Individual QI projects from single institutions

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Improved Compliance of Pediatrics High Blood Pressure Guidelines in Well-Child Clinic Visits

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Abstract

Introduction: Childhood hypertension can lead to cardiovascular morbidity and mortality in young adult life. We aim to improve compliance with the American Academy of Pediatrics recommended blood pressure (BP) guideline steps to 75% over 12 months in children 9 to 18 years old during well-child visits. **Methods:** The providers were educated on American Academy of Pediatrics high BP clinical practice guidelines. We integrated the guideline steps into the electronic medical record (EMR) and analyzed outcome measures. The outcome measures were: (1) BP recorded in the chart, (2) screening done by simplified BP table by clinic staff, (3) repeat manual BP by the provider, (4) BP classification, (5) documentation of BP classification, (6) management plan, and (7) follow-up schedule. Specific interventions were made based on each plan-do-study-act (PDSA) cycle, including reeducating the guidelines, reemphasizing following the EMR steps, and providing providers with individualized feedback and alerts. **Results:** Six of 7 outcome measures (except repeat manual BP by provider) achieved 86%–100% range after the second PDSA cycle. The annotated run chart demonstrates that repeat manual BP by provider improved from 38% to 89% in the fourth PDSA cycle. **Conclusion:** Pediatric residents who run well-child clinics improved adherence to pediatric high BP guidelines by providing education and integrating prompts and information into the EMR.
(Pediatr Qual Saf 2023;8:e670; doi: 10.1097/pq9.0000000000000670; Published online August 7, 2023.)

INTRODUCTION

Problem Description

Texas Tech University Health Sciences Center El Paso is located on the El Paso (USA)-Juarez (Mexico) border serving a mostly Latino-Hispanic population with a high obesity rate and significant family history of cardiovascular disease. Before initiating this project, the providers in our center recommended having school blood pressure (BP) measurements to make a diagnosis of hypertension or deciding to make referrals to subspecialists. However, the current American Academy of Pediatrics (AAP) guideline does not recommend diagnosing hypertension from school or home blood pressure readings for children.[1] Since childhood hypertension commonly leads to adult hypertension and cardiovascular disease risk in adulthood,[2] this inefficiency can lead to incorrect diagnosis and management of childhood hypertension.

Available Knowledge

Hypertension in children and adolescents is a growing health problem, and the prevalence of childhood hypertension in the US has reached 3%–4%.[3] Increased risks of primary hypertension in children and adolescents correlate with obesity, family history, and sleep disorder.[4,5] Hispanic and non-Hispanic Black children have a higher risk of hypertension than non-Hispanic White children.[6] In a cohort of American Indian children, childhood hypertension significantly increased mortality risk before the age of 55 years.[7]

In 2017, the AAP updated the guidelines for the diagnosis of hypertension.[1] The definition of hypertension remains ≥95th percentile BP for age, sex, and height in children <13 years. For adolescents ≥13 years of age, hypertension is defined as BP ≥130/80 mm Hg, regardless of age, sex, or height.[1] In addition, the guideline updated

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Supplemental digital content is available for this article. Clickable URL citations appear in the text.

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To Cite: Khin EE, Villanos MT, Alvarado JC, Rodriguez D, Arbab B, De Guzman KN. Improved Compliance of American Academy of Pediatrics High Blood Pressure Guidelines in a Single-center Outpatient General Pediatric Clinic on the US-Mexico Border. Pediatr Qual Saf 2023;8:e670.

Presented at the Pediatric Academic Society Conference in Denver, Colo., on April 2022.

Received for publication October 4, 2022; Accepted June 7, 2023.

