

Research Article

Practical Lessons for Improving Care of Patients with High Blood Pressure in Urban Underserved Practices

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Abstract

Purpose: Assess impact of multi-component projects to improve care of racially diverse and low-income hypertension patients at three clinics in the Greater Rochester New York area.

Methods: Used multi-method strategy to assess qualitative data on four-year effort to improve care in a real world underserved setting. We reviewed direct-observation, interview, phone meeting, and patient-level blood-pressure data. To model changes, we used a logistic-regression spline model of 51,654 visits by 12,918 patients, adjusting for patient demographic characteristics and for the clustering of physician and patient.

Results: Clinics that standardized blood-pressure monitoring, redesigned patient flow and scheduling, involved clinical pharmacists, embedded care management into patient flow, had frequent visits for out-of-control patients, and created a culture focusing on individual-patient needs improved control rates from 40.1% to 56.6% ($P < 0.001$ for trend), exceeding national improvements of the time. Logistic-regression spline models confirmed these results and showed statistically significant improvements within the first 6 months and subsequent 2.5 years.

Conclusions: Five themes emerged: 1) Leadership at all levels is necessary. 2) Quality- and process-improvement are integral to sustaining change. 3) Integrating care management into team-based care is critical for patients with hypertension. 4) Frequent follow-up visits are needed when hypertension is not controlled. 5) Daily review of patients on the schedule and periodic reporting of hypertension outcomes raise consciousness. Practical lessons were identified: Changing clinical processes to raise awareness and increase focus can improve control. Medication and treatment-management protocols increasing visit frequency for hypertension patients whose blood pressure is uncontrolled improve patient choices and behaviors. Assessing strategies for improving the management of hypertension, identifying daily solutions and tracking outcomes by patient and doctor help improve control rates in clinics serving low-income populations.

Keywords: Quality improvement; Hypertension; Chronic care management

Abbreviations

CMA: Case-Mix Adjustors; EMR: Electronic Medical Record; GRMSA: Greater Rochester Metropolitan Statistical Area; HEDIS: Healthcare Effectiveness Data and Information Set; NCQA: National Committee for Quality Assurance; NHANES: National Health and Nutrition Examination Survey; PDSA: Plan-Do-Study-Act; PPO: Preferred Provider Organization; QI: Quality-Improvement

Introduction

Hypertension affects one in three U.S. adults [1]. Although substantial knowledge is available regarding its epidemiology, pharmacotherapy, and genetics, many people with hypertension remain under diagnosed and undertreated [2], with National Health and Nutrition Examination Survey (NHANES) 2012 data indicating about half (45.9%) of those with hypertension do not have it controlled [1].

Clinical guidelines for hypertension management emphasize controlling it through healthy lifestyle behaviors and using appropriate medications with integrated clinical systems to sustain adherence [2]. Health systems struggle with identifying hypertension efficiently and delivering care that helps patients bring hypertension under control.

Multi-faceted interventions that include quality-improvement strategies for controlling hypertension can, but do not always, increase control rates [3-9]. One effective intervention is the large-scale community-based program at Kaiser Permanente Northern California that uses a multi-faceted approach including a robust quality-improvement and reporting mechanism to increase hypertension control [8]. Key elements of that program include establishing a comprehensive hypertension registry, development and sharing of performance metrics, evidence-based guidelines, medical-assistant visits for blood-pressure measurement, and single-pill combination pharmacotherapy. Another effective intervention is

Table 1: Demographics of Rochester, Monroe County and Greater Rochester MSA.

Statistic	Rochester	Monroe County	GRMSA
Total population	210,358	749,606	1,127,483
Percentage under age 18	23.3%	21.7%	
Percentage over age 65	14.1%	15.1%	
Percentage White	43.7%	77.7%	83.6%
Percentage Black	41.7%	16.0%	11.6%
Percentage Hispanic	16.4%	7.9%	6.1%
Percentage Female	50.8%	51.7%	6.1%
English not home language	19.1%	19.6%	
High School education or more (over age 25)	80.0%	89.6%	88.1%
BA or more (over age 25)	24.8%	35.8%	30.8%
Below poverty line	32.9%	14.8%	14.2%

Key: GRMSA = Greater Rochester Metropolitan Statistical Area.

