registries and their role in healthcare practice. The review aimed to include material specific to hypertension, treatment of hypertension, tools to identify undiagnosed hypertension, socioeconomic factors that could affect the chances of diagnosis, clinical practice guidelines, and patient registries.

Methods

Strategies

This literature review utilized a systematic search for peer-reviewed literature using five databases: CINHAL, Montana State University Library, Cochrane, PubMed, and EBSCOhost. These databases were searched for articles available online and published in English within the previous 5 years. Search terms included the following keywords: “hypertension,” “undiagnosed hypertension,” “clinical guidelines,” and “patient registries.”

Eligibility-Inclusion Criteria

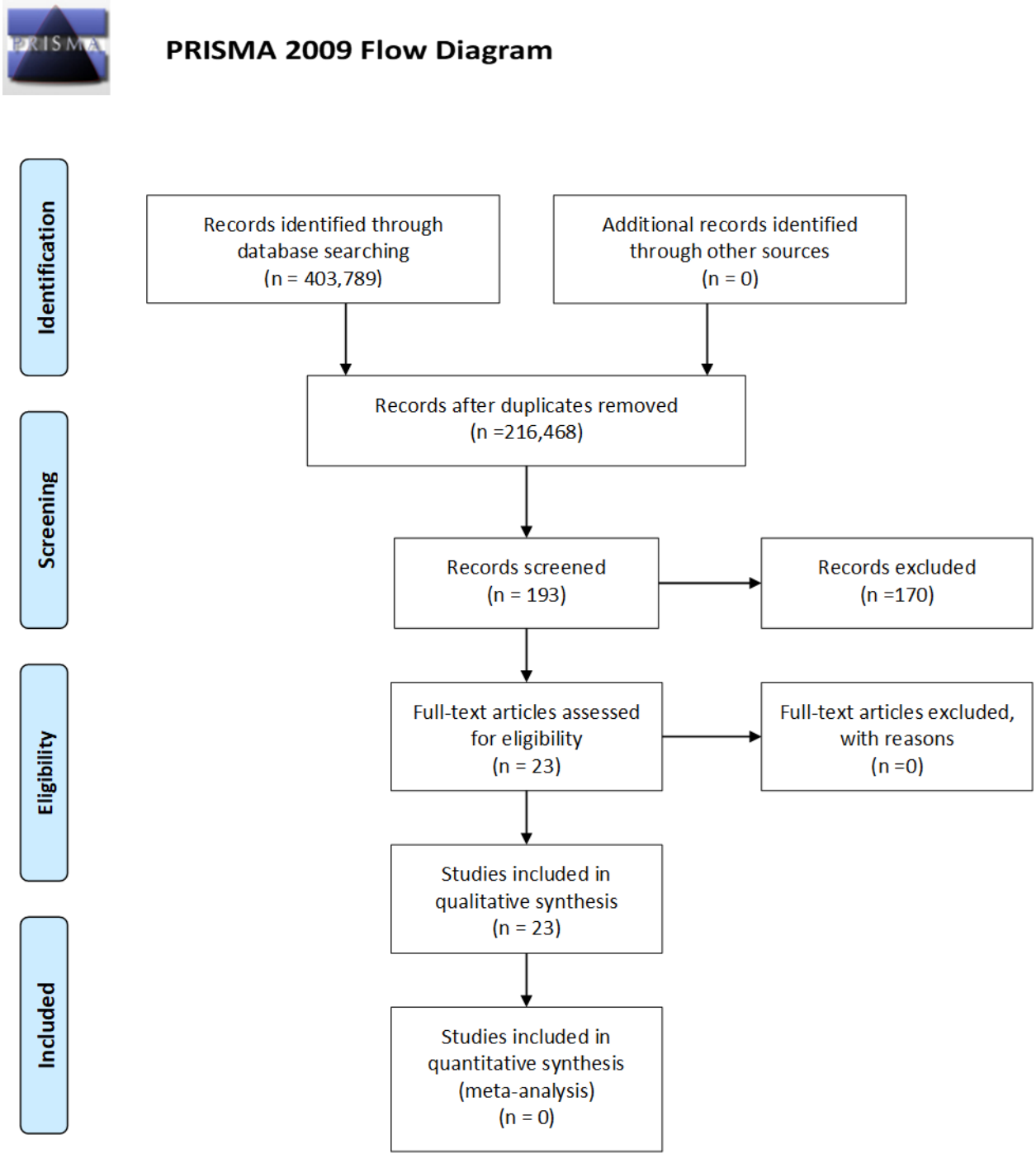
Articles were included if they met one or more of the following conditions established by the author. These conditions were: hypertension, undiagnosed hypertension, the potential for undiagnosed hypertension in various situations, tools for diagnosing hypertension earlier, current guidelines for diagnosing and treating hypertension, clinical practice guidelines, patient registries, and how to use patient registries to treat chronic disease.

Results

The original search produced a total of 403,789 results. Of those results, 187,321 were duplicates. After removing all duplicates, 216,468 articles remained. This author performed an abstract review of the top 193 results relevant to this project. Of those 193 articles, 170 were excluded due to lack of eligibility, leaving 23 items for a full-text review.

As evidenced by this search, there is ample information on hypertension, treatment of hypertension, undiagnosed hypertension, clinical practice guidelines, and patient registries. While having enough data is essential, it can become difficult to sort through and find relevant material for this translation project. The 23 articles selected provided current, relevant data for inclusion.

Figure 1. PRISMA 2009 Flow Diagram



Literature Review

The literature in this detailed review were categorized as adverse effects of hypertension, undiagnosed hypertension, clinical practice guidelines**,** and patient registries**.** Adverse effects of hypertension and undiagnosed hypertension were the most prevalent types of studies, with some overlap between the two categories. Studies pertaining to clinical practice guidelines were available in moderate amounts. Evidence-based studies on patient registries were most limited.

Adverse Effects of Hypertension

Multiple studies in this review provided information about the adverse effects of hypertension. Cardiovascular disease is the primary cause of death globally and is expected to account for 23.6 million deaths by 2030 (Zhou et al., 2018). Hypertension is proven to be the number one risk factor contributing to cardiovascular disease, attributing to about 50% of cardiovascular events each year (Zhou et al., 2018). It is crucial to treat hypertension to reduce the risk of cardiovascular events (Zhou et al., 2018; Armitage et al., 2019; Kario et al., 2021). Two studies discussed that United States adults who were hypertensive and either untreated or uncontrolled were at higher risk for cardiovascular events than those who were normotensive (Zhou et al., 2018; Park et al., 2018). Another study by Ostchega and associates (2020) shows that several factors, such as age, gender, and education, affect the prevalence of hypertension. Throughout 2017 and 2018, the incidence of hypertension was noticeably higher at 51% among adult men than adult women only 39.7%, with an average of 45.4%. Adults over 60 years of age had hypertension at a rate of 75.2% for men and 73.9% for women, with an average of 74.5%. Level of education was also strongly associated with the prevalence of hypertension. Adults with

college degrees showed a significantly lower occurrence of hypertension at 38.5% than those with a high school education or less at 47% (Ostchega et al., 2020).

With the 2017 ACC/AHA hypertension guideline change, the number of adults considered to have hypertension significantly increased, causing much debate among medical professionals (Park et al., 2018; Kaneko et al., 2020). According to Kaneko and colleagues (2020), two large-scale studies validated the 2017 ACC/AHA guidelines, and the majority of providers rely on these guidelines. Another study showed that having a target blood pressure of 110-130 mm Hg resulted in a significantly lower occurrence of cardiovascular events than those with a target blood pressure of 130-150 mm Hg (Kario et al., 2021). In another cross-sectional study with 220 participants, the prevalence of hypertension among professional educators was approximately 80% utilizing the new 2017 ACC/AHA guidelines (Purohit et al., 2021).

Undiagnosed Hypertension

Multiple studies prove that undiagnosed hypertension is a significant problem in the United States and globally. Tsuchiya and Demmer (2021) report social determinants play an essential role in adverse cardiovascular outcomes. Hasan and partners (2020) report that, in a study they conducted in Nepal, out of 3334 patients with hypertension, 50.4% remained undiagnosed, disproportionately higher among lower socioeconomic populations. Niazi and colleagues (2019) report during their research that nearly 25% of potential kidney donors had undiagnosed hypertension, affecting the underprivileged at a higher rate than the wealthy. Another study by Ciemins and associates (2018) used the Million Hearts Hypertension Prevalence Estimator Tool to calculate the prevalence of hypertension among nearly 9 million United States adults. They found that almost one in eight patients with hypertension may not

have been diagnosed, underscoring the need for reasonable adherence to the 2017 ACC/AHA guidelines.

Two studies showed that patients frequently leave emergency departments and inpatient floors with elevated blood pressures and with poor post-discharge follow-up care addressing hypertension (Armitage et al., 2019; Goldberg et al., 2019). Providers often dismiss hypertension in the emergency department and inpatient unit to pain, anxiety, underlying health conditions, or white coat syndrome. However, many of these patients remain hypertensive. Armitage and colleagues (2019) and Goldberg and associates (2019) agree that the emergency department and inpatient hospital setting reliably and routinely identify patients with undiagnosed hypertension. These patients need a post-discharge follow-up that addresses hypertension using the 2017 ACC/AHA guidelines.

An additional study conducted by Kumar and colleagues (2022) reports 59% of 100 participants 30 years old or older from the outpatient department in Gohana, Haryana, had undiagnosed hypertension. Undiagnosed hypertension was statistically associated ($P<0.05$) with decreased physical activity, alcohol intake, smoking, high BMI, and a family history of hypertension. Another study showed that even in a small-study population of 220 professional medical educators in Vadodara City, roughly 50% of the participants had elevated blood pressure, even those with normal BMIs. Approximately 55% of participants who were 41–50 years old had hypertension (Purohit et al., 2021). Park and associates (2018) report geographical patterns and trends in undiagnosed hypertension. Greater incidence occurs in southern states, at a higher rate in men than women.

Clinical Practice Guidelines

Clinical practice guidelines are systematically developed instruments created to assist medical providers in making healthcare decisions about specific disease processes (U.S. Department of Health and Human Services, 2022). Whelton and colleagues (2018) report the ACC and the AHA have been translating scientific evidence into clinical practice guidelines with cardiovascular treatment recommendations since 1980. In 2014, the ACC, AHA, and several other professional societies initiated clinical practice guidelines on the prevention, detection, evaluation, and management of high blood pressure in adults. While these guidelines are focused on medical practice in the United States, they are developed in association with global organizations and have a worldwide impact. Whelton and associates (2018) found it valuable to note that recommendations are meant to guide clinical decision-making but should not replace clinical judgment. Another study by Mancia and Corrao (2018) reports the 2017 ACC/AHA Clinical Practice Guidelines has several unique qualities. One important quality is that it covers multiple aspects of hypertension, providing concise recommendations based on scientific evidence. It also discusses the level and strength of evidence for each intervention provided. Mancia and Corrao (2018) state the 2017 ACC/AHA Clinical Practice Guidelines is a vital article that encourages change in a positive direction for the treatment and management of hypertension. Another study by Mahdavi and colleagues (2020) reported that more young people are considered hypertensive since the 2017 ACC/AHA guideline changes. Lowering the threshold for a hypertension diagnosis allows patients to receive treatment and, in some cases, qualify for programs that would enable them to receive funding for medication and lifestyle modifications. In an article by Philip and associates (2021), the authors state hypertension affects

approximately 1.39 billion people globally, accounting for 10.4 million premature deaths annually. In a 2017 multinational cross-sectional study, researchers found that 35% of individuals had hypertension; 58% of those participants were receiving treatment, but 46% did not achieve adequate blood pressure control. This study also detected 48 national and international clinical guidelines for the management of hypertension. They found the thresholds for diagnosing, hypertension staging, and recommendations were widely consistent across guidelines. Recommendations on antihypertensive medication therapy did vary significantly, providing clinician autonomy in choosing drug therapy (Philip et al., 2021).

In another article, researchers Arnett and associates (2019) explain adults 40 to 75 years old who are being evaluated for cardiovascular disease should undergo a 10-year atherosclerotic cardiovascular disease (ASCVD) risk estimation by their primary care provider. Pairing this with the 2017 ACC/AHA Clinical Practice Guidelines, the provider and patient can discuss lifestyle modifications and potentially start antihypertensive medication, statins, or aspirin. Arnett and colleagues (2019) report the updated 2017 ACC/AHA Clinical Practice Guidelines are written in modular piece format, which improved the “user friendliness” of the document. The usable form, additional tables, and flow diagrams make it widely favorable among practitioners.

Patient Registries

The study that most closely parallels the author’s current translation project is one by Major Health Partners, a large medical facility in Indiana. It consists of a 51-bed medical center with a wide range of services (Meditech, 2022). Major Health Partners decided to implement MEDITECH Expanse, which provided the ability to utilize and tailor patient registries within their electronic medical records system. These patient registries allowed them to focus on and

track specific patient populations with the same diagnosis. They could identify the size and scope of the patient population and prioritize which patients needed to be addressed first. Major Health Partners started by implementing a hypertension registry. They began by targeting patients with systolic blood pressure readings of 160 mm Hg or greater with the following phases of target blood pressures of 150-160 mm Hg and 140-150 mm Hg. Within a few weeks of the implementation of their program, Major Health Partners began to see downward trends in blood pressure readings. Since then, they have routinely seen noticeable drops in systolic blood pressure in patients above 160 mm Hg. In May 2020, 57% of their initial target population of systolic blood pressure 160 mm Hg or greater significantly improved their blood pressure. Throughout 2020 they saw average monthly reductions in blood pressure of roughly 30%. Researchers state they expect the numbers to change some through the COVID-19 pandemic (Meditech, 2022). The author is conducting a quality improvement (QI) project in a rural facility in Northwest Montana that uses patient registries within MEDITECH to reduce the number of undiagnosed hypertension cases within their patient population.

A study by Ayilara and colleagues (2019) explains that clinical registries capture information about patients' health with specific health conditions or treatments. They often focus on patient-reported outcomes that provide information about the patient's health assessment. This study focuses on the impact missing data can have on healthcare decision-making. They found that missing data can significantly affect the accuracy and effectiveness of clinical registries (Ayilara et al., 2019). Their results underscore the importance of entering complete data in the registries to maximize the benefits. Another study by Egholm and associates (2019) reports that using clinical registries in healthcare seems promising. However, there are some

challenges when implementing them. This study focused on what factors should be considered when implementing a registry. They found that targeting and addressing barriers to facilitating factors was critical in implementing clinical registries (Egholm et al., 2019).