Published online August 7, 2023

DOI: 10.1097/pq9.0000000000000670

the frequency of blood pressure management, simplified the screening table, established normative BPs from normal weight children, modified the BP measurement algorithm, updated echocardiogram use, and endorsed using 24-hour ambulatory blood pressure monitor.[1] Using the 2017 clinical practice guidelines has improved identifying target organ damage in hypertensive participants.[8]

Rationale

Due to the long-term impact of childhood hypertension on cardiovascular morbidity and mortality,[9] it is critical to apply the recommended diagnostic algorithm and management in evaluating childhood hypertension. We identified multiple areas of improvement. These areas included education enhancement for all the providers, defining correct BP measurement methods, providing the availability of variable BP cuff sizes, and integration with the electronic medical record (EMR) system. The latter was also useful for improving adherence to dyslipidemia screening[10] and Down syndrome guidelines.[11]

Specific Aims

This quality improvement (QI) initiative aimed to improve compliance with the 2017 AAP guidelines for screening and managing high blood pressure in children 9–18 years in our pediatric outpatient well-child clinic to 75% over a 12-month period by enhancing education and integrating AAP guideline steps into the EMR.

METHODS

Context

This QI was conducted at Texas Tech University Health Sciences Center El Paso, affiliated with the Paul L. Foster School of Medicine and El Paso Children's Hospital. The EMR system used is Centricity (GE Healthcare, Chicago).

The residents-run clinic visits are half-day continuity clinics occurring 5 days per week, supervised by 7 general pediatric faculty. The program has a total of 35–37 residents. Depending on the postgraduate year (PGY) level, 4, 7, or 9 patients were assigned to each PGY1, PGY2, and PGY3 resident, respectively. Each clinic group is composed of 4 residents and supervised by 1 faculty. If a resident in the group is unavailable (for example, on vacation, on-call, and postcall), one of the other residents in the group will see their patients.

The QI initiative involved retrospective charts review to obtain baseline adherence to blood pressure guidelines and implemented gap analysis, key drivers (Fig. 1), and aim statement. We executed plan-do-study-act (PDSA) cycles and interventions and tracked improvement with chart reviews.

Interventions

The QI team identified improving knowledge of AAP guidelines to the providers and staff and integrating guideline steps in EMR as crucial to improving overall compliance with our QI project's aim. Our team consisted of a QI leader, a champion, an information technology analyst, and 4 resident champions.

The QI leader created the project protocol, developed interventions with the team members, and assessed the benchmark for each goal. In addition, the QI champion collaborated with the information technology analyst in embedding guideline steps in EMR, and resident champions contributed to data collection and communication of the project to the residents.

Providers Education

The pediatric nephrologist created the "diagnosis and correct BP measurement method" online module in our institution's learning management platform (Canvas, Instructure, Salt Lake City, UT). The self-enrollment link for online module https://ttuhscelpaso.instructure.com/enroll/HELYL8 was provided to the providers. **Supplementary 1 Online Module outline,** (***http://links.lww.com/PQ9/A503***) described the objectives and content summary. It takes 20–25 minutes to finish the module. It includes 5 pretest questions, an 11-minute video that includes the AAP correct measurement method in children (https://www.youtube.com/watch?v=bYcCkiXJA_Q), and the definition and diagnosis of hypertension from the AAP guidelines, a summary of blood pressure guidelines article, and 10 posttest questions (**Supplementary 2 Online Module Content,** ***http://links.lww.com/PQ9/A504***). The summary article is also available on the El Paso Children's Hospital website volume 3, April 2019 physician newsletter (https://elpasochildrens.org/wp-content/uploads/2019/06/epch-thepediatricjourneyvol.3-compressed.pdf). Learners' premodule test scores ranged from 40% to 60%, while postmodule test scores increased to 90%–100%.

Residents' education occurred via an in-person PowerPoint presentation of the comprehensive AAP guideline and new EMR updates during the residents' didactics. The general pediatric faculty lecture occurred as a continued medical education session with continued medical education credits provided to attendees. Medical assistants and nursing staff were educated with a simplified screening table and correct blood pressure measurement method video. These extensive education sessions occurred from July to October 2020.

EMR Integration of Guideline Steps

We embedded a simplified BP table in the EMR to alert clinic staff and providers to high BP. In addition, we added AAP BP tables for age and gender and a software application (MDCalc, New York) to look up classification and the next steps in managing BP according to AAP guidelines. We integrated and implemented 7 guideline steps in our Centricity EMR, which went live in January 2021. The guideline steps are (1) BP recorded in the chart, (2) screening done by simplified BP table by clinic staff, (3) repeat manual BP by the provider, (4) BP classification, (5) documentation of BP classification, (6) management plan, and (7) follow-up schedule.