Sources for this table were accessed 13 April 2015: <http://quickfacts.census.gov/ofd/states/36/3663000.html> [City of Rochester]; <http://quickfacts.census.gov/ofd/states/36/36055.html> [Monroe County]; http://www.newyorkfed.org/regional/profile_rochester.html [GRMSA]; www.smugtownbeacon.com/news.php?viewStory=746 [GRMSA].

the Community Preventive Services Task Force recommendation to use team-based care to improve blood pressure control (see <http://www.thecommunityguide.org/cvd/teambasedcare.html>).

Efforts to improve hypertension awareness and initiate appropriate treatment remain important to increase blood pressure control, particularly in areas with a high prevalence of hypertension. Primary-care practices increasingly focus on hypertension as part of their quality improvement but questions remain about what can improve control rates.

The Greater Rochester Health Foundation (referred to as the Health Foundation) funded in 2010 projects to improve the quality of clinical care for hypertension patients in the Greater Rochester area, which includes Genesee, Livingston, Monroe, Ontario, Orleans, Seneca, Wayne, Wyoming and Yates counties in New York.

An independent evaluation team used a multi-method evaluation strategy to assess quality-improvement (QI) strategies regarding care of hypertension patients. The analyses below assess how the clinic-site teams implemented multi-faceted intervention strategies with quality-improvement efforts to improve the care of patients with hypertension at three primary-care practices serving low-income and racially diverse patients in the Greater Rochester area. Then we examine the pre- and post-intervention control rate trends for these patients, and compared them to national trends.

Methods

Design

The study collected via direct observation, in-depth interviews, and monthly calls with QI-team participants information to describe and assess implementation of the chosen strategies. Pre and post-blood-pressure data was also gathered at patient visits to three primary-care practices over four years, allowing for an evaluation of the influence of the chosen strategies on clinic control rates.

Setting and participants

The Greater Rochester Metropolitan Statistical Area (GRMSA) approximates the Greater Rochester area. GRMSA comprises

Monroe, Ontario, Wayne, Livingston, and Orleans Counties in New York. Of its 1,128,000 residents, 748,000 live in Monroe County, including the 211,000 in Rochester city limits. The GRMSA features a core, racially diverse and economically disadvantaged central city surrounded by a white, better-educated, and more affluent suburban area (Table 1).

In 2010, the Health Foundation funded projects to improve the quality of clinical care for patients with hypertension. The participating practices included two hospital-affiliated medical practices and one community-health center, all serving predominantly racially diverse and economically disadvantaged patients. Each clinic used a different approach to improve outcomes for hypertension patients; though each approach had a dual focus on direct delivery of healthcare services and internal clinic processes. We describe each clinic below (Table 2).

Clinic A: Clinic A is associated with a large university hospital and used a patient-centered approach in progressive phases, designed to overcome barriers to adequate treatment of hypertension. Its main outcome was a 20% increase in patients whose blood pressure is under control (generally defined as systolic under 140 and diastolic under 90) among those patients diagnosed with hypertension, with an absolute minimum desired success rate of 50% of patients under control. Given the goal of 25% improvement and a baseline-control rate of 51%, Clinic A aimed to achieve a 63.8% control rate.

Clinic A pursued three main strategies: 1) education and awareness of physicians and staff to hypertension, 2) clinical pharmacist intervention and support, and 3) nurse-managed intervention, including protocol for hypertension patients and reporting and using of blood-pressure control rates by doctor and care team.

Clinic B: Clinic B's project goal was to increase the percentage of hypertensive's under control by 25% from 42% at baseline. Based on the goal of 25% improvement, Clinic B aimed to achieve a 53% control rate—later raised to 60% target when it achieved 53%.

Clinic B framed its project as six strategies: hiring a care manager, conducting center-wide monthly meetings on data and progress,

Table 2: Patient Characteristics of Hypertensive Population (N=12,912).

