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Breaking barriers: assessing the impact of clinical quality improvements on reducing health disparities in hypertension care among Mumbai's urban slums

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ABSTRACT

The clinical quality improvement initiatives, led by the organisation's Health Equity Working Group (HEWG), aim to support healthcare providers to provide equitable, quality hypertension care worldwide. After coordinating with the India team, we started monitoring the deidentified patient data collected through electronic health records between January and May 2021. After stratifying data by age, sex and residence location, the team found an average of 55.94% of our hypertensive patients control their blood pressure, with an inequity of 11.91% between male and female patients.

The objective of this study was to assess the effectiveness of using clinical quality improvement to improve hypertension care in the limited-resourced, mobile healthcare setting in Mumbai slums. We used the model for improvement, developed by Associates in Process Improvement. After 9-month Plan-Do-Study-Act (PDSA) cycles, the average hypertensive patients with controlled blood pressure improved from 55.94% to 89.86% at the endpoint of the initiative. The gender gap reduced significantly from 11.91% to 2.19%. We continued to monitor the blood pressure and found that the average hypertensive patients with controlled blood pressure remained stable at 89.23% and the gender gap slightly increased to 3.14%. Hypertensive patients have 6.43 times higher chance of having controlled blood pressure compared with the preintervention after the 9-month intervention ($p<0.001$).

This paper discusses the efforts to improve hypertension care and reduce health inequities in Mumbai's urban slums. We highlighted the methods used to identify and bridge health inequity gaps and the testing of PDSA cycles to improve care quality and reduce disparities. Our findings have shown that clinical quality improvement initiatives and the PDSA cycle can successfully improve health outcomes and decrease gender disparity in the limited-resource setting.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The overall control of blood pressure is better in females than males. Moreover, females are more likely to get their blood pressure checked and be adherent.

WHAT THIS STUDY ADDS

⇒ The study showed that it is feasible to apply improvement methods in the Americares mobile health programmes to improve gender inequity among patients with hypertension and quality of care.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Plan-Do-Study-Act cycles can be and should be applied to improve the quality of primary healthcare and eliminate health disparities in the limited-resourced setting in low-income and middle-income countries.

INTRODUCTION

Mumbai, the financial capital of India, is home to over 20 million people, making it one of the world's most populous cities. Despite the city's rapid economic growth, Mumbai continues to grapple with significant health disparities, particularly among its vulnerable and marginalised populations. The city's slums, which account for approximately 60% of the population, are characterised by poor living conditions, limited access to healthcare and high rates of infectious diseases.[1] Moreover, the burden of chronic diseases such as hypertension, diabetes and cardiovascular diseases is rising rapidly, further exacerbating health inequalities in the city. According to National Family Health Survey 5 2019–2020 data for Mumbai, 23.3% of males and 21% of females aged 15 and above showed elevated blood pressure (BP) levels or were taking medicine to control blood pressure.[2 3] Hypertension is one of the most critical risk factors for cardiovascular disease, lowering patients' quality of life.[4]

Though many patients are diagnosed and are in treatment for hypertension, the 'rule of

halves' holds true for this urban population, as established in the Chennai Urban Population Study, wherein 37.3% of hypertensive patients were aware of their condition. Of the known hypertensive patients, 50% were in some variation of antihypertensive therapy. Of these, only 40% had BP under control.[5] Furthermore, social determinants such as female sex, older age, increased wealth, higher body mass index and certain geographical regions were associated with poor BP control among antihypertensive medication users.[5] In addition, various studies have found a higher incidence of uncontrolled hypertension in males than in females.[6 7] However, the overall control of BP is better in females than males.[8 9] Moreover, females are more likely to get their BP checked and be self-aware.[5 9]

The India Hypertension Control Initiative, developed by the Government of India, aims to provide evidence-based strategies to strengthen the building blocks of hypertension management and control.[4 10 11] To align with the strategy of patient-centred services by enabling the availability of BP monitoring and drug refills closer to the patients, our organisation has operated right-modified automobile vans that are fully equipped to act as small mobile health clinics which visit preselected fixed locations and provide primary healthcare access and education services to the needy and vulnerable 130 urban slum locations across 13 wards of Mumbai. There is a marked difference in each location served vis-à-vis its geography, population, employment, economic status, etc. Each mobile health centre (MHC) conducts two clinical sessions daily on, Monday to Friday, at two distinct locations and visits the same locations every fortnight: serving about 50 patients per clinic session and 100 patients daily.