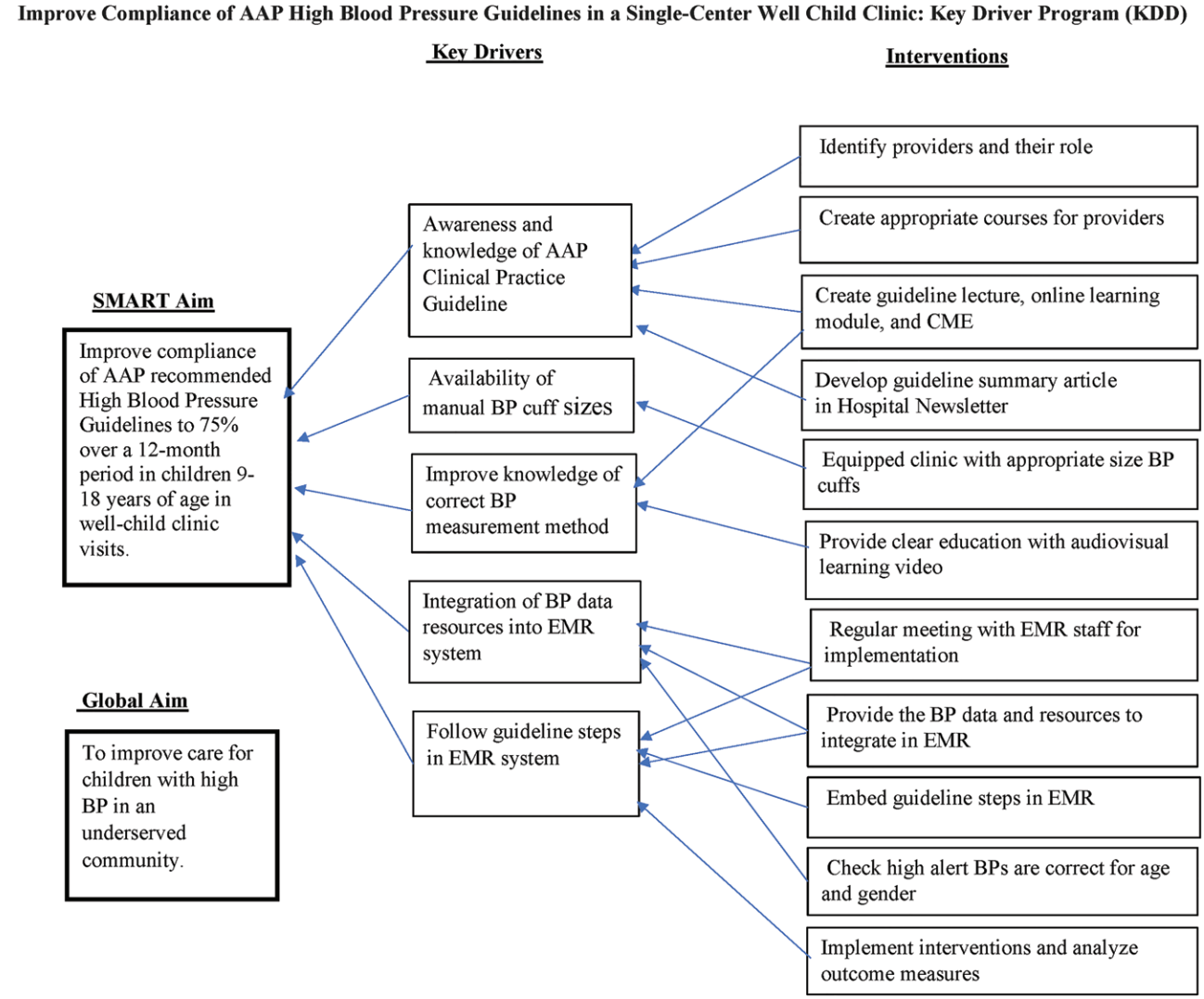

Fig. 1. Key driver diagram.