Characteristic	Mean	Range
Age	51	18-98 years
Average # of visits	2.8	1-8 visits
Characteristic	N	%
Male	5,896	46
Race		
White, Non-Hispanic	2,693	21
Asian	182	1
Hispanic	2,586	20
Black	6,865	53
Other and Multiracial	577	5
Unknown/Refused to report	9	0.1
Renal Disease	4,394	34
Clinic A	2,117	16
Clinic B	5,938	46
Clinic C	4,857	38
Time Period Visit Dates		
1: Visit Dates Q1/Q2 2010	3,164	25
2: Visit Dates Q3/Q4 2010	1,010	8
3: Visit Dates Q1/Q2 2011	1,637	13
4: Visit Dates Q3/Q4 2011	1,108	9
5: Visit Dates Q1/Q2 2012	1,555	12
6: Visit Dates Q3/Q4 2012	2,254	18
7: Visit Dates Q1/Q2 2013	1,049	8
8: Visit Dates Q3/Q4 2013	1,135	9

conducting Plan-Do-Study-Act (PDSA) cycles on key processes, developing templates for care management, revising printed materials given to patients, and conducting patient focus groups. The doctors and the care team also reported and used blood-pressure control-rate information and scheduling data regularly in standardized reports to manage the care of hypertensive patients. In January 2012, it added a 7th strategy and implemented a medication-and-treatment management protocol with follow-up visits every two weeks for out-of-control patients. The aim was to work on compliance with medications and to address lifestyle issues slowly with patients. The goal was to standardize the treatment of hypertension across doctors and test the details around scheduling frequent nurse visits with doctors. Out-of-control patients were scheduled for visits every two weeks with the nurse and a doctor checking in for a 6-week period until their blood pressure was in control for at least two consecutive visits.

Clinic C: Clinic C is affiliated with a teaching hospital. Its primary goal was to increase by 25% the number of diagnosed hypertensive patients whose blood pressure is controlled. Given the goal of 25% improvement and a baseline control rate of 45%, Clinic C aimed to achieve a 56.2% control rate. For its QI project, the clinic adopted a Lean Six Sigma redesign for delivery of care and hired a “black-belt” process manager to implement it. There were three overarching strategies within this redesign: increasing physician decision support,

implementing system-level process changes, and improving patient self-management support.

Patient characteristics: Hypertensive patients at these clinics had a mean age of 51 years (ranging from 18 to 98); 46 percent were male and 53 percent were African American (Table 2). These 12,912 patients across the three clinics had 51,654 visits in 4 years, with an average 2.8 visits per patient (and a range from 1 – 8 visits). By design only the most-recent blood-pressure reading at the most-recent visit was recorded for a single wave of data; there were 8 patient-visit data waves.

Organizational structures and processes

Quality improvement: We examined two aspects of quality improvement. The first was ascertaining what quality-improvement approaches the clinics used, including composition of the quality-improvement team and how they used audits. The second was reviewing how they disseminated information about quality-improvement efforts. We also assessed roles, responsibilities, and outcome measurement at each site.

Quality improvement approach: All three clinics used systematic quality-improvement approaches. Although the PDSA cycles at Clinic A were informal, the strong backing of senior leadership made them effective. Clinics B and C effectively used external Lean Six Sigma expertise to lead and direct their QI efforts.

All three clinics established diverse-quality improvement teams, with senior champions and representation throughout clinical and administrative staff.

In keeping with their Six Sigma orientation, Clinics B and C effectively used audits of designed changes, regarding both procedural differences and outcomes. Clinic C also encouraged competition among clinic-delivery teams and resident teams, resulting in innovative ideas first attempted on a small scale then, if successful, promulgated throughout the clinic.

Dissemination of information: All clinics shared outcome data on hypertension clinic-wide and posted the results weekly or monthly. They all sought to disseminate successes and best practices to other teams within their practices. Clinics B and C were able to do so through the efforts of the Six Sigma specialists. Clinic A had clinical pharmacists and nursing staff responsible for disseminating “performance improvement tips” on hypertension management to other clinical staff, but it was haphazard given their other responsibilities. Clinic C sought to form patient groups for obtaining feedback on how best way to manage hypertension but gave up because of limited staff time.

Roles and responsibilities: Senior clinic and project leader’s at all three sites were directly involved in project efforts, and contributed to their success. At all three clinics, physicians were dedicated to the effort and included in the quality-improvement team.

All three clinics also effectively used physicians to promote effective change. Residents present, at Clinics A and C were successfully integrated into the projects, as were nurses at all three sites.