Researchers Mocumbi and colleagues (2020) explain that patient registries use observational methods to collect data on persons with specific diseases. With the advancement of technology, data can be collected at global, national, and regional levels, thus allowing for a better depiction of disease processes, highlighting similarities and differences in different geographical areas and demographics, and providing valuable information to medical professionals (Mocumbi et al., 2020). Another study by McGettigan and associates (2019) explains that patient registries provide potentially valuable data that can assist in clinical decisions for treating uncommon diseases. They also emphasize how underused patient registries are and how much could be gained by using them. In 2015 the European Medicines Agency established the Patient Registries Initiative to support and encourage registries in collecting data, especially on safety and efficacy studies. McGettigan and colleagues (2019) conducted a survey of published observations and recommendations from a multi-stakeholder consultation and four disease-specific patient registry workshops. They concluded that implementing patient registries would provide a valuable data source and aid decision-making (McGettigan et al., 2019).

Practice and Policy Implications

With hypertension being one of the most prevalent chronic diseases worldwide, healthcare providers must have the most current knowledge and tools available to treat this horrible disease. Goetsch et al. (2021) report more cardiovascular events are accredited to hypertension than any other modifiable risk factor. The prevalence and frequency of

hypertension have increased in recent years, while control rates have declined. This change underscores the importance of utilizing patient registries and clinic practice guidelines to identify patients with hypertension and guide hypertension treatment to promote the best outcome for each patient.

Conclusion

Millions of Americans are predicted to have undiagnosed hypertension. Left untreated, it can have catastrophic effects. This systematic literature review looked at peer-reviewed articles that provided evidence of the scope and significance of the problem. It provided evidence to support the use of current clinical practice guidelines and patient registries to treat chronic diseases. This literature review also illustrates the need for practice and policy development to address the current problem of undiagnosed hypertension in primary care.

References

Armitage, L. C., Whelan, M. E., Watkinson, P. J., & Farmer, A. J. (2019). Screening for hypertension using emergency department blood pressure measurements can identify patients with undiagnosed hypertension: A systematic review with meta-analysis. The Journal of Clinical Hypertension, *21*(9), 1415–1425. doi.org/10.1111/jch.13643

Arnett, D. K., Blumenthal, R. S., Albert, M. A., Buroker, A. B., Goldberger, Z. D., Hahn, E. J., Himmelfarb, C. D., Khera, A., Lloyd-Jones, D., McEvoy, J. W., Michos, E. D., Miedema, M. D., Muñoz, D., Smith, S. C., Virani, S. S., Williams, K. A., Yeboah, J., & Ziaeian, B. (2019). 2019 ACC/AHA guideline on the primary prevention of cardiovascular disease: A report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Circulation, 140(11). doi.org/10.1161/cir.0000000000000678

Ayilara, O. F., Zhang, L., Sajobi, T. T., Sawatzky, R., Bohm, E., & Lix, L. M. (2019). Impact of missing data on bias and precision when estimating change in patient-reported outcomes from a clinical registry. *Health and Quality of Life Outcomes*, *17*(1). https://doi.org/10.1186/s12955-019-1181-2

Ciemins, E. L., Ritchey, M. D., Joshi, V. V., Loustalot, F., Hannan, J., & Cuddeback, J. K. (2018). Application of a tool to identify undiagnosed hypertension—United States, 2016. MMWR. Morbidity and Mortality Weekly Report, *67*(29), 798–802. doi.org/10.15585/mmwr.mm6729a2

Egholm, C. L., Helmark, C., Doherty, P., Nilsen, P., Zwisler, A.-D., & Bunkenborg, G. (2019). "Struggling with practices": A qualitative study of factors influencing the implementation of clinical quality registries for cardiac rehabilitation in England and Denmark. *BMC Health Services Research*, *19*(1). https://doi.org/10.1186/s12913-019-3940-5

Goetsch, M. R., Tumarkin, E., Blumenthal, R. S., & Whelton, S. P. (2021, July 21). New guidance on blood pressure management in low-risk adults with stage 1 hypertension. American College of Cardiology. https://www.acc.org/latest-in-cardiology/articles/2021/06/21/13/05/new-guidance-on-blood pressure-management-in-low-risk-adults-with-stage-1-htn

Goldberg, E. M., Wilson, T., Jambhekar, B., Marks, S. J., Boyajian, M., & Merchant, R. C. (2019). Emergency department-provided home blood pressure devices can help detect undiagnosed hypertension. High Blood Pressure & Cardiovascular Prevention, *26*(1), 45–53. doi.org/10.1007/s40292-019-00300-0

Hasan, M. M., Tasnim, F., Tariqujjaman, M., Ahmed, S., Cleary, A., & Mamun, A. (2020). Examining the prevalence, correlates and inequalities of undiagnosed hypertension in Nepal: A population-based cross-sectional study. BMJ Open, *10*(10). doi.org/10.1136/bmjopen-2020-037592

Kaneko, H., Itoh, H., Yotsumoto, H., Kiriyama, H., Kamon, T., Fujiu, K., Morita, K., Michihata, N., Jo, T., Takeda, N., Morita, H., Yasunaga, H., & Komuro, I. (2020). Association of isolated diastolic hypertension based on the cutoff value in the 2017 American College of Cardiology/American Heart Association Blood Pressure Guidelines with subsequent cardiovascular events in the general population. *Journal of the American Heart Association*, *9*(19). https://doi.org/10.1161/jaha.120.017963

Kario, K., Sakima, A., & Ohya, Y. (2021). Step to estimate cardiovascular events by home blood pressure in the era of digital hypertension. *Hypertension Research*, *45*(1), 11–14. https://doi.org/10.1038/s41440-021-00764-5

Kumar Silan, V., Kumar Verma, R., Pal, R., & Tarun, (2022). An unattended silent killer: A facility-based cross-sectional study on undiagnosed hypertension from Haryana, India. Asian Journal of Medical Sciences, *13*(9), 136–141. doi.org/10.3126/ajms.v13i9.44446

Mahdavi, M., Parsaeian, M., Mohajer, B., Modirian, M., Ahmadi, N., Yoosefi, M., Mehdipour, P., Djalalinia, S., Rezaei, N., Haghshenas, R., Pazhuheian, F., Madadi, Z., Sabooni, M., Razi, F., Samiee, S. M., & Farzadfar, F. (2020). Insight into blood pressure targets for universal coverage of hypertension services in Iran: The 2017 ACC/AHA versus JNC 8 hypertension guidelines. doi.org/10.21203/rs.2.12895/v4

Mancia, G., & Corrao, G. (2018). Global impact of the 2017 American College of Cardiology/American Heart Association Hypertension Guidelines. Circulation, *137*(9), 889–890. doi.org/10.1161/circulationaha.117.032850

McGettigan, P., Alonso Olmo, C., Plueschke, K., Castillon, M., Nogueras Zondag, D., Bahri, P., Kurz, X., & Mol, P. G. (2019). Patient registries: An underused resource for medicines evaluation. *Drug Safety*, *42*(11), 1343–1351. https://doi.org/10.1007/s40264-019-00848-9

Meditech. (2022, September 18). Case study: Major Health Partners uses Meditech Expanse hypertension patient registries in population health initiative. MEDITECH. https://ehr.meditech.com/news/case-study-major-health-partners-uses-meditech-expanse-hypertension-patient-registries-in

Mocumbi, A., Mastala, A., Guambe, P., & Dzudie, A. (2020). Pulmonary vascular disease in Africa: Lessons from registries. *Global Cardiology Science and Practice*, *2020*(1). https://doi.org/10.21542/gcsp.2020.2

Niazi, S., Schneekloth, T., Memon, S., Lesser, E., Vargas, E., & Aslam, N. (2019). Undiagnosed hypertension in potential kidney donors and case for comprehensive medical and psychosocial assessment. Journal of Psychosomatic Research, *121*, 114. doi.org/10.1016/j.jpsychores.2019.03.046

Øie, L. R., Madsbu, M. A., Giannadakis, C., Vorhaug, A., Jensberg, H., Salvesen, Ø., & Gulati, S. (2018). Validation of intracranial hemorrhage in the Norwegian patient registry. *Brain and Behavior*, *8*(2). https://doi.org/10.1002/brb3.900

Ostchega, Y., Fryar, C. D., Nwankwo, T., & Nguyen, D. T. (2020, April). Hypertension Prevalence Among Adults Aged 18 and Over: United States, 2017–2018. Centers for Disease Control and Prevention. https://www.cdc.gov/nchs/data/databriefs/db364-h.pdf

Park, S., Gillespie, C., Baumgardner, J., Yang, Q., Valderrama, A. L., Fang, J., Loustalot, F., & Hong, Y. (2018). Modeled state-level estimates of hypertension prevalence and undiagnosed hypertension among U.S. adults during 2013–2015. The Journal of Clinical Hypertension, *20*(10), 1395–1410. doi.org/10.1111/jch.13388

The Pediatric Pulmonary Hypertension Network Registry. PPHNet. (2015, April 6). http://www.pphnet.org/registry/

Philip, R., Beaney, T., Appelbaum, N., Gonzalvez, C. R., Koldeweij, C., Golestaneh, A. K., Poulter, N., & Clarke, J. M. (2021). Variation in hypertension clinical practice guidelines: A global comparison. *BMC Medicine*, *19*(1). https://doi.org/10.1186/s12916-021-01963-0

Purohit, G., Sharma, T., Shaikh, U., Sharma, P., Shekh, N., Shah, V., & Shukla, S. (2021). Undiagnosed hypertension in young professional educators: Recent update. National Journal of Physiology, Pharmacy and Pharmacology, 1. doi.org/10.5455/njppp.2021.11.07192202020012021

Seibt, R., Hunger, B., Stieler, L., Stoll, R., & Kreuzfeld, S. (2018). Early detection of undiagnosed hypertension based on occupational screening in the hotel and restaurant industry. BioMed Research International, 2018, 1–9. doi.org/10.1155/2018/6820160

Tanabe, P., Persell, S. D., Adams, J. G., McCormick, J. C., Martinovich, Z., & Baker, D. W. (2008). Increased blood pressure in the Emergency Department: Pain, anxiety, or undiagnosed hypertension? Annals of Emergency Medicine, *51*(3), 221–229. doi.org/10.1016/j.annemergmed.2007.10.017

Tsuchiya, K., & Demmer, R. T. (2021). Citizenship status and prevalence of diagnosed and undiagnosed hypertension and diabetes among adults in the U.S., 2011–2016. Diabetes Care, 44(3). doi.org/10.2337/dc20-2453

U.S. Department of Health and Human Services. (2022, November). *Clinical Practice Guidelines*. National Center for Complementary and Integrative Health. Retrieved November 9, 2022, from https://www.nccih.nih.gov/health/providers/clinicalpractice

Whelton, P. K., Carey, R. M., Aronow, W. S., Casey, D. E., Collins, K. J., Dennison Himmelfarb, C., DePalma, S. M., Gidding, S., Jamerson, K. A., Jones, D. W., MacLaughlin, E. J., Muntner, P., Ovbiagele, B., Smith, S. C., Spencer, C. C., Stafford, R. S., Taler, S. J., Thomas, R. J., . . . Wright, J. T. (2018). 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/apha/ash/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults. Journal of the American College of Cardiology, *71*(19). doi.org/10.1016/j.jacc.2017.11.006

World Health Organization. (2022, September 16). Non communicable diseases. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases

Zhou, D., Xi, B., Zhao, M., Wang, L., & Veeranki, S. P. (2018). Uncontrolled hypertension increases risk of all-cause and cardiovascular disease mortality in U.S. adults: The Nhanes III linked mortality study. *Scientific Reports, 8*(1). https://doi.org/10.1038/s41598-018-27377-2

CHAPTER TWO

UNDIAGNOSED HYPERTENSION PROJECT PROPOSAL

Introduction and Problem

"It is health that is real wealth and not pieces of gold and silver. - Mahatma Gandhi" (Shafneed, 2019). According to the World Health Organization (2020), ischemic heart disease, stroke, obstructive pulmonary disease, lower respiratory infections, and neonatal conditions were the top five causes of death globally in 2019. In 2021, 1.28 billion adults reportedly had hypertension worldwide. Approximately only one in five of those adults successfully maintained their chronic disease (World Health Organization, 2021). The Centers for Disease Control and Prevention (2022) report heart disease is the number one killer in the United States, closely followed by cancer and COVID in 2020. Adults in the United States, between 2017 and 2018, had hypertension at a rate of 45%, which increased with every year of age. Three-fourths of adults over 60 years of age had hypertension during this same time (Ostchega et al., 2020). According to the Montana Department of Public Health and Human Services (2022), 29.5% of Montanans have hypertension. The county that is the focus of this translation project is one of the least healthy counties in the state, with high rates of smoking, obesity, excessive alcohol consumption, and low rates of physical activity contributing to the local hypertension issue (County Health Rankings, 2022). The World Health Organization (2021) describes blood pressure as the force applied to the walls of arteries and major blood vessels throughout the body by circulating blood. It is called hypertension when the pressure on the arteries' and vessels' walls is too high. The 2017 American College of Cardiology and American Heart Association

(ACC/AHA) Clinical Practice Guidelines describes stage I hypertension as a systolic blood pressure of 130–139 mm Hg or diastolic blood pressure of 80–89 mm Hg. Stage II hypertension is defined as greater than 140 mm Hg or more than 90 mm Hg (Whelton et al., 2018). In order to diagnose hypertension, the ACC/AHA states providers are to use the averages of two or more blood pressure readings attained on two or more occasions. Ideally, patients would provide twice-daily blood pressure readings over a 2-week period to be evaluated during the visit (Whelton et al., 2018).

As previously stated, 45% of adults in the United States have hypertension, a rate that steadily grows with age (Ostchega et al., 2020). In the state of Montana, 29.5% of adults have hypertension (Montana DPHHS, 2022). According to the patient statistics within the project population, a little over 31% have hypertension, exceeding the average rate in Montana (Johnson, 2022). Hypertension has many risks, but those risks are much higher when hypertension goes undiagnosed; only 42% of adults worldwide are diagnosed (World Health Organization, 2021). Approximately 11 million United States adults with standard healthcare access have undiagnosed hypertension (Ciemins et al., 2018). This number has likely risen since the change to the 2017 ACC/AHA Clinical Practice Guidelines, which lowered the systolic and diastolic numbers required to meet the stage I hypertension criteria (Ciemins et al., 2018). This translation project aims to reduce the number of patients with undiagnosed hypertension within the observed population.

Organizational Microsystem Assessment

This project occurs within a network of four federally designated Rural Health Clinics (RHC) and a walk-in clinic associated with a 25-bed critical-access hospital that includes obstetrical and emergency care in rural Western Montana. It is a community-owned and operated facility. The organization employs fourteen physicians, seven physician assistants, and three nurse practitioners. It is located on a federally recognized reservation and provides care for a significant number of Native American people. According to the American Heart Association News (2020), heart disease rates are about 50% higher in the Native American population than in Caucasians within the United States. According to this report, Native Americans also have a high rate of smoking, obesity, type 2 diabetes, and low socioeconomic status putting them at risk for hypertension and cardiovascular disease (American Heart Association News, 2020). The inclusion of this demographic serves to increase the clinical importance of this project. It is important to note that, while this project takes place on a federally recognized reservation, it was not limited to Native American populations, nor did it collect patient-specific information or data.