The management plan and follow-up schedule consisted of lifestyle intervention instructions and rescheduled the visit with notes based on the classification of BP.

Study of the Interventions

This work followed the SQUIRE 2.0 reporting guidelines.[12]

We collected preimplementation data by retrospective chart review of 40 randomly chosen charts from well-child visits from November to December 2020 in children 9–18 years old. Then, we implemented PDSA cycles, QI team meetings, and specific interventions for each cycle. We collected postintervention data from January to November 2021 by evaluating 30 randomly selected charts in each cycle and assessed the impact of our interventions with chart review data.

Measures

The outcome measures were the 7 guideline steps previously mentioned: (1) BP recorded in the chart; (2) screening is done by simplified BP table by clinic staff; (3) repeat manual BP by provider; (4) BP classification (BP percentiles); (5) documentation of BP classification (Elevated BP, stage 1 or stage 2 hypertension); (6) management plan; and (7) follow-up schedule.

Analysis

The percentage of improvement in compliance with outcome measures was analyzed for the goal of 75%. In addition, manual BP by the provider outcome measure was analyzed in the last 2 PDSA cycles after specific interventions were implemented.

Barrier Assessments

As a part of our QI process, we assessed challenges and barriers in this project's implementation. For example, for EMR integration, the availability of the EMR staff was variable, and programmed blood pressure values had to be rechecked several times for accuracy during implementation. The QI team conducted a team meeting every 2 weeks before and during the implementation phase. It

offered multiple sessions of EMR training for the providers depending on their clinical assignments.

Ethical Considerations

According to our institutional guidelines, this project met the criteria for QI and was not reviewed by institutional review board. There were no specific ethical concerns.

RESULTS

This QI study was conducted from November 2020 to November 2021. Our preimplementation data showed that we complied with the recorded BP in the chart outcome measure to 100% but did not comply with the other measures (0%).

After implementing outcome measures in EMR and EMR training, we collected 7 outcome measures from 30 well-child visit charts from January 2021 and analyzed them in the first PDSA cycle. There were 4 outcome measures (repeat manual BP, documentation of BP classification, management plan, and follow-up schedule) below our target of 75%. The specific intervention consisted of reeducating and reemphasizing the importance of screening guidelines and sending reminder emails to staff and pediatric residents to comply with EMR.

The second PDSA cycle data were collected from 30 well-child visit charts in February 2021, and the 7 outcome measures were analyzed. Following this cycle, we achieved 6 outcome measures to our target of 75%, except for repeat manual BP by the providers. The specific interventions after this cycle to improve repeat manual BP by the providers consisted of educating and sending reminders to all providers. Reminder notes were also posted around the work area.

Outcome measures improvement percentage of preimplementation data and postintervention data is shown in Fig. 2.

We had a gap between the second and third cycles (November 2021) as the residents graduated, and there was a shortage of staff and trainees due to the rise of COVID-19 cases in our city. In October 2021, our resident champions repeatedly provided our QI project information to all the residents and reminded them to repeat manual BP if the automatic BPs were high. We collected and analyzed a single observation of repeat manual BP by the provider outcome from 30 charts randomly chosen from the first 2 weeks of November 2021 as the third PDSA cycle and the last 2 weeks as the fourth cycle. Although it was improved from 38% to 50% in the third cycle, we could not reach our target of 75%. We intervened by providing individualized feedback to providers via email and alerted the providers with a red stamp on the patient's face sheet if the blood pressure was high. In the fourth PDSA cycle, repeat manual BP by provider outcome improved to 89%. The run chart for repeat manual BP by the provider is shown in Fig. 3.

DISCUSSION

Summary

We achieved compliance with 6 of 7 outcome measures (except repeat manual BP by provider) over 75% in the second PDSA cycle. In addition, with the specific interventions, repeat manual BP by the provider improved from 38% to 89% in the fourth PDSA cycle. In summary, we improved compliance with AAP high BP guidelines to 75% over 1 year in our well-child clinic by improving providers' education and implementing guideline steps in EMR.