Methods

Our principal evaluation method was to assess how the QI

strategies affected each organization's control rates. The qualitative review is based on information collected via direct observation, in-depth interviews, and monthly calls with QI-team participants about the process and implementation of the chosen strategies. The quantitative analyses are based on data from the 3 clinic sites for hypertension-patient visits from December 2009 through January 2014 (submitted every 6 months with linking de-identifiers). We used a "pre-post" methodology to measure intervention effects, with the JNC-7 control rate as our outcome measure. We considered a patient without diabetes or chronic kidney disease to be controlled if having blood pressure less than 140/90 and considered patients with these comorbidities to be controlled if having blood pressure less than 130/80.

To model the pre-post changes, we used a *spline model* [10] which tests for changes in outcomes over multiple points in time for which data are available, adjusting for patient demographics. Spline models allow for a change in the slope at the point of implementation and test the difference between pre-implementation and post-implementation slopes. The spline model assumes that the implementation effect could be both instantaneous and gradual. To test for instantaneous change, the spline model can allow for a large change at the very start of implementation (referred to as a "jump").

Analysis

For the process evaluation, the team of researchers reviewed direct-observation, interview notes and transcripts, and phone-meeting data. Analysis of the data included 1) a careful reading of the notes and transcripts to understand 'the story' of each clinic and overall strategies; 2) identifying of organizational characteristics and strategies; 3) extraction of data on central themes.

Control-rate data are comparable across physicians and sites only after case-mix adjustments for patient characteristics. Compositional changes in patient population overtime could influence changes in outcomes, should healthier people systematically enter the data/clinic. Previous research has identified age, education, and mental health as respondent characteristics not under the control of the entities being assessed but as related to survey responses [11-13]. To ensure that comparisons between entities reflect differences in outcomes rather than differences in case-mix, responses/outcomes must be adjusted for such characteristics. We used case-mix adjustors (CMA) of age, race and gender for analysis of control rates analyses, as done by O'Malley et al. 2005 [14] and Martino et al. 2009 [15]. All standard errors across all the models were corrected for clustering of patients within physicians [16,17].

To compare overall trends in control rates by clinic, we calculated case-mix adjusted means of the control rate for each site location. We also pooled the data across clinics and calculated the case-mix adjusted mean for each time period.

To test for changes in blood-pressure control rate over time, we used logistic regression because the control rate variable has a value of 0 or 1. The model predicted whether a hypertensive patient has blood pressure under control (control rate=1) with clinic (or physician-team) indicators, adjusting for age, gender, race, and testing for the main effect of time parameters (pre-intervention, jump, post-intervention). The model used data from all 51,654 visits by patients

with hypertension at least 18 years old for all three clinics over four years.

Results and Discussion

Strategies

The clinics were independent, allowing them to adopt their own strategies to improve the percentage of hypertensive patients whose blood-pressure measures were under control. We identified eight general categories of strategies implemented.

Meeting JNC-7 standards for blood pressure measurement: The Health Foundation was concerned that blood-pressure measurements did not always conform to The Seventh Report of the Joint National Committee on High Blood Pressure, known as the JNC-7 standards [2]. All three clinics made a good faith effort to meet these standards; Clinics A and B were in full compliance except that they used the second blood-pressure reading from the same visit as the official one rather than averaging.

Better blood pressure monitoring: All three clinics attempted to improve care through monitoring above and beyond the technical standards of JNC-7. Clinic A purchased new blood pressure cuffs for all examination rooms, enabling multiple readings required by JNC-7 standards, and increased the involvement of physicians in the monitoring process. Clinic B purchased new cuffs that facilitated interfacing with the electronic medical record (EMR), thereby automating measurements. Clinic C proposed providing 400 battery-operated blood-pressure cuffs for home use by patients whose hypertension was not controlled. Following this successful intervention, it provided an additional 200 cuffs to patients. Clinic A, encouraged by Clinic C's success, distributed 60 cuffs to its high-risk patients. Its clinical pharmacist and nurse care manager also encouraged patients to purchase and use their own blood-pressure devices.

Enabling a 15-minute patient visit for physicians: Clinics B and C sought to improve care by modifying their encounter processes to give patients at least 15 minutes of attention from their physician. Clinic C successfully implemented a system that flagged hypertensive patients not under control for special attention. Clinic B attempted to rearrange physician time for this effort but experienced only moderate success.