This project is working in conjunction with the establishment in which it takes place as part of their organizational grant application to improve hypertension outcomes within their facility and the community. Data from this project will serve to support the acquisition and implementation of ambulatory blood pressure monitoring equipment aimed at improving patient outcomes related to hypertension. This organization provides primary care for 13,519 out of the 31,134 people in the county (*QuickFacts Montana*, 2021). Of those 13,519 people, 4,326 have been diagnosed with hypertension (Johnson, 2022). That is slightly over 32% and 2% more than

the average person in Montana. If the percentage of diagnosed hypertension is higher than the state average, it stands to reason that the rate of undiagnosed also exceeds the state level. The age range of 18–85 years was determined by the medical staff of the project organization based on internal criteria. The intent of this project is to reduce adverse risks associated with hypertension by identifying persons in this community with undiagnosed hypertension and connecting them with a provider to rule in or rule out the diagnosis of hypertension, affording the opportunity for evidence-based treatment.

Rationale

The Plan-Do-Check-Act (PDCA) will be utilized as the framework for this quality improvement project. According to the Lean Enterprise Institute (2022), this method is an improvement cycle based on the scientific method of initiating a change process, executing the change, measuring the outcomes, and taking suitable action. Sutton et al. (2021) explain the scientific community continues to use and rely on the PDCA process to initiate change in various organizations. These cycles can be easily altered, making minor adjustments to the ongoing process until the team decides the cycles are complete or they are satisfied with the outcomes (Sutton et al., 2021). This project utilized PDCA cycles conducted every 2 weeks for a total of 6 weeks. A description of the elements of the project and related phases of the PDCA follows.

Plan: The planning step for this quality improvement project involved forming a quality improvement team and identifying the stakeholders. The team defined the project's scope and got the process approved within the organization. The information technology specialist set

parameters within Meditech to detect any person between the ages of 18 and 85 who have had two or more hypertensive readings within the last year and is not diagnosed with hypertension.

Do: The Do phase included: providing medical staff with education related to current clinical practice guideline recommendations on diagnosing hypertension, providing nursing staff with teaching on how to take an accurate blood pressure, and licensed clinical social workers contacted patients between the ages of 18 and 85 who have two or more blood pressures greater than 130 mm Hg or 80 mm Hg within the last year and who do not have a hypertension diagnosis. Patients were then invited to schedule an appointment with a provider to address the possibility of undiagnosed hypertension. The newly created patient registry was utilized to manage hypertensive patients.

Check: During the Check phase, the information technology specialist reran the queries to determine if there has been a decrease in the number of patients who have had two or more hypertensive readings in the last year without a hypertension diagnosis. The patient registry was updated using that information.

Act: The Act phase involved evaluating where the process can be improved, reminding providers to leave room on their schedules for these patients, and maintaining the hypertension patient registry. This cycle was run in 2-week intervals during the 6-week project period.

Specific Aims

The project's ultimate goal was to identify patients in a specific population who may have undiagnosed hypertension. Information from this project can then be used to improve patients' cardiovascular risk factors and improve patient and population health outcomes by

addressing modifiable risk factors. This goal was accomplished by reducing the number of undiagnosed hypertensive patients. While it may seem counterintuitive, the number of diagnosed hypertensive patients in the community should increase with project success.. Increasing the number of patients with hypertension provides further opportunities for treatment, which could have the net effect of enhancing the health of the individuals within the community. The risks of cardiovascular events are significantly lower for diagnosed and treated hypertensive patients than those for undiagnosed patients (Zhou et al., 2018). Providers determined if patients have hypertension based on the current clinical practice guidelines. The 2017 ACC/AHA Clinical Practice Guidelines is recognized as the universal guideline for preventing and managing hypertension (Mancia & Corrao, 2018). If it is determined that the patient has hypertension, the provider has the opportunity to create a patient-specific treatment plan. If the patient does not have hypertension, their name will be removed from the patient registry, and their normotensive blood pressure readings will be entered into the chart. The short-term goals for this project are to have 80% of patients contacted return to the clinic to meet with a provider to discuss their blood pressure and to have 95% of providers apply the current AHA/ACC guidelines to diagnose or rule out hypertension. Providers will create individualized treatment plans with each patient to reduce their blood pressure or optimize their health. The intermediate goals for this project were to update the patient registry every 2 weeks, successfully make contact with 95% of new patients added to the registry, and, of those patients, 80% will return to the clinic to meet with a provider. The long-term goal of this project was to reduce the number of undiagnosed hypertensive patients.

Context

The primary participants and stakeholders in this quality improvement project are the chief operations officer, a nurse practitioner, the clinic manager, the clinic's nurse manager, a quality improvement officer, a health information technology specialist, a licensed clinical social worker, and the author. The setting for this quality improvement project is a primary care clinic organization that comprises four clinics and is associated with a 25-bed critical-access hospital in rural Montana. The hospital provides emergency, obstetrical, and orthopedic care. This organization employs fourteen physicians, specialists, and 10 mid-level providers (SLCH, 2022). This facility is within the borders of a federally recognized Indian Reservation and serves a county of approximately 31,000 (*QuickFacts Montana*, 2021).

Intervention and Implementation

This quality improvement project had multiple steps over several months, starting in the fall of 2022 and continuing through the spring of 2023. A detailed timeline is included in Appendix C. The proposed intervention began with the information technology specialist setting up parameters in the EHR and determining the number of patients who are between 18 and 85 years old, and have had two or more blood pressure readings above 130 mm Hg or 80 mm Hg within the last year, and do not have a diagnosis of hypertension. Next, an undiagnosed hypertension registry was created within the EHR and those patients identified through the aforementioned query added to that registry. Patients identified in the registry as potentially having undiagnosed hypertension were presented to their primary care provider to determine if an office visit was appropriate. A licensed clinical social worker then contacted patients whom

the providers requested office visits with via phone calls or patient portal messaging to be evaluated for hypertension. The clinic's nurse manager provided the nursing staff with education and demonstration on how to take an accurate blood pressure. The author educated the medical staff on current clinical practice guidelines for diagnosing hypertension and sent each provider the current 2017 ACC/AHA guidelines via email. The goal of this education is, if determined that patients have hypertension, they will be appropriately diagnosed with stage I or stage II hypertension. Next, they will have a patient-specific treatment plan created through shared decision-making with the provider, then be moved to a hypertension registry and removed from the registry created for this project. The patients with a hypertension diagnosis and blood pressure readings above 130 mm Hg or 80 mm Hg would be on the hypertension registry and are out of this project's scope. The patients who do not have hypertension will be removed from the registry created for this project, and normotensive blood pressure readings updated in their chart. Normotensive readings must be entered into their chart for verification that they do not have hypertension and for Centers for Medicare and Medicaid Services reimbursement purposes. This cycle was repeated every 2 weeks from the beginning of January 2023 to the beginning of March 2023.

The author collected the data from the registry and the information technology specialist at the end of each PDCA cycle and compared the data with the previous cycle. The author presented the former and current data to the team at the biweekly meeting. The project team then decided what adjustments should be made to improve the process. The author and one medical provider are the primary contact persons for the project. The author was available for questions from the team, staff, and medical providers by work phone, cell phone, and email. At the

biweekly meeting, the author checked in with the team to see how they feel things are going and if there is anything they can do to improve the project process.

Budget

The facility where this project takes place has a small grant to improve hypertension within the patient population, which will be used to create the hypertension registry and pay for blood pressure cuffs that insurance will not cover. The chief operating officer will reach out to our local pharmacies to see if they have blood pressure cuffs to donate in honor of heart health month. For longevity purposes, it is essential to keep the project costs minimal.

Barriers and Challenges

This project has a few barriers to overcome. The first one is the limitations of provider availability. It is predicted that there will be far more patients that need to be seen for hypertension episodes than open appointments. This was addressed by requesting providers to leave one appointment a day available to see a hypertension patient. Another barrier was the limited number of staff contacting patients.

Only one licensed clinical social worker was tasked with contacting patients and getting them scheduled. This person was also responsible for entering any home blood pressure readings that patients bring in when providers are in the process of diagnosing hypertension. These tasks are in addition to their daily duties and may quickly become overwhelming for one person. One solution to this is to spread this out among the nursing staff. There is a potential that every provider, with the help of their nursing staff, will manage their own patients using the hypertension registry. Adding this task to providers and nursing staff who are already busy is

challenging. Another option is to pass this on to chronic care management, who are also limited in time and resources. If this project proves to be successful, a new position could be created, but this would be in the future.

Another barrier is patient access to home blood pressure monitoring supplies. Some insurances will pay for the automatic blood pressure cuffs with a prescription, but others will not. The quality improvement team is working on finding money to pay for supplies for patients whose insurance will not cover the necessary supplies.

Evaluation

This quality improvement project was evaluated in various ways throughout the project. The short-term goal was assessed by calculating the number of people successfully seen in the clinic by a provider compared to the total number of people produced by the project's parameters. The goal was to have 80% of people contacted return to the clinic to see a provider. The intermediate goal was evaluated after each 2-week PDCA cycle. The project's parameters will capture additional patients, and the goal was to have 95% of them contacted by the licensed clinical social worker and scheduled for an appointment.

The long-term goal of this project was to reduce the number of undiagnosed hypertensive patients. This goal was evaluated by comparing the number of patients aged 18 to 85, who have two or more blood pressures above 130 mm Hg or 80 mm Hg within the last year, who do not have a diagnosis of hypertension, to the previous number of potentially undiagnosed hypertensive patients produced by the last PDCA cycle. Prior to any interventions, 4,326 patients, or 32%, were diagnosed with hypertension (Johnson, 2022). At the end of this project,

the goal was to have increased the rate of diagnosed hypertension to 35% and decrease the rate of undiagnosed hypertension. Reducing the risk of undiagnosed hypertension will decrease cardiovascular risks and improve the health of the organization's patient population.

Table 1. SMART Goal #1

<table>
<tr><td colspan="3">SMART Goal #1: 80% of people contacted will return to the clinic to see a provider regarding two or more hypertensive readings.

This goal is set at 80% as it is understood that not every person will be available to see a provider in the 2-week timeframe and that some will not be interested in pursuing preventative care.</td></tr>
<tr><td colspan="3">● A licensed clinical social worker (LCSW) will contact patients via phone or patient portal messaging to attempt to schedule patients at their earliest convenience.
● Providers will leave one appointment a day open for hypertension patients.
● Nursing staff will be available to answer questions via phone calls and the patient portal related to hypertension</td></tr>
<tr><td>Data to be collected</td><td>Method of Collection and who is responsible</td><td>Planned data analysis</td></tr>
<tr><td>● The total number of patients detected in the project population
● The number of patients called by LCSW seen in the clinic for hypertension concerns.
● Calculate the percentage</td><td>● Run a check of the Meditech database, which will provide the numbers needed for the project population
● The LCSW will have a list of every patient that they successfully contact. This list will be updated if they attend their appointment because they may need to update their vital sign list.</td><td>● The percentages will be calculated at the end of the PDCA cycle.
● If the 80% goal is not met, the quality improvement team will decide what improvements can be made to encourage people to come to appointments.</td></tr>
</table>

Table 2. SMART Goal #2

<table>
<tr><td colspan="3">SMART Goal #2: 95% of the patients added to the patient registry in the second PDCA cycle will be contacted by the LCSW and scheduled with a provider.

The goal is set at 95%, understanding that it will be a smaller number and that the process should have improved after the first PDCA cycle.</td></tr>
<tr><td colspan="3">● A licensed clinical social worker (LCSW) will contact patients via phone or patient portal messaging to attempt to schedule patients at their earliest convenience.
● Providers will leave one appointment a day open for hypertension patients.
● Nursing staff will be available to answer questions via phone calls and the patient portal related to hypertension
● Providers, nursing staff, and LCSW will assist patients in getting home blood pressure monitoring equipment if needed.</td></tr>
<tr><td>Data to be collected</td><td>Method of Collection and who is responsible</td><td>Planned data analysis</td></tr>
<tr><td>● The total number of patients detected in the project population
● The number of patients called by LCSW seen in the clinic for hypertension concerns.
● Calculate the percentage</td><td>● Run a check of the Meditech database, which will provide the numbers needed for the project population
● The LCSW will have a list of every patient that they successfully contact. This list will be updated if they attend their appointment because they may need to update their vital sign list.</td><td>● The percentages will be calculated at the end of the PDCA cycle.
● If the 95% goal is not met, the quality improvement team will meet and decide what improvements can be made.</td></tr>
</table>

References

American Heart Association News. (2020, May 28). Heart disease, diabetes rates higher for American Indians, Alaska natives. www.heart.org. https://www.heart.org/en/news/2020/05/28/heart-disease-diabetes-rates-higher-for-american-indians-alaska-natives

Centers for Disease Control and Prevention. (2022, September 6). *FASTSTATS - leading causes of death*. Centers for Disease Control and Prevention. https://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm

Ciemins, E. L., Ritchey, M. D., Joshi, V. V., Loustalot, F., Hannan, J., & Cuddeback, J. K. (2018). Application of a tool to identify undiagnosed hypertension—United States, 2016. MMWR. Morbidity and Mortality Weekly Report, *67*(29), 798–802. doi.org/10.15585/mmwr.mm6729a2

County Health Rankings. (2022). Montana. County Health Rankings & Roadmaps. https://www.countyhealthrankings.org/app/montana/2022/rankings/lake/county/factors/overall/snapshot

Johnson, D. (2022). Meditech Patient Demographics. Ronan; Meditech Database.