Interpretation

After gap analysis, we defined gaps in knowledge and improvement areas in system-based practice. Our first initiative was the education enhancement to all providers about current AAP guidelines and correct BP

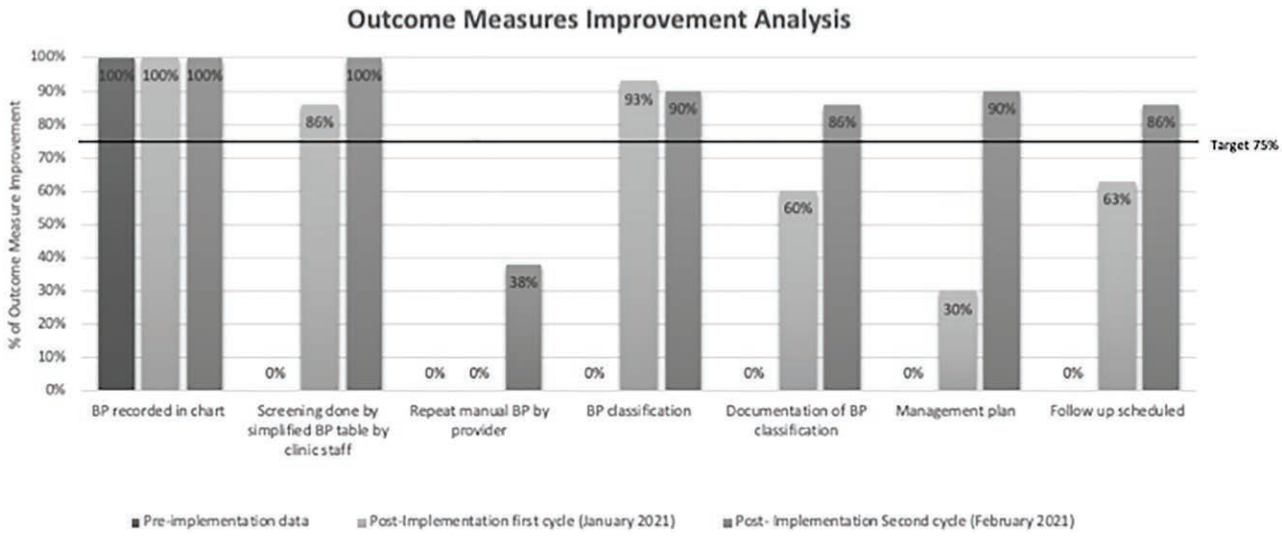

Fig. 2. Outcome measures improvement analysis.