All three clinics instituted team huddles, each in different ways. All three instituted post-examination reviews that included patient education. These were successful for Clinic C, but less so for Clinic B given less space for post-examination discussions with patients. Clinic B was able to use nursing staff to good effect, reducing the average per-patient time spent by providers from 25 to 15 minutes, while Clinic C achieved efficiencies by improving the patient-encounter experience flow.

Redesigning the scheduling system and call center: All three clinics attempted to improve care by making their scheduling system, call center and reminder call processes more responsive to patient needs. Clinics B and C used their call centers for reminder calls; both significantly reduced no-shows, achieving measurable cost savings. Clinic A used its care managers to do this and was successful. Clinic C provided new examination rooms and changed provider work hours,

Table 3: Blood Pressure Control Rate Trends – National vs. Health Foundation Clinic Sites, Overall and by Site.

	Q1 Q2 2010	Q3 Q4 2010	Q1 Q2 2011	Q3 Q4 2011	Q1 Q2 2012	Q3 Q4 2012	Q1 Q2 2013	Q3 Q4 2013
PPO Commercial- 50 th percentile+	49.9		56.4		59.9		57.7	
PPO Medicare- 50 th Percentile+	60.8		55.0		60.7		60.5	
Health Foundation Sites Pooled:								
CMA Mean	40.7	39.2	44.6	46.2	52.9	53.0	51.7	56.6
Standard Deviation	0.013	0.011	0.008	0.008	0.007	0.006	0.006	0.005
Number of visits (N)	3,259	3,660	4,778	4,890	6,092	8,737	9,097	11,141
By Site:								
CMA Mean								
Clinic A	54.6	52.6	57.0	62.1	65.6	62.3	63.6	59.4
Clinic B	40.3	37.9	40.7	45.0	55.1	56.6	54.3	54.5
Clinic C	34.5	32.6	39.1	38.0	42.6	43.3	41.2	57.0

Note: + Source for these data are National Commercial and Medicare HEDIS measures for PPOs for hypertension control. The measure is CBP, Controlling High Blood Pressure – Total, which is measure #20 in 2010 and 2011, measure #52 in 2012 and measure #57 in 2013; NCQA, 2014. CMA = case mix adjusted.

improving patient-throughput time; though not much as desired because of subsequent contractual problems with the providers as well as problems in managing same-day appointments. Clinics B and C attempted to provide urgent-care slots, but neither was fully successful. Clinic B reserved physician time but did not have enough patients for urgent-care slots; the same problem led Clinic C to abandon it's the effort here. Clinic B dedicated a receptionist slot for new patients, achieving considerable efficiency gains.

Involvement of the clinical pharmacy: Because of the importance of medication in managing hypertension, all clinics sought some intervention related to pharmacists. They attempted to improve care by greater involvement of the clinical pharmacist, thereby providing closer monitoring of prescribed medications, easing the prescribing and refilling processes, and increasing compliance with prescriptions. All three clinics involved a clinical pharmacist in patient visits; this was more successful for Clinics A and C than Clinic B, where the clinical pharmacist was not a core-team member. Clinic C attempted to expedite electronic transmission of prescriptions, but this was delayed until the new EMR system was introduced in 2012. Clinic A gave out medisets with success, while Clinic C improved compliance with annual post-card reminders.

Care management of patients with hypertension: All three clinics attempted to improve care by introducing care managers to the provider team and having these managers focus on patients diagnosed with hypertension. Clinics A and B used care managers to improve treatment of hypertensive patients by identifying solutions and assessing strategies for improving the management of hypertension on a daily basis. Clinic C did not have a specified care-manager function but beginning in 2013 assigned team members to that role on an ad-hoc basis.

Strategies for changing culture: All the clinics attempted to change their culture so as to have providers and staff focus more on patients and thereby improve the patient's experience of care and staff satisfaction. They all employed clinic-wide meetings to increase awareness of problems in treating hypertension and how they could adapt to solve them. Clinic C also used meetings of their resident

teams.