Lean Enterprise Institute. (2022, June 3). *Plan, do, check, act (PDCA) - A resource guide*. Lean Enterprise Institute. Retrieved October 21, 2022, from https://www.lean.org/lexicon-terms/pdca/

Mancia, G., & Corrao, G. (2018). Global impact of the 2017 American College of Cardiology/American Heart Association Hypertension Guidelines. Circulation, *137*(9), 889–890. doi.org/10.1161/circulationaha.117.032850

Montana DPHHS. (2022). *Cardiovascular*. Cardiovascular Health. https://dphhs.mt.gov/publichealth/cardiovascular/

Ostchega, Y., Fryar, C. D., Nwankwo, T., & Nguyen, D. T. (2020, April). *Hypertension Prevalence Among Adults Aged 18 and Over: United States, 2017–2018*. Centers for Disease Control and Prevention. https://www.cdc.gov/nchs/data/databriefs/db364-h.pdf

Shafneed, C. H. (2019). Gandhi & Health: *Award-Winning Essay*. *The Indian journal of medical research, 149*(Suppl), S153–S157. https://doi.org/10.4103/0971-5916.251673

St. Luke Community Healthcare. (2022, August 19). https://stlukehealthcare.org/

Sutton, K. F., Richman, E. L., Rees, J. R., Pugh-Nicholson, L. L., Craft, M. M., Peaden, S. H., Mackey, M., & Halladay, J. R. (2021). Successful trial of practice facilitation for plan, do, study, act quality improvement. *The Journal of the American Board of Family Medicine*, *34*(5), 991–1002. https://doi.org/10.3122/jabfm.2021.05.210140

QuickFacts Lake County, Montana. United States Census Bureau. (2021). https://www.census.gov/quickfacts/fact/table/lakecountymontana/PST120221

Whelton, P. K., Carey, R. M., Aronow, W. S., Casey, D. E., Collins, K. J., Dennison Himmelfarb, C., DePalma, S. M., Gidding, S., Jamerson, K. A., Jones, D. W., MacLaughlin, E. J., Muntner, P., Ovbiagele, B., Smith, S. C., Spencer, C. C., Stafford, R. S., Taler, S. J., Thomas, R. J., . . . Wright, J. T. (2018). 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/apha/ash/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults. Journal of the American College of Cardiology, *71*(19). doi.org/10.1016/j.jacc.2017.11.006

World Health Organization. (2020, December 9). *The top 10 causes of death*. World Health Organization. Retrieved October 16, 2022, from https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death

World Health Organization. (2021, August 25). *Hypertension*. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/hypertension

Zhou, D., Xi, B., Zhao, M., Wang, L., & Veeranki, S. P. (2018). Uncontrolled hypertension increases risk of all-cause and cardiovascular disease mortality in US adults: The Nhanes III linked mortality study. *Scientific Reports*, *8*(1). https://doi.org/10.1038/s41598-018-27377-2

CHAPTER THREE

UNDIAGNOSED HYPERTENSION MANUSCRIPT

Abstract

Hypertension is a disease that affects millions of people worldwide. It often goes undiagnosed, causing an increased risk of cardiovascular events. This project aimed to reduce the number of patients with undiagnosed hypertension within the observed population. It was conducted within a network of clinics associated with a 25-bed critical-access hospital in rural Western Montana. Participants included clinic staff, physicians, nurse practitioners, physician assistants, registered nurses, licensed practical nurses, medical assistants, and a licensed clinical social worker.

The Plan-Do-Check-Act was used as the framework for this quality improvement project. Hypertension was defined using the 2017 American College of Cardiology and American Heart Association (ACC/AHA) Clinical Practice Guidelines. The electronic medical record system included all out-of-range blood pressures in the last 2 years in a clinical registry. Clinical personnel performed chart reviews to eliminate patients who did not meet the criteria defined by the stakeholders. A patient registry was created and used to manage the list of potentially hypertensive patients. Messages were sent to providers offering to schedule patients for an office visit to rule in or out hypertension. The identified patients were contacted by a licensed clinical social worker and invited to schedule an appointment with a provider to address the possibility of undiagnosed hypertension.

The final numbers were assessed 6 weeks after the undiagnosed hypertension project implementation. A significant reduction in the overall number of potentially undiagnosed hypertensive patients was observed. Out of a total patient population of 13,519 persons, the initial data collection produced 3,617 patients between the ages of 18 and 85, and the last revealed that only 1,210 patients met the criteria. The most significant decrease in number was seen in the 56–65 age group, dropping from 700 to 188 patients potentially with undiagnosed hypertension.

This quality improvement project aimed to identify potentially undiagnosed hypertensive patients and establish a system to assess those patients by a provider. This project accomplished that objective. This quality improvement project was structured on innovative research, a trusted conceptual framework, and current practice guidelines. If the quality improvement team were to extend this project, the next step would be implementing clinical practice guidelines and monitoring hypertension outcomes within the patient population.

Introduction

According to the World Health Organization (2021), 1.28 billion adults reportedly had hypertension worldwide in 2021. Approximately only one in five of those adults successfully managed their chronic disease. The Centers for Disease Control and Prevention (2022) reported heart disease as the number one killer in the United States, followed by cancer and COVID in 2020. According to Ostchega et al. (2020), 45% of adults in the United States have hypertension, a rate that steadily grows with age. In the state of Montana, 29.5% of adults reportedly have hypertension (Montana DPHHS, 2022). The county where this project takes place is one of the

least healthy counties in the state. Reporting high rates of smoking, obesity, excessive alcohol consumption, drug use, and low rates of physical activity, contributing to the local hypertension issue (County Health Rankings, 2022).

The World Health Organization (2021) explains blood pressure as the force applied to the walls of arteries and major blood vessels throughout the body by circulating blood. It is defined as hypertension when the pressure on the arteries' and vessels' walls is too high. Stage I hypertension is defined as a systolic blood pressure of 130–139 or a diastolic blood pressure of 80–89 mm Hg by the 2017 American College of Cardiology and American Heart Association (ACC/AHA) Clinical Practice Guidelines (Whelton et al., 2018). Stage II hypertension is characterized as greater than 140 mm Hg or more than 90 mm Hg. The ACC/AHA states providers are to use the averages of two or more blood pressure readings attained on two or more occasions to diagnose hypertension. Providing twice-daily blood pressure readings over 2 weeks to be assessed during a visit would be ideal (Whelton et al., 2018).

Hypertension has many associated risks, but those risks significantly increase when hypertension goes undiagnosed; only 42% of adults worldwide are diagnosed (World Health Organization, 2021). Ciemins et al. (2018) report roughly 11 million adults in the United States with universal healthcare access have undiagnosed hypertension. This number has likely increased since the 2017 ACC/AHA Clinical Practice Guideline change, which decreased the systolic and diastolic numbers necessary to meet the stage I hypertension criteria (Ciemins et al., 2018). This project aimed to reduce the number of patients with undiagnosed hypertension within the observed population.

Conceptual Framework

The Plan-Do-Check-Act (PDCA) was the framework chosen for this quality improvement project. PDCA is an improvement cycle based on the scientific method of initiating a change process, executing the change, measuring the outcomes, and taking suitable action (Lean Enterprise Institute, 2022). These cycles can be simply altered, modifying the ongoing process until the team decides the cycles are concluded, or they are satisfied with the results (Sutton et al., 2021). The team conducted PDCA cycles every 2 weeks for a total of three cycles. A description of the elements of the project and related phases of the PDCA follows.

Plan: The planning phase for this quality improvement project included forming a quality improvement team and identifying the stakeholders. The team defined the project's scope and approved the process within the organization. The information technology specialist created parameters within Meditech to detect any person between the ages of 18 and 85 who have had two or more hypertensive readings within the last 2 years and is not diagnosed with hypertension.

Do: The Do phase included providing medical staff with education related to current clinical practice guideline recommendations on diagnosing hypertension, providing nursing staff with teaching on how to take an accurate blood pressure reading, and clinical personnel on the team performed chart reviews to look at blood pressure trends in an effort to exclude patients not likely to have hypertension from the intervention group. Messages were sent to providers offering to schedule patients for an office visit to rule in or out hypertension. A licensed clinical social worker (LCSW) contacted patients who were to be included in the intervention. The LCSW called patients and invited them to schedule an appointment with a provider to address

the possibility of undiagnosed hypertension. The newly created patient registry was utilized to manage and sort hypertensive patients. Follow-up appointments were scheduled as needed for each patient based on the ACC/AHA Clinical Practice Guidelines.

Check: During the Check phase, the information technology specialist reran the queries to determine if there had been a change in the number of patients who have had two or more hypertensive readings in the last 2 years without a hypertension diagnosis. The patient registry was updated using current Meditech data.

Act: The Act phase involved evaluating where the process could be improved after each PDCA cycle. Multiple adjustments were made throughout the three PDCA cycles. The order of each PDCA process and interventions are discussed in detail in the following sections.

Methods

There are multiple methods and tactics for QI projects; however, the basic underlying fundamentals of cyclic activity remain the same (Section 4: Ways to approach the quality improvement process, 2020). This project underwent several adjustments. Due to barriers and unforeseen challenges, multiple unplanned changes and accommodations had to be made.

The first PDCA began on January 16, 2023. During the week prior to that, the IT team built the patient registry. They worked on programing the functions needed to set the age parameters to capture patients 18–85 years old with two or more blood pressures greater than 130mm Hg (systolic) or 80mm Hg (diastolic) who do not have an existing diagnosis of hypertension. At the January medical staff meeting, just before starting the first PDCA cycle, providers voiced their concern about patients being called to the clinic to be seen for unnecessary

visits regarding out-of-range blood pressure. Medical staff consensus was that when patients were identified for potential visits, the LCSW would message the providers for their approval or denial before contacting the patient. This PDCA cycle ran for 2 weeks and ended at midnight on January 29, 2023.

The first PDCA cycle revealed several barriers the team needed to address. The team's first and most significant challenge was Meditech's limitations. Meditech could capture the desired age range, 18–85, but it could not capture two blood pressures greater than 130mm Hg systolic or 80mm Hg diastolic on one patient within the 2-year timeframe. This limitation created the need for manual chart reviews by clinical personnel. Chart reviews were time-consuming and could not be done by the author due to the IRB limitations, which further limited the staff available for such a time-intensive process.

After the first PDCA cycle, the team also realized that numerous patients were not assigned to a primary care provider within the project organization. Due to the vast number of patients the first cycle produced, the team decided to remove those patients from the registry. As part of community wellness, it was recognized that the organization and the team had to start implementing change in a manageable number of patients and within a patient population that was reachable within our facility before the team could reach outside of the organization.

The second PDCA cycle began on January 30, 2023, and ran till midnight on February 12, 2023. The second PDCA cycle generated feedback from the providers that several patients they received messages about had been seen recently. They did not want to receive notifications on any patient they had seen for an office visit within the last 6 months. It was determined by IT that Meditech could not implement a filter for the registry to eliminate patients who had been

seen in the previous 6 months. This had to be done manually through the chart reviews. Looking for a visit within the last 6 months as well as out-of-range blood pressures, added time to the already tedious process of manual chart reviews.

The second PDCA cycle also produced feedback from the providers regarding numerous messages in a day from the team. According to several providers, this became overwhelming and frustrating for them. The team decided to use the registry function to sort patients according to provider and send no more than three messages per day to each provider. Reducing the number of messages sent kept the workload manageable for each provider, clinical personnel, and the LCSW making the patient phone calls.

The third PDCA cycle ran from February 13, 2023, to midnight February 26, 2023. After this PDCA cycle, providers stated they would have liked to tailor the messages they received to their practice criteria to eliminate getting messages about certain patients, such as pregnant patients or patients over the age of 75, not 85. The team also learned that the medical staff did not have a significant buy-in with this process. They strongly supported the ACC/AHA guidelines but felt like they would address hypertension at regular appointments. Having low buy-in with the organizational leadership and medical staff creates a barrier to any project.

Interventions

As previously stated, multiple planned and unplanned accommodations were necessary to make this project successful. Due to limiting factors of the electronic medical record (EMR) system, the team had to implement manual chart reviews by clinical personnel to filter out patients who did not meet the criteria. Once the team eliminated those patients who did not meet the requirements, the remaining patients were referred to the LCSW. The LCSW sorted the

charts by the primary care provider, using the patient registry, and then sent each provider three patient referrals a day. The providers then approved or denied the referral based on the patient's chart and provider-patient history. Those approved referrals were contacted by the LCSW and invited to have an appointment to rule in or rule out undiagnosed hypertension. Those patients denied by the provider were effectively ruled out based on their medical history and the provider's personal practice criteria, as they did not meet the criteria for the project.

Measures

A change in the number of patients with potentially undiagnosed hypertension within each PDCA cycle is how the team measured this project. With each change, the QI team met and discussed how they could improve the process. The patient registry was broken down into seven age groups and the number of patients in each age group was tracked throughout each cycle. At the beginning of each PDCA cycle, Meditech calculated every patient within the organization who was between the ages of 18 and 85 years and had blood pressure greater than 130mm Hg or 80mm Hg who did not have a diagnosis of hypertension. These patients were added to the registry if they were not already on it. The registry number decreased as the team worked to remove patients through the project process. That is how the number of potentially undiagnosed hypertension was measured.

The participation and cooperation of multiple stakeholders were one of many factors that contributed to the project's success. All of the stakeholders, the LCSW, and all the providers participated and communicated throughout this project. The key stakeholders in this project were the chief operations officer, a nurse practitioner, the clinic manager, the clinic nurse manager, a quality improvement officer, two health information technology specialists (IT), a licensed

clinical social worker, and the author. The nurse practitioner, the clinic manager, the clinic's nurse manager, and the author frequently spoke to the 10 participating providers within the organization to gain feedback and input throughout the 6 weeks of PDCA cycles. The nurse practitioner and the clinic manager went to monthly staff meetings to provide updates and gain information from the medical staff.

Results

The first PDCA cycle revealed 3,617 patients with potentially undiagnosed hypertension. This is roughly 26.8% of the total patient population for this organization. The total patient population varies daily as patients expire, leave the area, and new patients establish care. There were 410 patients between the ages of 18 and 25 years; 646 between the ages of 26 and 35; 637 between the ages of 36 and 45; 653 between 46 and 55; 700 between 56 and 65; 453 between 66 and 75; and 118 between the ages of 76 and 85. The second PDCA cycle displayed a reduction in the overall numbers. The reduction was due to four steps the team took. First, the team eliminated all patients who did not have a primary care provider within the organization in which this project took place. Second clinical personnel performed chart reviews, effectively ruling out patients who did not meet the project criteria. Next, the primary care providers ruled out a significant portion of patients based on their personal practice criteria. Lastly, patients were removed from the registry by being referred to a primary care provider for a hypertensive assessment. The second PDCA cycle revealed 2,221 patients with potentially undiagnosed hypertension, representing approximately 16.4% of the total patient population. There were 214 patients between the ages of 18 and 25; 327 between the ages of 26 and 35; 364 between the ages

of 36 and 45; 434 between 46 and 55; 465 between 56 and 65; 331 between 66 and 75; and 87 between the ages of 76 and 85. The third and final PDCA cycle again revealed a reduction in the overall number of patients with potentially undiagnosed hypertension. The reduction was due to three steps the team implemented. First clinical personnel performed chart reviews. These chart reviews effectively ruled out patients who did not meet the project criteria. Second, the primary care providers ruled out patients based on their personal practice criteria. Lastly, patients were removed from the registry by being referred to a primary care provider for a hypertensive assessment. The final PDCA number was 1,201, which was about 8.9% of the total patient population. There were 167 patients between the ages of 18 and 25; 154 between the ages of 26 and 35; 195 between the ages of 36 and 45; 207 between 46 and 55; 188 between 56 and 65; 168 between 66 and 75; and 122 between the ages of 76 and 85.