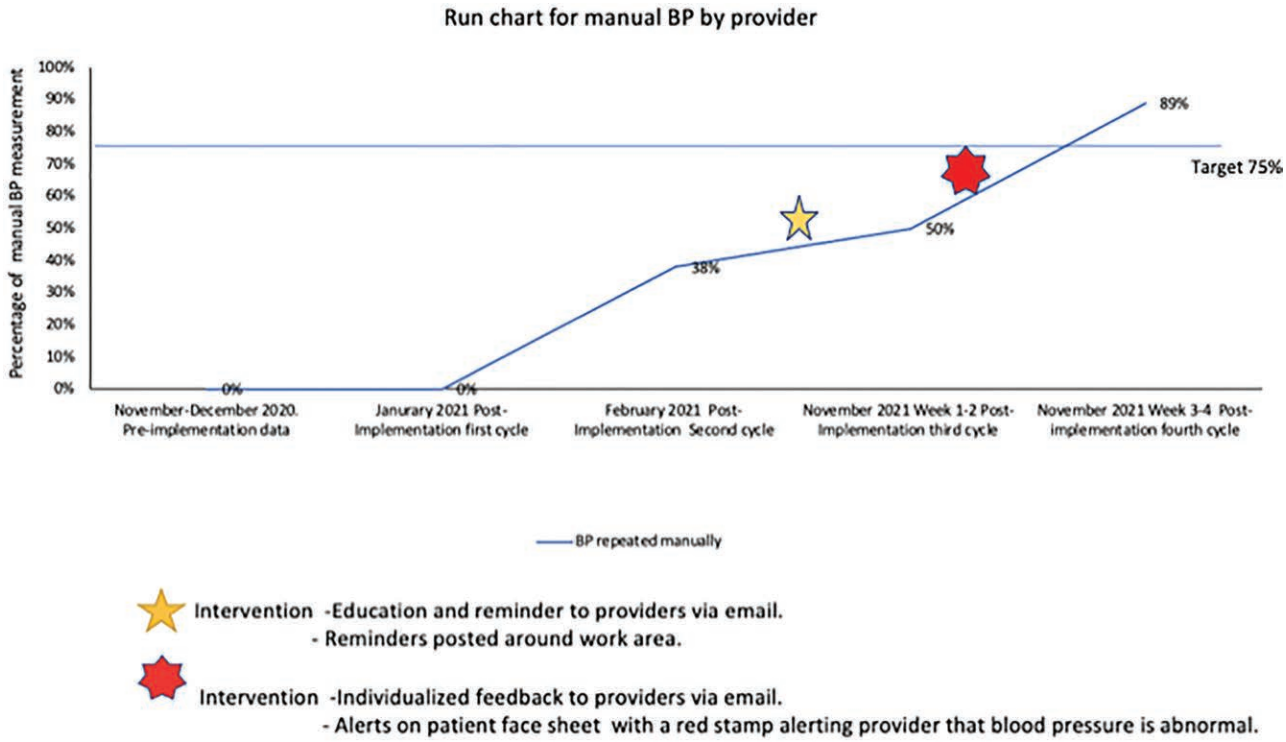

Fig. 3. Run chart for manual BP by provider.

measurement methods by creating online courses and lectures. It is important to update and reassure the providers that a diagnosis of hypertension in children can be made with the correct BP measurement method after following three office visits BPs.[1] If the primary care providers still suspect white coat hypertension, they can refer to the specialists for 24-hour ambulatory blood pressure monitor.[1]

Programming BPs based on the patient's age in our EMR system can screen and alert providers to high BP in the chart. Our EMR system requires providers to document patients' BP percentiles and classification (elevated BP or stages of hypertension), leading the providers to formulate the management plan. Lifestyle intervention started early, and a follow-up visit was scheduled to reevaluate the clinic's BP.

One of the challenges of this QI project was achieving our target for repeat manual blood pressure by the provider. Mitsnefes and Bolling[13] mentioned some of the contributing factors for nonadherence of repeat manual blood pressure by providers. The primary care providers could be not familiar with the content of the guideline, might not recognize and document elevated blood pressure or hypertension, or have poor time and resources to complete this during visits.[13] In addition, there is a low prevalence of hypertension in children or less experience caring for children with high blood pressure.[13] The challenges for this particular outcome measure in our project were time limitation and low awareness of high BP. Time limitation was due to high patient census and staff shortage. The specific interventions for repeat manual BP in our QI included education, individualized feedback to resident physicians via email, reminder notes in residents' working stations, and visual alerts to providers if there is high BP. As a result, it improved to 89% in PDSA cycle 4.

Persistently elevated BP in childhood to adulthood correlates with carotid atherosclerosis and cardiovascular disease mortality in adulthood.[14,15] Juhola et al[14] showed that early atherosclerosis could be reversed or resolved if normal BP can be achieved and maintained into adulthood. It is important to correctly diagnose and intervene early in childhood hypertension to improve the outcome of patients. Treatment initiation can delay in our underserved area with limited availability of subspecialists. Our providers were educated to initiate the medications for the primary essential hypertension patients who have failed at least 6 months of lifestyle modifications. The characteristic of the primary hypertension patients is children who are 6 years or older, overweight or obese, have a family history of hypertension, and have no secondary signs and symptoms of hypertension.[1] This QI initiative improved diagnosing and treating hypertension in our underserved community.