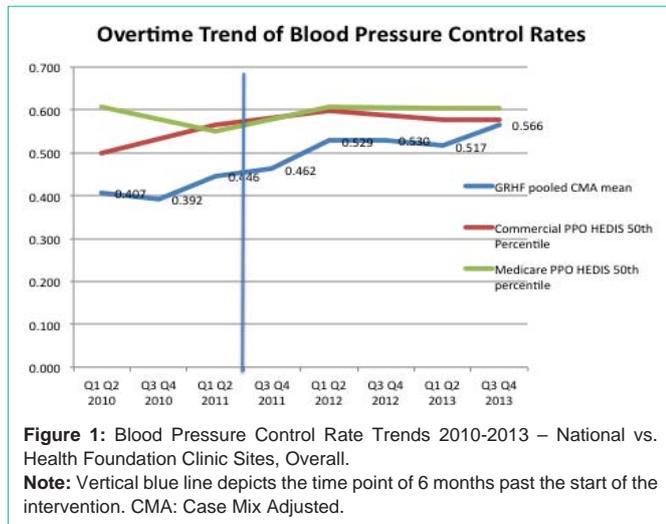
All three clinics shared data on hypertension among all teams within a clinic. For Clinics A and C, this increased the competitiveness among clinical teams to be the best at controlling the blood pressure of hypertensives. In all cases, data transparency helped increase acceptance of the importance of hypertension. All three clinics promoted physician champions to lead hypertension-treatment efforts. Clinic C successfully encouraged resident champions as well. All three clinics succeeded in engaging all clinic-team members to take joint responsibility for managing hypertension.

Control rate trends

Table 3 shows the control-rate trends for the Health Foundation clinics individually and overall by time compared to national trends. We reviewed the adjusted overall Health Foundation mean control rate over time (case-mix adjusted for age, race, and gender) for the 3 clinics combined/pooled and compared it to the 50th percentile of Preferred Provider Organization (PPO) Commercial and PPO Medicare National Committee for Quality Assurance (NCQA) Healthcare Effectiveness Data and Information Set (HEDIS) control blood-pressure measure. Table 3 and Figure 1 provide quarterly details and how the pooled Health Foundation case-mix adjusted mean improved more than the national populations, from 40.1% (95% CI: 39.3-42.0) in 2010 to 56.6% (95% CI: 56.1-57.2) in 2013 (P<0.001 for trend).

This improvement in control rates brought the clinics closer to the national-mean blood-pressure control rates found in the commercial and Medicare populations. The national mean blood pressure control rate increased slightly for commercial (49.9% in 2010 to 57.7% in 2013) but remained flat for Medicare (60.8% in 2010 to 60.5% in 2013) populations in this same period. Yet from our qualitative analyses and information regarding when each site implemented its strategies, we can confirm that the improvement followed the strategies, and is not attributable to simple regression to the mean.

We also found that Clinics A and B reached their 25% improvement goal in Q1/Q2 2012; and Clinic C did so in Q3/Q4



2013. This mirrored the different implementation paths and strategies for each.

Table 4 shows the logistic spline model results. These confirm the improvement in Health Foundation control-rate trends seen in Figure 1 (and Table 2) showing, both a statistically-significant improvement in control rates within 6 months of the start and over the subsequent 2.5 years (0.05; SE: 0.02; $p < 0.027$) and a significant discontinuity in the slope of the control rate trend at the intervention start (0.09; SE: 0.04; $p < 0.021$).

Discussion and summary of central themes

Five central themes emerged from our analyses: 1) Leadership at all levels is necessary for improvement. 2) Quality and process improvement are integral to sustaining systematic incremental change. 3) Integrated care management is a critical component of the team-based care needed for patients with hypertension. 4) Frequent follow-up visits are critical for managing hypertension needed when hypertension is not controlled. 5) Daily review of hypertension patients on the schedule and periodic reporting of hypertension outcomes by physician or team raise awareness and responsibility for controlling blood pressure.

Leadership at all levels is necessary for improvement: The lead physician in QI efforts must have an active role, including at least day-to-day awareness of project efforts and a visible presence as a change agent. Hands-on engagement in the processes also helps, although this can go too far if the leader must take on tasks better left to supervised subordinates. Institutional leadership must offer moral support, provide resources for unforeseen exigencies, and offer rewards for success.

Physician engagement is crucial for all phases of a project whose objective is to improve the quality of healthcare delivery. This can be problematic if the thrust of quality improvement is towards a patient-centered approach to healthcare by a team and physicians have been accustomed to being at the top of a hierarchical chain. But effective leadership sometimes requires adapting to changing culture. Our analysis showed that team-building and effective training, endorsed by leadership, was key to culture change needed for collective management of hypertension. Without these, outcomes suffered.