Figure 2. Undiagnosed Hypertension

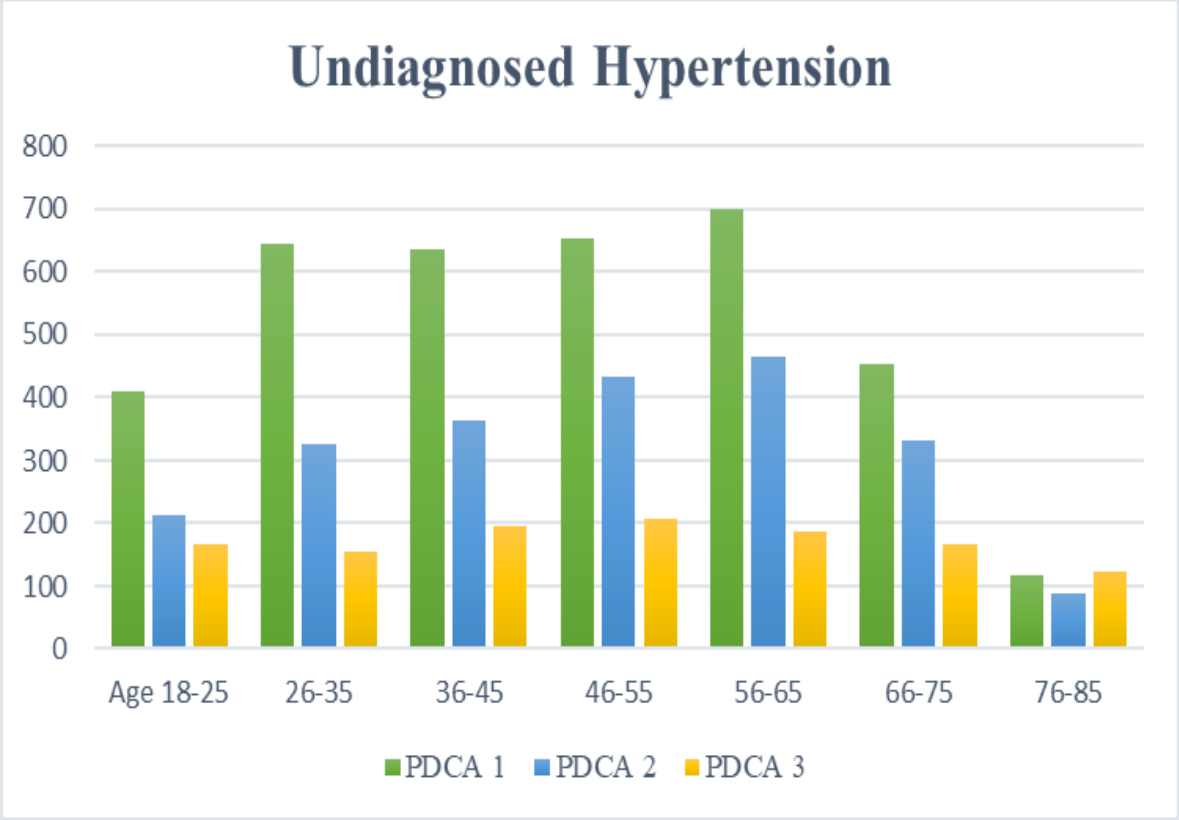
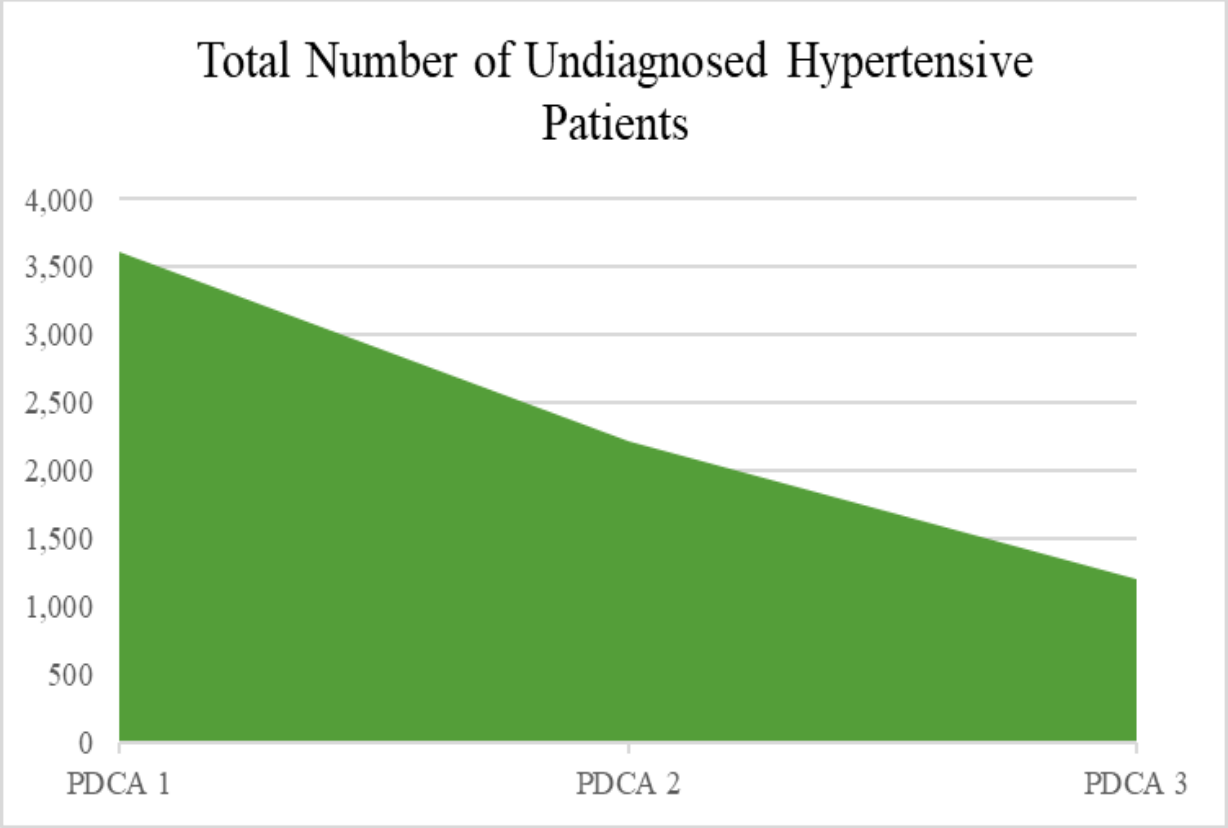


Figure 3. Total Number of Undiagnosed Hypertensive Patients



Analysis

Every patient on the registry who was between the ages of 18 and 85 and had two or more blood pressures greater than 130 systolic or 80 diastolic within the last 2 years was referred to their primary care provider. Due to the limitations of the platform, this number was not tracked. If they did not meet these criteria, they were removed from the registry and were not referred for care as they did not fit the measures for undiagnosed hypertension. Every provider has their own personal practice criteria; if they did not feel like that patient met their criteria, the patient was removed from the registry per their instruction.

Once patients were identified, the intervention the team implemented was getting those patients seen by a provider to afford them the opportunity to receive evaluation and, potentially,

treatment. Treatment may be pharmacological or nonpharmacological. According to Whelton et al. (2018), weight loss, following the DASH diet, reducing dietary sodium intake, increasing dietary potassium intake, and increasing daily aerobic physical activity may be adequate treatment for patients with stage I hypertension.

Due to this project's time constraints, our LCSW could only contact 79 patients successfully. Of those 79 patients, 30 of them agreed to make an appointment. Reaching multiple patients was an overwhelming task for one person in addition to her busy daily schedule. It also highlighted the number of patients who do not have working phone numbers listed within the EMR. This was a major barrier she faced when attempting to contact identified patients. She also struggled to get patients scheduled within the project's timeframe.

Of the 12 providers in the organization, 10 were assigned patients. The two newest providers to the organization were not yet listed on any patients' charts as primary care providers. According to the clinical personnel doing the chart reviews who sent the messages to the primary care providers, a significant portion of the messages were returned with a "no," meaning the provider did not want the patient to be seen. Throughout all three of the PDCA cycles, it was estimated that providers only approved 10% to 15% of patients they received messages about. These patients were identified by clinical personnel as the ones who they deemed appropriate for potential appointments to rule in or rule out undiagnosed hypertension. The low volume of patient referrals speaks to the lack of buy-in of the medical staff and their tendency to follow their traditional practice patterns versus translating evidence into practice. Many providers aim for ACC/AHA guidelines but are comfortable with the old JNCC 8 guidelines. This is further reinforced by CMS reimbursement standards that follow the JNCC 8

guidelines for hypertension of 140/90. Experienced providers also accept that there is a level of realistic expectations from patients, meaning that many are comfortable with the 140/90 standard because they know that this is an attainable goal for their patient population.

The team did not accomplish its first SMART goal. However, after all the project changes, a slightly altered SMART goal would have been more appropriate. The first SMART goal stated, “80% of people contacted will return to the clinic to see a provider regarding two or more hypertensive readings.” This goal would have been more appropriate if it stated, “80% of people contacted will be scheduled to see a provider.” After seeing the vast number of patients the team was dealing with, it was clear there was not enough time during this project to get all of these patients in to see providers. According to the LCSW, most patients were receptive to being scheduled for appointments, although some did not have active phone numbers, and some were not interested. Throughout the three PDCA cycles, approximately 49% of patients identified as having potentially undiagnosed hypertension had agreed to be seen by providers.

The second SMART goal stated, “95% of the patients added to the patient registry in the second PDCA cycle will be contacted by the LCSW and scheduled with a provider.” In practice, this project produced far more patients than predicted. To accomplish this SMART goal, additional staff would be needed to contact all the patients on the registry. The time allotted for this project in light of the LCSW’s regular duties was insufficient. The team agreed that not meeting this goal revealed an opportunity to expand the scope of a future project with adequate resources allocated in order to achieve the goal. A more appropriate SMART goal would have been “95% of the patients added to the patient registry will be contacted by a clinical team

member and scheduled with a provider." Future projects would benefit from additional staff, resources, and time to accomplish their goals.

Discussion

Summary

In final reflection, the foundation of this project is sound. Lessons learned would enhance the framework for a future project translating current research regarding undiagnosed hypertension into improved practice. The limitations of the health information technology and the scope of the project would necessitate a larger project team and more time to complete the project. Improvements to the EMR could potentially reduce the amount of manual chart review the team had to perform. The manual chart review to screen patients who did not meet requirements took significant time and clinical judgment to complete. The team would also benefit from more than one person making phone calls to make contact with patients. This was also more time-demanding than expected. Overall, this could be a very successful and beneficial QI project in the future.

Interpretation

With adults in the United States having hypertension at a rate of 45% and Montanans having hypertension at a rate of nearly 30%, it is clear that identifying patients with undiagnosed hypertension is essential (Ostchega et al., 2020; Montana DPHHS, 2022). This project translates research into current practice by implementing a functional system that identifies patients that potentially have undiagnosed hypertension and gets them assessed by a provider. Evaluating patients for undiagnosed hypertension is particularly imperative in the county where this project

took place, as it is one of the least healthy counties in the state. This county statistically shows high rates of obesity, smoking, excessive alcohol consumption, and low rates of physical activity (County Health Rankings, 2022).

In PDCA 1, the total number of potentially undiagnosed hypertensive patients was 3,617. By PDCA 3, that number had dropped to 1,201. The decrease between these cycles signifies the effectiveness and necessity of this project. While there is room for improvement, the project successfully reduced the number of patients with potentially undiagnosed hypertension within the target population. Reducing the number of those with undiagnosed hypertension also decreases adverse CVD events and potentially improves overall health outcomes.

Limitations

Several limitations and challenges were encountered in implementing this project, the most remarkable being time. Significantly more information could have been gleaned from this project if it had spanned 6 to 9 months. The expanded timeframe would have allowed for conducting several PDCA cycles. Working out the EMR issues to eliminate the manual chart reviews and removing patients from the registry who had been seen by their provider within the last 6 months would have saved a significant amount of time for the team. Having more time to get patients in to see providers would allow the team time to collect more data. Allowing more time for this project would also provide the opportunity to expand it to track blood pressure trends. Monitoring blood pressure trends would have revealed if we captured undiagnosed hypertension as well as reduced hypertension rates within the project population. The longer patients live with undiagnosed hypertension, the poorer their health outcomes are, potentially shortening their life expectancy.

As mentioned, the EMR system was a limiting factor as it was only able to capture one out-of-range blood pressure versus the two needed by the 2017 ACC/AHA guidelines to meet the criteria for hypertension. Only being able to flag one hypertensive episode generated the need for manual chart reviews to weed out patients who did not meet the requirements. Performing manual chart reviews was a very time-consuming task for clinical personnel and one that was not included in the plan when designing this QI project. A cost-benefit for correcting this EMR issue would be eliminating the hourly cost of every clinical personnel who worked on the manual chart reviews. Fine-tuning this process would turn this project into a proactive versus reactive patient management process. For example, providers would not wait to see patients and only then realize they have hypertension. Or, the organization would seek out patients with a potential problem.

Another limitation was related to provider buy-in due to their busy schedules and multiple daily computer tasks. Getting patients booked with a provider in a short time-period to be evaluated for hypertension was difficult. Some providers also found the additional messages and appointments to be a burden to their already heavy daily workload. The team attempted to limit this by only sending three messages per day to each provider. Overall, the project was widely accepted, and all departments participated, but there was some minor pushback.

Recommendations

Currently, it is undecided if the project will continue within the facility. It has been proposed to the medical staff, but no final decision has been made. The project's structure is still in place and can be continued anytime. The EMR being unable to capture two or more blood pressures within the given timeframe and incapable of removing the patients seen by a provider within the last 6 months from the patient registry creates a significant barrier. It is unlikely that

staff will continue to be available to do the time-consuming task of manual chart reviews. These limiting factors make the project difficult to sustain in the long term. If, at some time in the future, it is determined that the EMR can make these changes, the medical staff may be willing to consider this a long-term preventative tool for capturing undiagnosed hypertension.

After meeting with the medical staff in January to review the prevalence of undiagnosed hypertension and the criteria for stage I hypertension, each provider was emailed a current copy of the 2017 ACC/AHA Clinical Practice Guidelines. This guideline provides multiple algorithms and charts that support diagnosis, nonpharmacological, and pharmacological treatment of hypertension as well as multiple other complex facets of hypertension. These tools are easy to read and quick to reference. Despite providing evidence-based tools to the primary care providers, affecting change to traditional practice patterns is a slow process. This highlights the need for other innovative ways to incorporate current research and clinical practice guidelines into daily practice patterns.

Conclusion

The overriding objective of this quality improvement project was to identify potentially undiagnosed hypertensive patients and organize a system to get those patients assessed by a provider. The project accomplished that objective. Although the team was unable to follow the steps initially planned, it did achieve its end goal. The team created a quality improvement project that could be replicated within the organization where it took place or another healthcare facility. The project was structured on innovative research, a trusted conceptual framework, and current practice guidelines. Also, the number of patients identified with out-of-range blood

pressures highlights the need for a project of this type, in that the scope of the problem warrants implementing an evidence-based solution. If the quality improvement team were to advance this project in the future, the next logical step would be to implement the 2017 ACC/AHA Clinical Practice Guidelines and monitor hypertension outcomes within the patient population. Following that, the project framework lends itself to look outside of the organization's current patient population to those patients with data in the EHR, but who are not established with a primary care provider. Healthcare should not be a business of treating numbers but people. With this quality improvement project, the team turned data-driven care into patient-driven care.