Limitations

The limitations of our study were a single-center study with large Latino populations, our specific Centricity EMR system, and the study sample size limiting the generalizability to other health systems. In addition, the last 2 PDSA cycles were conducted in the winter months with a higher census and limited workforce due to the COVID-19

pandemic. Our providers had time limitations to repeat manual BP, and future evaluation should account for this seasonality issue. Finally, one can argue that our QI projects had multiple outcome measures. However, EMR optimization and team effort to screen not to miss any required steps made this QI project successful.

CONCLUSIONS

Our resident-run well-child clinic on the US-Mexico border successfully improved adherence to pediatric high blood pressure guidelines by interventions including education and integration of prompts and information into the EMR. This QI project proved that compliance with the AAP guidelines could improve with low-cost educational interventions and EMR integration. Future QI will focus on younger children and the sustainability of this project. Interventions are sustainable if we keep improving and maintaining EMR features and adding the active pop-up prompting clinicians' awareness for manual BP. In the future, an oscillometric device that provides standardized BP for children would help providers manage pediatric hypertension more effectively.

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

REFERENCES

1. Flynn JT, Kaelber DC, Baker-Smith CM, et al; Subcommittee on screening and management of high blood pressure in children. Clinical practice guideline for screening and management of high blood pressure in children and adolescents. *Pediatrics*. 2017;140:e20171904.
2. Chen X, Wang Y. Tracking of blood pressure from childhood to adulthood: a systematic review and meta-regression analysis. *Circulation*. 2008;117:3171–3180.
3. Force USPST, Krist AH, Davidson KW, et al. Screening for high blood pressure in children and adolescents: US preventive services task force recommendation statement. *JAMA*. 2020;324:1878–1883.
4. Falkner B, Gidding SS, Ramirez-Garnica G, et al. The relationship of body mass index and blood pressure in primary care pediatric patients. *J Pediatr*. 2006;148:195–200.
5. Archbold KH, Vasquez MM, Goodwin JL, et al. Effects of sleep patterns and obesity on increases in blood pressure in a 5-year period: report from the Tucson children's assessment of sleep apnea study. *J Pediatr*. 2012;161:26–30.
6. Kit BK, Kuklina E, Carroll MD, et al. Prevalence of and trends in dyslipidemia and blood pressure among US children and adolescents, 1999–2012. *JAMA Pediatr*. 2015;169:272–279.
7. Franks PW, Hanson RL, Knowler WC, et al. Childhood obesity, other cardiovascular risk factors, and premature death. *N Engl J Med*. 2010;362:485–493.
8. Khoury M, Khoury PR, Dolan LM, et al. Clinical implications of the revised AAP pediatric hypertension guidelines. *Pediatrics*. 2018;142:e20180245.
9. Yang L, Magnussen CG, Yang L, et al. Elevated blood pressure in childhood or adolescence and cardiovascular outcomes in adulthood: a systematic review. *Hypertension*. 2020;75:948–955.
10. Pradhan S, Dodgen AL, Snyder CS; Improving Compliance with Dyslipidemia Screening Guidelines in a Single-center U.S. Outpatient pediatric cardiology clinic. *Pediatr Qual Saf*. 2021;6:e401.
11. Santoro SL, Bartman T, Cua CL, et al. Use of electronic health record integration for down syndrome guidelines. *Pediatrics*. 2018;142:e20174119.
12. Ogrinc G, Davies L, Goodman D, et al. Squire 2.0 (Standards for Quality Improvement Reporting Excellence): revised publication guidelines from a detailed consensus process. *Am J Crit Care*. 2015;24:466–473.
13. Mitsnefes MM, Bolling C. An ongoing challenge: why do primary care providers struggle to adhere to blood pressure guidelines? *J Pediatr*. 2022;242:9–11.
14. Juhola J, Magnussen CG, Berenson GS, et al. Combined effects of child and adult elevated blood pressure on subclinical atherosclerosis: the International Childhood Cardiovascular Cohort Consortium. *Circulation*. 2013;128:217–224.
15. Juonala M, Järvisalo MJ, Mäki-Torkko N, et al. Risk factors identified in childhood and decreased carotid artery elasticity in adulthood: the Cardiovascular Risk in Young Finns Study. *Circulation*. 2005;112:1486–1493.