Table 4: Logistic Regression of Control Rate Spline Model Results: Testing for Significance in Change of Pre- to Post-Intervention slope, allowing for Jump at Start of Intervention.

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	-0.0582	0.0727	0.6412	0.423
Time	0.0321	0.0224	2.0485	0.152
Jump	0.0895	0.0388	5.3268	0.021*
Max	0.0531	0.024	4.8806	0.027*
Age	-0.00247	0.000955	6.709	0.009
Male	-0.0666	0.0272	6.0154	0.014
Asian	0.3355	0.1211	7.6761	0.006
Hispanic	0.1615	0.0353	20.9158	<.0001
White	0.3036	0.0356	72.7576	<.0001
Other	-0.0159	0.0679	0.0548	0.815
Unknown race	0.1078	0.27	0.1594	0.690

Note: Model also includes physician team dummies and patient MRN to adjust for clustering.
 * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ for test of significance in change of slopes, adjusting for case mix.

Quality-and process-improvement are integral to sustaining systematic incremental change: Using evidence to discern whether processes are implemented as planned as well as what facilitates or impedes both implementation and desired outcomes leads to more stable and useful change. Process management is also important. Improvement efforts generated by PDSA cycles were incremental and led to systematic change. Investing in small-scale micro-innovations can be a very successful change strategy. Not all innovations worked—nor should they have been expected to—but trying several things in parallel can yield promising ideas to apply elsewhere.

Integrated care management is a critical component of team-based care needed for patients with hypertension: The experience of the care managers at these sites provides lessons on what is required for a care manger to become part of a healthcare-delivery team. Care managers can efficiently provide follow-up with patients with uncontrolled hypertension and help patients improve their choices and behaviors. They can also efficiently manage some administrative tasks and there by allow providers to see more patients.

For a care manager to be a fully accepted, fully participating member of the healthcare-delivery team, clinic culture must accept and value care-manager services. In an accepting culture, care managers can be an integral part of daily team huddles, with patients requiring special attention flagged for discussion on how best to approach them.

Geographical integration of the care manager can facilitate success. Care managers need dedicated office space and a private place to meet patients. The office space needs to be near other team members to facilitate communication. As was said in our interviews, “A central person needs a central location.”

We found that for care managers to be used, they must be embedded into the health-care team. Giving all team members a role in reviewing patients and their needs in preparation for clinic visits allows for a more comprehensive focus on all patient needs.

Frequent follow-up visits are critical for hypertension patients

whose blood pressure is not controlled: Implementing a medication and treatment-management protocol with bi-weekly follow-up visits enhanced treatment of hypertension for patients not in control. In follow-up visits, physicians revisited their medication protocols and treatment plans, and patients had their vital measures taken, briefly saw their provider, and spent time with a nurse or care manager discussing goals, compliance with medication, lifestyle changes, and barriers to reducing blood pressure. The nurse or care manager helped ensure patient adherence to clinic visits and recommendations discussed in coaching sessions. Frequent visits allow the nurse and doctor to slowly work through any issues with patients whose blood pressure is not controlled. The strategy of working diligently with a patient when hypertension is not controlled regarding medication, lifestyle choices, periodic vital measurements, and building rapport helped manage hypertension in these clinics with predominantly low-income populations. This is supported by Turchin et al. 2010 [18] who found that the greatest benefit to blood-pressure normalization for patients whose blood pressure was not controlled was when the time between patient encounters was no more than 2 weeks.

Daily review of hypertension patients on the schedule and periodic reporting of hypertension outcomes by physician or team can raise awareness and responsibility for controlling blood pressure: It is important to have a daily review of hypertension patients on the schedule and to discuss these patients not only with the clinical team responsible for the individual patient but also periodically to report out in aggregate form information on hypertension patient needs, progress and status to all clinic teams and—if possible—all clinics within the organization. This transparency of outcomes and use of the data to manage patient visits can engender a sense of responsibility toward the goal of controlling the blood pressure of hypertensives. It can also build a healthy sense of competition yielding the behavioral and cultural changes needed to improve service delivery and outcomes. When tracking outcomes, feedback should not be punitive. Competitive success is its own reward and will generate improvement amongst clinic teams who see their results in public [19-22].