References

Centers for Disease Control and Prevention. (2022, September 6). *FASTSTATS - leading causes of death*. Centers for Disease Control and Prevention. https://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm

Ciemins, E. L., Ritchey, M. D., Joshi, V. V., Loustalot, F., Hannan, J., & Cuddeback, J. K. (2018). Application of a tool to identify undiagnosed hypertension—United States, 2016. MMWR. Morbidity and Mortality Weekly Report, *67*(29), 798–802. doi.org/10.15585/mmwr.mm6729a2

County Health Rankings. (2022). Montana. County Health Rankings & Roadmaps. https://www.countyhealthrankings.org/app/montana/2022/rankings/lake/county/factors/overall/snapshot

Lean Enterprise Institute. (2022, June 3). *Plan, do, check, act (PDCA) - A resource guide*. Lean Enterprise Institute. https://www.lean.org/lexicon-terms/pdca/

Montana DPHHS. (2022). *Cardiovascular*. Cardiovascular Health. https://dphhs.mt.gov/publichealth/cardiovascular/

Ostchega, Y., Fryar, C. D., Nwankwo, T., & Nguyen, D. T. (2020, April). *Hypertension Prevalence Among Adults Aged 18 and Over: United States, 2017–2018*. Centers for Disease Control and Prevention. https://www.cdc.gov/nchs/data/databriefs/db364-h.pdf

Section 4: Ways to approach the quality improvement process. AHRQ. (2020, January). https://www.ahrq.gov/cahps/quality-improvement/improvement-guide/4-approach-qi-process/index.html

Sutton, K. F., Richman, E. L., Rees, J. R., Pugh-Nicholson, L. L., Craft, M. M., Peaden, S. H., Mackey, M., & Halladay, J. R. (2021). Successful Trial of Practice Facilitation for plan, do, study, ACT Quality Improvement. *The Journal of the American Board of Family Medicine, 34*(5), 991–1002. https://doi.org/10.3122/jabfm.2021.05.210140

Whelton, P. K., Carey, R. M., Aronow, W. S., Casey, D. E., Collins, K. J., Dennison Himmelfarb, C., DePalma, S. M., Gidding, S., Jamerson, K. A., Jones, D. W., MacLaughlin, E. J., Muntner, P., Ovbiagele, B., Smith, S. C., Spencer, C. C., Stafford, R. S., Taler, S. J., Thomas, R. J., . . . Wright, J. T. (2018). 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/apha/ash/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults. Journal of the American College of Cardiology, *71*(19). doi.org/10.1016/j.jacc.2017.11.006

World Health Organization. (2021, August 25). *Hypertension*. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/hypertension

World Health Organization. (2022, September 16). Non communicable diseases. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases

CHAPTER FOUR

A REFLECTION OF THE DOCTORATE OF NURSING PRACTICE ESSENTIALS

Essential I: Scientific Underpinnings for Practice

According to The Essentials of Doctoral Education for Advanced Nursing Practice (2006), graduates can incorporate nursing science with ethics, psychosocial, biophysical, and organizational sciences as a foundation for the ultimate nursing practice. The graduate will utilize scientific theories and concepts to determine the impact of health and healthcare delivery, detail the actions and tactics that will improve healthcare delivery experiences, and critically evaluate the outcomes. Lastly, the graduate will create and critique new practice approaches (The Essentials of Doctoral Education for Advanced Nursing Practice, 2006).

Completing the quality improvement project has allowed the graduate to fulfill the first DNP essential. The graduate has incorporated nursing science with biophysical and organizational sciences throughout this project by analyzing undiagnosed hypertension and coordinating interdepartmental strategic outcomes. Navigating this project proved the graduate capable of utilizing scientific theories and concepts and of evaluating the results they produced. The PDCA cycle was implemented during the quality improvement project. This process exemplifies how the graduate implemented scientific concepts and assessed the outcomes. At the end of each PDCA cycle, the graduate coordinated with the stakeholders. They evaluated the results and determined the best action to improve the process and outcomes.

Essential II: Organizational and Systems Leadership

The second DNP essential, Organizational and Systems Leadership, contains three components. According to The Essentials of Doctoral Education for Advanced Nursing Practice (2006), the first component of this essential is developing and evaluating care-delivery approaches that meet the current and future needs of patient populations based on scientific findings in nursing, other clinical sciences, and organizational, political, and economic sciences. The graduate adequately met this essential through the Evidence-Based Practice I and II courses. Evidence-Based Practice I and II classes required the completion of matrix tables. Creating matrix tables required scientific-based studies, organization, and structure. Any disorganization leads to confusion and misinformation. Putting all the data into a matrix table made it easy to analyze the information. Based on data analysis, conclusions were drawn, and a care plan was developed. The care plan for each patient was different and continuously flexible to accommodate their ever-changing needs. In Evidence-Based Practice II, a paper was written based on the data compiled in the matrix table.

The second component addressed communication processes, employing business, finance, economics, and health policy principles, developing and monitoring budgets, and analyzing the cost-effectiveness of practice initiatives (The Essentials of Doctoral Education for Advanced Nursing Practice, 2006). This element was successfully met through the Design H C Delivery Systems course. Graduates had to complete a 5P Microsystem Assessment. The 5P Microsystem Assessment accentuated the importance of effective communication between staff and multiple departments throughout the organization. Later in the course, students completed Learning Circle (LC) five: Supply Management. This LC required nursing students to spend a

few hours in their local hospital's materials management department. This time was highly informative as it expressed the importance of minimizing waste and how reducing it can significantly affect the organization. The last assignment of LC five required students to create a Pareto chart. The Pareto chart pushed the nursing staff to analyze the cost-effectiveness of their practice habits and the habits of those around them.

The third component, developing and evaluating effective strategies for managing the ethical dilemmas inherent in patient care, the healthcare organization, and research (The Essentials of Doctoral Education for Advanced Nursing Practice, 2006), was completed through the course of Evidence-Based Practice I. During the last few weeks of the semester, students had to write a group paper about health promotion. This paper addressed effective methods for handling ethical dilemmas relating to patient care and within healthcare organizations. The Evidence-Based Practice I and II courses provided several valuable articles about issues dealing with ethical dilemmas. The Belmont Report is an excellent example of readings addressing ethical research issues.

Essential III: Clinical Scholarship and Analytical Methods for Evidence-Based Practice

Doctorate of Nursing Practice Essential III, Clinical Scholarship and Analytical Methods for Evidence-Based Practice has three main components. The first component, using analytical methods to critically appraise existing literature and other evidence to determine and implement the best evidence for practice (The Essentials of Doctoral Education for Advanced Nursing Practice, 2006), has been successfully met through the completion of courses Evidence-Based Practice I and II. Both classes required the creation of matrix tables. Generating a matrix table

provided an organized platform to review and analyze literature to write a paper or create a PowerPoint presentation. Working in groups provided additional insights, ideas, and references. Each team member searched for relevant information using Google Scholar, US National Library of Medicine, Web of Science, Cochrane Library, CINAHL, Google, and CatSearch, which links to multiple health-related databases.

The second component, designing and implementing processes to evaluate outcomes of practice, practice patterns, and care systems within various practice settings to determine variances in practice outcomes and population trends, was met through the Design H C Delivery Systems course and Evidence-Based Practice II (The Essentials of Doctoral Education for Advanced Nursing Practice, 2006). In the Design H C Delivery Systems course, students were challenged with creating an A3 model, an excellent, evidence-based, problem-solving tool that provides the structure for continued improvement. Continuous improvement is highly beneficial to patients and staff in the healthcare setting.

The Design H C Delivery Systems course fulfilled the third and final component, designing, directing, and evaluating quality improvement methodologies to promote safe, timely, effective, efficient, equitable, and patient-centered care (The Essentials of Doctoral Education for Advanced Nursing Practice, 2006). Multiple quality improvement projects were required. These projects included a Value Stream Map, 5P Microsystem Assessment, Pareto Chart, Lean process, and numerous flow charts. Being proficient at quality improvement projects is an invaluable trait in a team member and ensures that patient-centered care is always a priority in the organization.

Essential IV: Technology for the Improvement and Transformation of Health Care

Doctorate of Nursing Practice Essential IV, Technology for the Improvement and Transformation of Health Care, has multiple components. Acquiring a comprehensive understanding of these components provided the groundwork needed for building a successful practice. The first component of this essential addresses programs that evaluate and monitor care systems and quality improvement, including consumer use of healthcare information systems (The Essentials of Doctoral Education for Advanced Nursing Practice, 2006). This component was met through the following courses: Design of Health Care Systems, Health Care Informatics, Program Planning and Evaluation, Outcomes, and Quality Improvement. These classes provided the opportunity to research and evaluate different programs and their outcomes. In the Design of Health Care Systems course, a 5P Microsystem Assessment was performed. This project allowed the analyst to observe the subpopulations served at St. Luke Convenient Care and evaluate the efficiency of their care.

The second component speaks to the graduate analyzing and communicating critical elements necessary to selecting, using, and evaluating healthcare information systems and patient care technology (The Essentials of Doctoral Education for Advanced Nursing Practice, 2006). This constituent was met through a reflective essay for the Design of Health Care Systems class. The essay described and explained the importance of improving healthcare systems, quality management, coordinating interdisciplinary teams, and reducing risk through decreased medical error. The second component was also met through the Health Care Informatics Project in the

Health Care Informatics course. This project reviewed a medical device and proposed the implementation of the device into a vulnerable population.

Component three consists of students demonstrating the conceptual ability and technical skills to develop and execute an evaluation plan involving data extraction from practice information systems and databases (The Essentials of Doctoral Education for Advanced Nursing Practice, 2006). This constituent was met through the Statistical Application and Design of Health Care Systems courses. During the Statistical Application class, a distribution table was created using information gathered from a database. In the Design of Health Care Systems course, a Supply Management Quality Improvement project was proposed. This project evaluated current systems, extracted database information, and suggested improvements.

Essential V: Health Care Policy for Advocacy in Health Care

According to The Essentials of Doctoral Education for Advanced Nursing Practice (2006), DNP essential V prepares the graduate to accomplish a multitude of things. These include critically analyzing health policy proposals and demonstrating leadership in developing and implementing institutional, local, state, and federal policymakers through active participation on committees, boards, or task forces at the institutional, regional, and state levels to improve healthcare delivery and outcomes. The graduate demonstrated this essential through the completion of the quality improvement project. This project invoked policy change within the organization where it took place. Through active participation on a committee, the graduate took part in improving healthcare delivery and outcomes.

Essential VI: Interprofessional Collaboration for Improving Patient and Population Health Outcomes

Doctorate of Nursing Practice Essential VI, Interprofessional Collaboration for Improving Patient and Population Health Outcomes, has three components. The first component declares the graduate will engage in effective communication and collaboration skills in creating and implementing models, peer review, practice guidelines, health policy, standards of care, and other scholarly products (The Essentials of Doctoral Education for Advanced Nursing Practice, 2006). In the course Advanced Nursing Leadership, the "Personal Leadership Philosophy" paper addressed the importance of exceptional communication, demonstrated collaborative skills by leading by example, and being aware of individual and team strengths and weaknesses.

The second component addresses leading interprofessional teams in analyzing complex practice and organizational issues (The Essentials of Doctoral Education for Advanced Nursing Practice, 2006). The course that most clearly demonstrates this constituent is Advanced Nursing Leadership. The group paper "Conflict During a Disaster" demonstrated leadership in constructing the document and the body of the article. It also addressed organizational issues and interprofessional teams.

The third constituent speaks to the graduate employing leadership skills with interprofessional teams to create change in healthcare and complex healthcare delivery systems (The Essentials of Doctoral Education for Advanced Nursing Practice, 2006). This component was demonstrated in the group PowerPoint, "Substance Abuse," in the Vulnerability and Health Care in Diverse Communities class. This PowerPoint addressed the need for more

interprofessional communication and collaboration, especially in rural areas, to improve the health outcomes of those who suffer from addiction.

Essential VII: Clinical Prevention and Population Health for Improving the Nation's Health

According to The Essentials of Doctoral Education for Advanced Nursing Practice (2006), DNP Essential VII prepares the graduate to synthesize concepts, including psychosocial dimensions and cultural diversity related to clinical prevention and population health, to address health promotion and disease prevention. This concept was demonstrated through the course Vulnerable Populations. The assignment "Substance Abuse ABCDE Assessment" addressed the healthcare needs of rural patient populations. This assessment occurred on a federally recognized reservation, representing an underserved and culturally diverse population.

Essential VIII: Advanced Nursing Practice

Essential VIII prepares the graduate to conduct a comprehensive and systematic assessment of health and illness parameters in complex situations and demonstrate advanced clinical judgment and systems thinking. The graduate should also be able to deliver and evaluate evidence-based care to improve patient outcomes (The Essentials of Doctoral Education for Advanced Nursing Practice, 2006). The courses NRSG Advanced Clinical 621, 622, 623, and 624 fulfilled this essential. These classes provided over 670 hours of clinical experience with patients in various specialties. The graduate was required to complete SOAP notes, care plans, and charting in Meditech and Typhon. The graduate created each individualized patient care plan based on current clinical practice guidelines using evidence-based practice.