Conclusion

The substantial improvements observed in the control rate trends over time were attributed to several key components. Medication and treatment-management protocols that bring out-of-control hypertension patients regularly to clinics were key to bringing hypertension under control. We found that the sites that engaged in frequent follow-up with patients enabled better patient choices and behaviors and successful management of patients' health. Care managers were effective when integrated closely into the care team for treating hypertension. They play a key role in identifying solutions and assessing strategies for improving the management of hypertension on a daily basis. Efficient use of care managers as part of the care team required leadership commitment at institutional, clinical and provider levels.

Our study supports that committed leadership can produce difficult but necessary changes when they maintain their focus on monitoring process and outcome data while pushing for continual incremental changes in outcomes. We also found that quality- and process-improvement including PDSA cycles are integral to

systematic incremental change. Investing in small-scale micro-innovations within clinic pays off. Additionally, transparency with data across team members facilitates change. Non-punitive team-oriented feedback to providers is highly effective. Team building and training are key to culture change and ownership of hypertension management.

Daily review of hypertension patients on the schedule and periodic reporting of hypertension outcomes by physician or team raise consciousness. We found that the availability of population-level data for daily use among the clinical team allowed for the improvements in hypertension control to be sustained.

Changing clinical processes to raise awareness and focus on hypertension can improve control rates in clinics that serve low-income populations. Working with patients and diligently checking their medication regime, diet and exercise choices, taking their vital measurements, and building rapport can produce success in managing hypertension. Greater Rochester clinics employing these strategies showed greater in control rates than were experienced nationwide at the same time. Our qualitative analysis and information on implementation indicate that such change was not attributable to simple regression to the mean. Regression spline model results also confirmed the improvement, both within the first six months of intervention and throughout the post-implementation period.

Our evaluation has some limitations. Although we documented the implementation of individual strategies and QI activities at each clinic, we could not link each strategy specifically to each hypertension patient and instead assumed that all strategies implemented at the site impacted and influenced all hypertension patients there. Moreover the sites implemented similar strategies but had varying implementation paths. The different targets and interventions that each clinic chose for quality improvement made it difficult to draw lessons from any particular one or to test any a priori hypotheses specific to any one strategy. Therefore, our evaluation method correctly tested for change in the control rate of all hypertension patients *at the clinic-site level*, not at the individual level.

The findings from this study may not generalize to all U.S. practices or to all FQHCs because the Rochester sites were self-selected, motivated to participate, and relatively experienced in quality improvement. Two of the sites had Six Sigma Black Belts familiar with their work from past projects and therefore able to establish rapport and more quickly engage staff in developing a robust process-improvement system. In addition, we studied urban underserved clinics only in the Greater Rochester New York area, not the whole country, and there are some differences in the care of hypertension patients across different regions in the country.

The authors were also aware of the changes in control rates and in culture at the clinic sites as strategies were implemented from the monthly monitoring of the projects and derived the suggestions of factors associated with successful data use *post hoc*. However, the features of this evaluation and our research design permitted exploring a rich range of intervention strategies and QI with practice-level leadership who has experience in performance measurement and implementing process changes for hypertension patients. There was a strong consensus among the sites regarding the strategies

implemented and QI and their relationship to the improved blood-pressure control-rate data.

Our study also has several important implications for the future practice. Overall we found that the substantial improvements observed in this study of practices in the Greater Rochester New York area identified several key factors that shaped how practices in an urban underserved area can change their clinical processes for hypertension patients and improve control rates. These include 1) changing clinical processes to raise awareness and focus on hypertension, 2) using medication and treatment management protocols that bring out-of-control hypertension patients into the PCP office regularly, 3) having care managers integrated closely into the care team for treating chronic diseases, focusing on hypertension, and 4) identifying solutions and assessing strategies for improving the management of hypertension patients on a daily basis, in addition to tracking outcomes by patient and doctor. The practices in this study improved BP control in patients independent of age, race and gender in a real-world urban setting.

As increasing numbers of U.S. practices focus on improving chronic-disease care management, researchers will need to continue to assess specific strategies and clinical processes for improving control rates for patients with hypertension. Moving forward, the expansion of PCMHs offers an important opportunity to support team-based care for hypertension. Within the context of the PCMH, the key components of this study may be replicated and offer the potential to improve hypertension control in an underserved population of patients.

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