References

Carey, R., & Whelton, P. (2018). Prevention, detection, evaluation, and management of high blood pressure in adults: Synopsis of the 2017 American College of Cardiology/American Heart Association hypertension guideline. Annals of Internal Medicine, *168*(5), 351–358. doi: 10.7326/M17-3203

The Essentials of Doctoral Education for Advanced Nursing Practice. (2006). American Association of College of Nursing. https://ecat.montana.edu/d2l/le/content/739281/viewContent/7144098/View

CUMULATIVE LIST OF REFERENCES CITED

American Heart Association News. (2020, May 28). Heart disease, diabetes rates higher for American Indians, Alaska natives. www.heart.org. https://www.heart.org/en/news/2020/05/28/heart-disease-diabetes-rates-higher-for-american-indians-alaska-natives

Armitage, L. C., Whelan, M. E., Watkinson, P. J., & Farmer, A. J. (2019). Screening for hypertension using emergency department blood pressure measurements can identify patients with undiagnosed hypertension: A systematic review with meta-analysis. The Journal of Clinical Hypertension, *21*(9), 1415–1425. doi.org/10.1111/jch.13643

Arnett, D. K., Blumenthal, R. S., Albert, M. A., Buroker, A. B., Goldberger, Z. D., Hahn, E. J., Himmelfarb, C. D., Khera, A., Lloyd-Jones, D., McEvoy, J. W., Michos, E. D., Miedema, M. D., Muñoz, D., Smith, S. C., Virani, S. S., Williams, K. A., Yeboah, J., & Ziaeian, B. (2019). 2019 ACC/AHA guideline on the primary prevention of cardiovascular disease: A report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Circulation, *140*(11). doi.org/10.1161/cir.0000000000000678

Ayilara, O. F., Zhang, L., Sajobi, T. T., Sawatzky, R., Bohm, E., & Lix, L. M. (2019). Impact of missing data on bias and precision when estimating change in patient-reported outcomes from a clinical registry. *Health and Quality of Life Outcomes, 17*(1). https://doi.org/10.1186/s12955-019-1181-2

Carey, R., & Whelton, P. (2018). Prevention, detection, evaluation, and management of high blood pressure in adults: Synopsis of the 2017 American College of Cardiology/American Heart Association hypertension guideline. Annals of Internal Medicine, *168*(5), 351–358. doi: 10.7326/M17-3203

Centers for Disease Control and Prevention. (2022, September 6). *FASTSTATS - leading causes of death*. Centers for Disease Control and Prevention. https://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm

Ciemins, E. L., Ritchey, M. D., Joshi, V. V., Loustalot, F., Hannan, J., & Cuddeback, J. K. (2018). Application of a tool to identify undiagnosed hypertension—United States, 2016. MMWR. Morbidity and Mortality Weekly Report, *67*(29), 798–802. doi.org/10.15585/mmwr.mm6729a2

County Health Rankings. (2022). Montana. County Health Rankings & Roadmaps. https://www.countyhealthrankings.org/app/montana/2022/rankings/lake/county/factors/overall/snapshot

Egholm, C. L., Helmark, C., Doherty, P., Nilsen, P., Zwisler, A.-D., & Bunkenborg, G. (2019). "Struggling with practices": A qualitative study of factors influencing the implementation of clinical quality registries for cardiac rehabilitation in England and Denmark. *BMC Health Services Research*, *19*(1). https://doi.org/10.1186/s12913-019-3940-5

The Essentials of Doctoral Education for Advanced Nursing Practice. (2006). American Association of College of Nursing. https://ecat.montana.edu/d2l/le/content/739281/viewContent/7144098/View

Goetsch, M. R., Tumarkin, E., Blumenthal, R. S., & Whelton, S. P. (2021, July 21). New guidance on blood pressure management in low-risk adults with stage 1 hypertension. American College of Cardiology. https://www.acc.org/latest-in-cardiology/articles/2021/06/21/13/05/new-guidance-on-blood pressure-management-in-low-risk-adults-with-stage-1-htn

Goldberg, E. M., Wilson, T., Jambhekar, B., Marks, S. J., Boyajian, M., & Merchant, R. C. (2019). Emergency department-provided home blood pressure devices can help detect undiagnosed hypertension. High Blood Pressure & Cardiovascular Prevention, *26*(1), 45–53. doi.org/10.1007/s40292-019-00300-0

Hasan, M. M., Tasnim, F., Tariqujjaman, M., Ahmed, S., Cleary, A., & Mamun, A. (2020). Examining the prevalence, correlates and inequalities of undiagnosed hypertension in Nepal: A population-based cross-sectional study. BMJ Open, *10*(10). doi.org/10.1136/bmjopen-2020-037592

Johnson, D. (2022). Meditech Patient Demographics. Ronan; Meditech Database.

Kaneko, H., Itoh, H., Yotsumoto, H., Kiriyama, H., Kamon, T., Fujiu, K., Morita, K., Michihata, N., Jo, T., Takeda, N., Morita, H., Yasunaga, H., & Komuro, I. (2020). Association of isolated diastolic hypertension based on the cutoff value in the 2017 American College of Cardiology/American Heart Association Blood Pressure Guidelines with subsequent cardiovascular events in the general population. *Journal of the American Heart Association*, *9*(19). https://doi.org/10.1161/jaha.120.017963

Kario, K., Sakima, A., & Ohya, Y. (2021). Step to estimate cardiovascular events by home blood pressure in the era of digital hypertension. *Hypertension Research*, *45*(1), 11–14. https://doi.org/10.1038/s41440-021-00764-5

Kumar Silan, V., Kumar Verma, R., Pal, R., & Tarun, (2022). An unattended silent killer: A facility-based cross-sectional study on undiagnosed hypertension from Haryana, India. Asian Journal of Medical Sciences, *13*(9), 136–141. doi.org/10.3126/ajms.v13i9.44446

Lean Enterprise Institute. (2022, June 3). *Plan, do, check, act (PDCA): A resource guide*. Lean Enterprise Institute. Retrieved October 21, 2022, from https://www.lean.org/lexicon-terms/pdca/

Mahdavi, M., Parsaeian, M., Mohajer, B., Modirian, M., Ahmadi, N., Yoosefi, M., Mehdipour, P., Djalalinia, S., Rezaei, N., Haghshenas, R., Pazhuheian, F., Madadi, Z., Sabooni, M., Razi, F., Samiee, S. M., & Farzadfar, F. (2020). Insight into blood pressure targets for universal coverage of hypertension services in Iran: The 2017 ACC/AHA versus JNC 8 hypertension guidelines. doi.org/10.21203/rs.2.12895/v4

Mancia, G., & Corrao, G. (2018). Global impact of the 2017 American College of Cardiology/American Heart Association Hypertension Guidelines. Circulation, *137*(9), 889–890. doi.org/10.1161/circulationaha.117.032850

McGettigan, P., Alonso Olmo, C., Plueschke, K., Castillon, M., Nogueras Zondag, D., Bahri, P., Kurz, X., & Mol, P. G. (2019). Patient registries: An underused resource for medicines evaluation. *Drug Safety*, *42*(11), 1343–1351. https://doi.org/10.1007/s40264-019-00848-9

Meditech. (2022, September 18). Case study: Major health partners uses Meditech Expanse hypertension patient registries in population health initiative. MEDITECH. https://ehr.meditech.com/news/case-study-major-health-partners-uses-meditech-expanse-hypertension-patient-registries-in

Mocumbi, A., Mastala, A., Guambe, P., & Dzudie, A. (2020). Pulmonary vascular disease in Africa: Lessons from registries. *Global Cardiology Science and Practice*, *2020*(1). https://doi.org/10.21542/gcsp.2020.2

Montana DPHHS. (2022). *Cardiovascular*. Cardiovascular Health. https://dphhs.mt.gov/publichealth/cardiovascular/

Niazi, S., Schneekloth, T., Memon, S., Lesser, E., Vargas, E., & Aslam, N. (2019). Undiagnosed hypertension in potential kidney donors and case for comprehensive medical and psychosocial assessment. Journal of Psychosomatic Research, 121, 114. doi.org/10.1016/j.jpsychores.2019.03.046

Øie, L. R., Madsbu, M. A., Giannadakis, C., Vorhaug, A., Jensberg, H., Salvesen, Ø., & Gulati, S. (2018). Validation of intracranial hemorrhage in the Norwegian patient registry. *Brain and Behavior*, *8*(2). https://doi.org/10.1002/brb3.900

Ostchega, Y., Fryar, C. D., Nwankwo, T., & Nguyen, D. T. (2020, April). Hypertension Prevalence Among Adults Aged 18 and Over: United States, 2017–2018. Centers for Disease Control and Prevention. https://www.cdc.gov/nchs/data/databriefs/db364-h.pdf

Park, S., Gillespie, C., Baumgardner, J., Yang, Q., Valderrama, A. L., Fang, J., Loustalot, F., & Hong, Y. (2018). Modeled state-level estimates of hypertension prevalence and undiagnosed hypertension among U.S. adults during 2013–2015. The Journal of Clinical Hypertension, *20*(10), 1395–1410. doi.org/10.1111/jch.13388

The Pediatric Pulmonary Hypertension Network Registry. PPHNet. (2015, April 6). http://www.pphnet.org/registry/

Philip, R., Beaney, T., Appelbaum, N., Gonzalvez, C. R., Koldeweij, C., Golestaneh, A. K., Poulter, N., & Clarke, J. M. (2021). Variation in hypertension clinical practice guidelines: A global comparison. *BMC Medicine*, *19*(1). https://doi.org/10.1186/s12916-021-01963-0

Purohit, G., Sharma, T., Shaikh, U., Sharma, P., Shekh, N., Shah, V., & Shukla, S. (2021). Undiagnosed hypertension in young professional educators: Recent update. National Journal of Physiology, Pharmacy and Pharmacology, 1. doi.org/10.5455/njppp.2021.11.07192202020012021

QuickFacts Lake County, Montana. United States Census Bureau. (2021). https://www.census.gov/quickfacts/fact/table/lakecountymontana/PST120221

Section 4: Ways to approach the quality improvement process. AHRQ. (2020, January). Retrieved February 25, 2023, from https://www.ahrq.gov/cahps/quality-improvement/improvement-guide/4-approach-qi-process/index.html

Seibt, R., Hunger, B., Stieler, L., Stoll, R., & Kreuzfeld, S. (2018). Early detection of undiagnosed hypertension based on occupational screening in the hotel and restaurant industry. BioMed Research International, 2018, 1–9. doi.org/10.1155/2018/6820160

Shafneed C. H. (2019). Gandhi & Health: *Award-Winning Essay. The Indian journal of medical research*, *149*(Suppl), S153–S157. https://doi.org/10.4103/0971-5916.251673

St. Luke Community Healthcare. (2022, August 19). https://stlukehealthcare.org/

Sutton, K. F., Richman, E. L., Rees, J. R., Pugh-Nicholson, L. L., Craft, M. M., Peaden, S. H., Mackey, M., & Halladay, J. R. (2021). Successful Trial of Practice Facilitation for plan, do, study, act Quality Improvement. *The Journal of the American Board of Family Medicine*, *34*(5), 991–1002. https://doi.org/10.3122/jabfm.2021.05.210140

Tanabe, P., Persell, S. D., Adams, J. G., McCormick, J. C., Martinovich, Z., & Baker, D. W. (2008). Increased blood pressure in the Emergency Department: Pain, anxiety, or undiagnosed hypertension? Annals of Emergency Medicine, *51*(3), 221–229. doi.org/10.1016/j.annemergmed.2007.10.017

Tsuchiya, K., & Demmer, R. T. (2021). Citizenship status and prevalence of diagnosed and undiagnosed hypertension and diabetes among adults in the U.S., 2011–2016. Diabetes Care, *44*(3). doi.org/10.2337/dc20-2453

U.S. Department of Health and Human Services. (2022, November). *Clinical Practice Guidelines*. National Center for Complementary and Integrative Health. Retrieved November 9, 2022, from https://www.nccih.nih.gov/health/providers/clinicalpractice

Whelton, P. K., Carey, R. M., Aronow, W. S., Casey, D. E., Collins, K. J., Dennison Himmelfarb, C., DePalma, S. M., Gidding, S., Jamerson, K. A., Jones, D. W., MacLaughlin, E. J., Muntner, P., Ovbiagele, B., Smith, S. C., Spencer, C. C., Stafford, R. S., Taler, S. J., Thomas, R. J., . . . Wright, J. T. (2018). 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/apha/ash/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults. Journal of the American College of Cardiology, *71*(19). doi.org/10.1016/j.jacc.2017.11.006

World Health Organization. (2020, December 9). *The top 10 causes of death*. World Health Organization. Retrieved October 16, 2022, from https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death

World Health Organization. (2021, August 25). *Hypertension*. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/hypertension

World Health Organization. (2022, September 16). Non communicable diseases. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases

Zhou, D., Xi, B., Zhao, M., Wang, L., & Veeranki, S. P. (2018). Uncontrolled hypertension increases risk of all-cause and cardiovascular disease mortality in U.S. adults: The Nhanes III linked mortality study. *Scientific Reports*, *8*(1). https://doi.org/10.1038/s41598-018-27377-2

APPENDICES

APPENDIX A

MATRIX TABLE

Appendix A: Matrix Table

Author/Date	**Topic/Focus Question**	**Concepts Theore-tical Model**	**Paradigm or Method**	**Context/ Sample**	**Findings**	**Future Research**
Arnett, D. K., Blumenthal, R. S., Albert, M. A., Buroker, A. B., Goldberger, Z. D., Hahn, E. J., Himmelfarb, C. D., Khera, A., Lloyd-Jones, D., McEvoy, J. W., Michos, E. D., Miedema, M. D., Muñoz, D., Smith, S. C., Virani, S. S., Williams, K. A., Yeboah, J., & Ziaeian, B. (2019).	Summary of primary prevention guidelines for clinicians. This strives to reduce the risk of ASCVD and encourage patients to make healthier lifestyle changes when needed.	Not Stated	Evidence Review	This document was reviewed by 5 official reviewers nominated by the ACC and AHA; 3 reviewers on behalf of the American Association of Cardiovascular and pulmonary Rehabilitation, the American Society for Nutrition, and the American Society of Preventive Medicine; and 23 individual content reviewers.	Most ASCVD events are avoidable through primary prevention and control of traditional cardiovascular risk factors. Tobacco avoidance is crucially important for ASCVD prevention, and adults should exercise daily and adhere to a healthy diet to help lower future ASCVD risk	None Mentioned
Armitage, L. C., Whelan, M. E., Watkinson,	This study explores the extent to which	Not Stated	Systematic review with meta-analysis	The initial electronic database search	This study shows that HTN screening	This study reports the need for research

P. J., & Farmer, A. J. (2019).	high in-hospital blood pressure readings can predict the presence of hypertension-sion in adults with no previous hypertensive diagnosis or treatment.			returned 4923 citations. After removal of duplicates, 3993 citations were screened by title and abstract. Full texts of 43 articles considered potentially eligible were reviewed. Of these, 12 citations met inclusion criteria	in the E.D. consistently identifies groups of patients with undiagnosed HTN. However, it was unable to identify any studies of hospital inpatients and found notable differences in reported rates of HTN at follow-up, likely due to variation in method.	involving hospital inpatients and a consistent and systematic methodology for screening and follow-up assessment.
Ayilara, O. F., Zhang, L., Sajobi, T. T., Sawatzky, R., Bohm, E., &; Lix, L. M. (2019).	Missing data can affect the value of Patient Reported Outcomes (PRO) data for healthcare decision-making.	Not Stated	Qualitative Analysis	This study consisted of 5631 patients between 2009 and 2015	Missing data can substantially affect the precision of estimated change in PRO scores from clinical registry data.	None Mentioned.

Ciemins, E. L., Ritchey, M. D., Joshi, V. V., Loustalot, F., Hannan, J., & Cuddeback, J. K. (2018).	This study applied a blood pressure predictor tool using medical billing data in combination with clinical data to calculate and compare predicted and observed adult hypertension prevalence.	Not Stated	Descriptive	Patients from 25 health organiz-ations, overall population of 8.92 million.	This study showed that the Million Hearts HTN Prevalence Estimator Tool to calculate, compare and predicted that nearly one in eight patients with HTN might not have received a diagnosis.	None mentioned
Egholm, C. L., Helmark, C., Doherty, P., Nilsen, P., Zwisler, A.-D., & Bunkenborg, G. (2019).	This study aimed to illuminate barriers of clinical registries by exploring how staff perceive the implementation process related to the registries within the field of cardiac rehabilitation in	Not Stated	This is a qualitative interview-based study with staff	Two case registries: England N = 12 and Denmark N = 12	Overall, implementation received little focused attention. There was a lack of active support from management, and staff may experience a struggle of fitting use of a registry into a busy and complex	None mentioned

	England and Denmark.				everyday practice	
Goldberg, E. M., Wilson, T., Jambhekar, B., Marks, S. J., Boyajian, M., Merchant, R. C. (2019).	This study used E.D. visits to capture hypertensive patients then sent them home with blood pressure monitoring supplies to see if they remained hypertensive.	Not Stated	Prospective Cohort Observational Study	This study had 136 participants, 93 returned the blood pressure with at least 4 home blood pressure measurements	This study concluded that patients with elevated blood pressure in the E.D., blood pressure could be beneficial for determining which patients have HTN and require expedient follow-up	This article reported the need for further research on the ideal frequency and timing of blood pressure measurements after E.D. visits
Hasan, M. M., Tasnim, F., Tariqujjaman, M., Ahmed, S., Cleary, A., &; Mamun, A. (2020)	This study examined the prevalence, correlations and sociodemograp hic inequalities of undiagnosed hypertension in Nepal	Not Stated	Cross-sectional	3334 Adult patients with HTN	This study showed 50.4% remained undiagnosed during the survey. Undiag-nosed HTN was disproportionat ely higher among lower socioeconomic groups.	None mentioned
Kaneko, H., Itoh, H., Yotsumoto, H.,	This study reviewed the clinical	Not Stated	Systema-tic Review	This study had 1,746,493	The analysis of this database showed that	None mentioned.

Kiriyama, H., Kamon, T., Fujiu, K., Morita, K., Michihata, N., Jo, T., Takeda, N., Morita, H., Yasunaga, H., & Komuro, I. (2020).	significance of isolated diastolic hypertension (IDH) according to the cutoff value of the 2017 ACC/AHA guidelines			individuals nationwide	isolated diastolic hypertension based on the cutoff value in the 2017 ACC/AHA BP guidelines was associated with an elevated risk of subsequent cardiovascular events.	
Kario, K., Sakima, A., & Ohya, Y. (2021).	This study demonstrated that intensive treatment with a systolic blood pressure target of 110–130 mmHg resulted in a lower incidence of cardiovascular events than standard treatment with a systolic B.P. target of 130–150 mmHg in older patients	Not Stated	Observational Study	Patients with hypertension with different cardiovascular outcomes.	This study indicates the future direction of hypertension management—namely, digital hypertension management with an initial focus on morning B.P.	None mentioned.

	with hypertension					
Kumar Silan, V., Kumar Verma, R., Pal, R., &; Tarun, (2022).	The goal of this study was to ascertain the prevalence of undiagnosed HTN among the attendees of a sub-district hospital.	Not Stated	Cross-sectional	There were 100 participants, 59 males and 41 females. They were selected based on convenience	This report showed 59% of participants had undiagnosed HTN, with higher rates in persons with high BMI, high salt intake, smokers, and sedentary lifestyles.	None Mentioned
Mahdavi, M., Parsaeian, M., Mohajer, B., Modirian, M., Ahmadi, N., Yoosefi, M., Mehdipour, P., Djalalinia, S., Rezaei, N., Haghshenas, R., Pazhuheian, F., Madadi, Z., Sabooni, M., Razi, F., Samiee, S. M., &; Farzadfar, F. (2020).	This study compared the prevalence, awareness, treatment, and control of hypertension in Iran based on two hypertension guidelines; the 2017 ACC/AHA and the JNC8	Not Stated	Regression models of survey design	Participants included 27,738 adults aged ≥25 years as a represent-tative sample of Iranians	The prevalence of hypertension based on JNC8 was 29.9%, which soared to 53.7% based on the 2017 ACC/AHA.	None mentioned.

Mancia, G., & Corrao, G. (2018)	This study analyzed the differences between the ACC/AHA and JNC8 Clinical guidelines.	Not Stated	Descriptive	This study was based on the most recent changes made to the current guidelines and authored by two M.D.'s.	This review agreed with most of the changes to the ACC/AHA guidelines however found some of them to be too strict classifying non hypertensive people as hypertensive.	None mentioned.
McGettigan, P., Alonso Olmo, C., Plueschke, K., Castillon, M., Nogueras Zondag, D., Bahri, P., Kurz, X., & Mol, P. G. (2019).	Patient registries are greatly underused in regulatory assessments. Reasons include heterogeneity in registry design and in the data collected, even across registries for the same disease, as well as unreliable data quality and data sharing impediments.	Not Stated	Qualitative synthesis of the published observations	The published observations and recommendations from an initiative-led multi-stakeholder consultation and four disease-specific patient registry workshops.	These are the first explicit proposals, from a regulatory perspective, on operational methods for increasing the use of patient registries in medicines regulation.	None mentioned.

Mocumbi, A., Mastala, A., Guambe, P., & Dzudie, A. (2020).	The epidemiology of pulmonary vascular disease (PVD) remains unclear in Africa, registries are important in gathering crucial information on PVD.	Not Stated	Descriptive	The only registry for pulmonary hypertension in Africa – the Pan African Pulmonary Hypertension Cohort (PAPUCO) – involved four countries	This study suggests that experts and researchers develop regional registries to determine the epidemiology of PVD in Africa, assess geographic, environmental and seasonal differentials.	None Mentioned.
Niazi, S., Schneekloth, T., Memon, S., Lesser, E., Vargas, E., & Aslam, N. (2019)	This study analyzed the utility of A blood pressureM in identifying kidney donors not previously diagnosed with HTN	Not Stated	Retrospec-tive Review	This study examined 284 women (mean age 56 ± 7 y) with CAD	This review revealed 1 out of 4 potential kidney donors had undiag-nosed HTN.	None Mentioned
Park, S., Gillespie, C., Baumgardner, J., Yang, Q., Valderrama, A. L., Fang, J., Loustalot, F., &	The authors generated multivariable logistic regression models predict the probability	Not Stated	Descrip-tive/mixed methods	This study assessed 10,907 adults aged ≥20 years 2011-2014. Two questions in BRFSS were	This article reports a combination of community and clinical approaches to HTN will be	None Mentioned

Hong, Y. (2018).	of HTN and undiagnosed HTN and then applied the fitted model parameters to BRFSS to generate state-level estimates.			used to assess the prevalence of self-reported HTN, 904,967 adults aged ≥20 years who were interviewed in 2013-2015.	necessary to improve HTN control.	
Philip, R., Beaney, T., Appelbaum, N., Gonzalvez, C. R., Koldeweij, C., Golestaneh, A. K., Poulter, N., & Clarke, J. M. (2021).	This study aims to analyze the variation between hypertension clinical practice guidelines globally. It aims to assess the variation in three areas: diagnostic threshold and staging, treatment and target blood pressure recommendations in hypertension.	Not Stated	Descriptive	A search was conducted on the MEDLINE repository to identify national and international hypertension CPGs from 2010 to May 2020.	Ninety-six per cent of guidelines defined hypertension as a clinic-based B.P. of ≥140/90 mmHg, and 87% of guidelines recommended a target B.P. of < 140/90 mmHg	Future research exploring the underlying drivers of this variation may improve outcomes for hypertensive patients across clinical contexts.

Purohit, G., Sharma, T., Shaikh, U., Sharma, P., Shekh, N., Shah, V., & Shukla, S. (2021)	The objective of the study was to assess the prevalence of HTN in professional educators	Not Stated	Cross-Sectional	220 professional medical educators	The prevalence of elevated blood pressure among professional educators was approximately 80% as per new AHA guidelines. HTN was found to be associated with age and body mass index	This study recommended larger groups and/or longer time frames be examined.
Seibt, R., Hunger, B., Stieler, L., Stoll, R., & Kreuzfeld, S. (2018).	This study examined the blood pressure changes between home and work with the use of home blood pressureM of hotel and restaurant employees who work stressful shifts.	Not Stated	Cross-Sectional	The participants in the study were 160 employees in the hotel and restaurant industry	This data indicates occupational screening with home blood pressureM to be an alternative path to detect undiagnosed HTN. However this should be done with close supervision of a medical provider.	None Mentioned

Tanabe, P., Persell, S. D., Adams, J. G., McCormick, J. C., Martinovich, Z., & Baker, D. W. (2008).	This study looked at E.D. patients with HTN with no history, to examine the relationship between pain and anxiety and the change in blood pressure after discharge	Not Stated	Prospective cohort study	189 patients were enrolled and 156 returned the monitors and completed the study	Patients without diagnosed HTN and increased E.D. blood pressures often have continually increased home blood pressures, which does not appear to be related to pain or anxiety in the E.D.	None Mentioned
Tsuchiya, K., & Demmer, R. T. (2021)	This study explored the relationship between citizenship status and cardiovascular disease disparities among immigrants.	Not Stated	Cross-sectional	This study used a sample of 15,201 adults	This study reveals that noncitizens are less likely to seek healthcare and more likely to go undiagnosed.	Not Mentioned
Whelton, P. K., Carey, R. M., Aronow, W. S., Casey, D. E., Collins, K. J., Dennison	This article provides the most current guidelines for treating cardiovascular	Not Stated	Qualitative Analysis	An extensive evidence review, which included literature derived from	Practice guidelines provide recommendations applicable to patients with or	This study states further research is needed in shared-decision making with

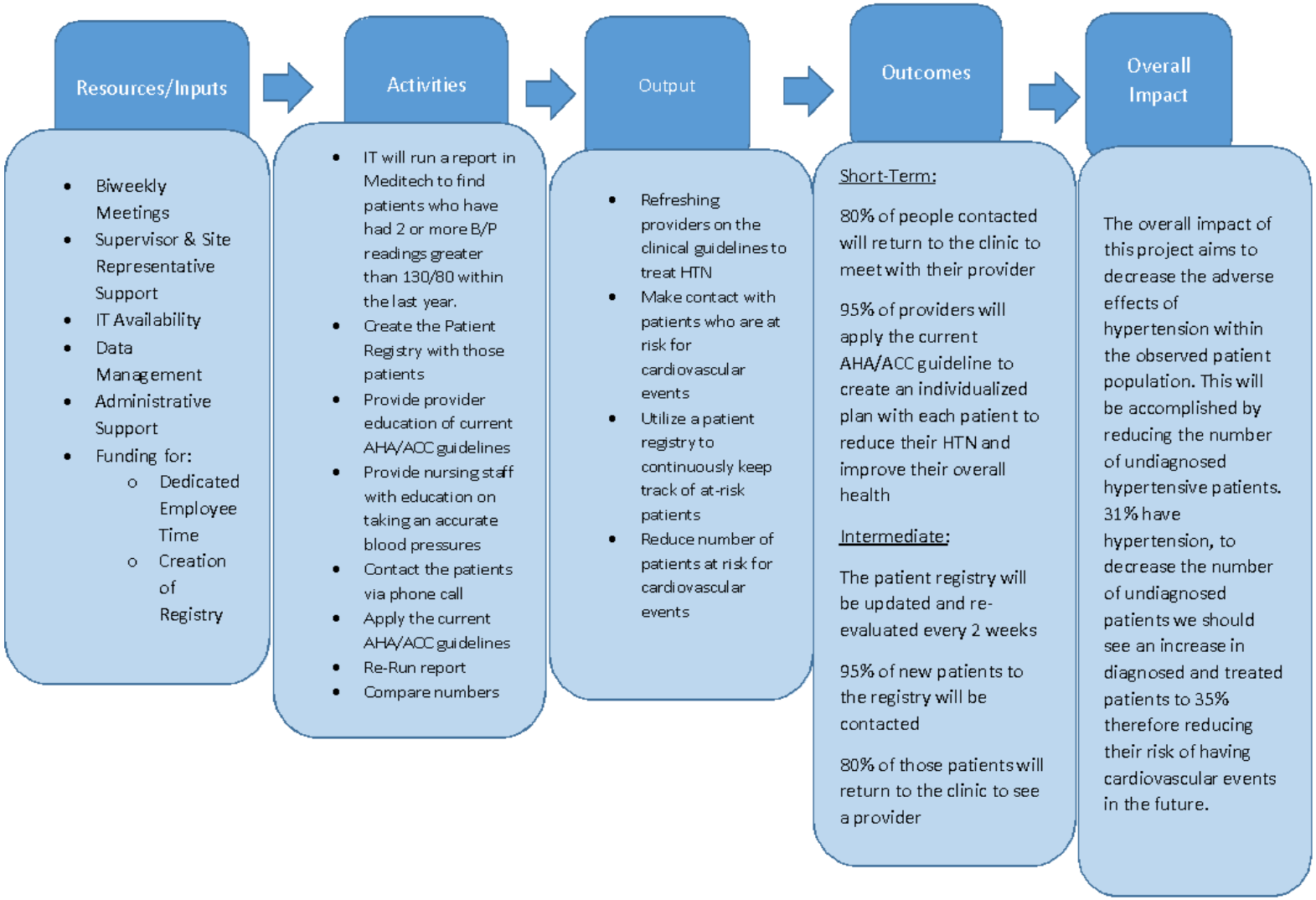
Himmelfarb, C., DePalma, S. M., Gidding, S., Jamerson, K. A., Jones, D. W., MacLaughlin, E. J., Muntner, P., Ovbiagele, B., Smith, S. C., Spencer, C. C., Stafford, R. S., Taler, S. J., Thomas, R. J., Williams, K. A., … Wright, J. T. (2018).	disease and hypertension.			research involving human subjects, published in English, and indexed in MEDLINE, EMBASE, the Cochrane Library, the Agency for Healthcare Research and Quality, and other selected databases relevant to this guideline, was conducted between February and August 2015.	at risk of developing CVD. The focus is on medical practice in the United States, but guidelines developed in collaboration with other organizations can have a global impact.	patients and their families. For Example; areas where evidence does not identify one treatment or goal better than another, where improved patient knowledge might enhance compliance, where reliance on patient collaboration improves success of outcomes.

Zhou, D., Xi, B., Zhao, M., Wang, L., & Veeranki, S. P. (2018)	This study compares the populations of diagnoses, undiagnosed, treated and uncontrolled hypertensive patients of different demographics.	Not Stated	This was a prospective cohort study	U.S. adults aged over 18 years enrolled in the Third National Examination and Nutritional Health Survey was used to conduct this study	This study highlights the need for multi-dimensional approach at all levels of prevention including primary prevention efforts, secondary prevention efforts, and tertiary prevention addressing the adverse health outcomes of hypertension later in life.	None mentioned

APPENDIX B

LOGIC MODEL

Appendix B: Logic Model



APPENDIX C

PLAN-DO-CHECK-ACT

Appendix C: Plan-Do-Check-Act