METHODS

Team development

Recognising health disparity as an ongoing public health issue, the organisation established a HEWG that aims to uncover and address health inequities among the services provided by the organisation. The HEWG group identified social determinants as a key factor influencing patients' health outcomes and sought input from patients to identify the challenges they faced while seeking healthcare and suggest changes beneficial to their health.

The India MHC programme was selected to participate in the study. A quality improvement (QI) team with four members from MHC and HEWG members was established in which the clinical director served as the chairman of the QI team. The QI team is responsible for leading and overseeing the change effort, developing action plans and training curriculum, and monitoring progress towards achieving those goals.

Change effort development

First, the QI team reviewed deidentified patient data from January to June 2021. To include patients aged 18 and above with hypertension, we conducted a keyword search using terms such as "ht", "HTN", "HTA" and 'hypertension.' Visits with systolic BP below 140 mm Hg and diastolic BP below 90 mm Hg were classified as controlled hypertension patient visits. Reaching only one target was not classified as controlled hypertension status. We tabulated control charts for the percentage of controlled hypertension patient visits weekly.

The results showed that an average of 55.94% of the patients with diagnosis of hypertension did not control their BP status. The QI team further desegregated the data by age, sex, religion and geography. We found a noticeable gender gap between male and female, where female patients have better control of their BP than males by 11.91%.

After identifying the above-mentioned gender inequity, two goals and objectives were determined:

1. Increase percentage of hypertensive patients whose BP is controlled.
2. Reduce the gender disparity in hypertension control by using rapid Plan-Do-Study-Act (PDSA) cycles.

PDSA cycle

The goals of this initiative are:

1. Increase the percentage of hypertensive patients with controlled BP to 75% within 9 months.
2. Reduce the gender disparity in hypertension control should be less than 10% within 9 months.

The QI and HEWG teams developed a 9 month initiative and began regular interaction sessions with MHC staff to collaboratively design context-specific changes tailored to meet the needs of each community served by the MHC, starting in July 2022. This ongoing process facilitated the generation of new ideas at the MHC level.

Each PDSA cycle starts with identifying a new intervention and subjecting it to a 30-day testing phase. During this testing and implementation period, patients followed the new intervention, and outcome data were actively measured. To track progress, staff conducted BP tests for patients every 15 days. At the end of each month, the QI team analysed the data collected by MHCs and shared the results with the staff. This information guided refinements, modifications or eliminations of actions or methods as necessary, paving the way for a second PDSA cycle with a different intervention approach.

All implemented changes were documented for subsequent analysis cycles, with patients informed about these adjustments during their biweekly visits. We explored various approaches to ensure regular MHC patient visits, using strategies from telephonic reminders to actively engaging MHC staff and Aarogya Mitra, community-based volunteers who assisted in community mobilisation efforts. Using hypertension control data, we evaluated the effectiveness of interventions, capturing MHC doctor's perceptions after each intervention and conducting qualitative interviews led by the QI team after the 9-month intervention period.

MHC teams held quarterly group meetings to share their successes and lessons learnt. If an action worked in an MHC, the team lead shared their experience with

other teams. If not, the team lead shared their lessons learnt with other MHCs. Due to the COVID-19 lockdown, the initiative was interrupted between December 2021 and February 2022. The MHC team maintained minimal operations without any activities during the lockdown. The initiative resumed in mid-February. At the end of the initiative, the QI and MHC team members selected activities that had proven effective throughout the initiative and continued those activities.

Analysis

To evaluate the mean percentage of controlled BP, categorised by gender, we used statistical process control (SPC) p charts, with upper and lower control limits set at three sigma levels. Microsoft Excel was employed for generating these SPC p charts.[12–15] To assess improvement, we adhered to standard SPC charting rules, considering specific criteria such as 8 or more consecutive points above or below the centreline, a single point outside the control limits, 6 consecutive points indicating increasing or decreasing trends, 2 out of 3 consecutive points near a control limit or 15 consecutive points close to the centreline. For statistical analyses, we conducted the χ^2 test, while the one-way Analysis of Variance (ANOVA) was employed to analyse the difference in the average percentage of controlled BP and gender equity gap at various phases of the initiative. ORs were also performed to compare the relative odds of the controlled BP, given exposure to our interventions. All statistical analyses were performed by SPSS V.29.

RESULTS

After removing missing and incomplete data, a total of 264 026 patient visits were identified from 1 January 2021 to 31 December 2022. Among these visits, we identified 84 648 visits that have the diagnosis of hypertension. The majority were from patients aged between 40 and 59 years old (N=40 661, 48.04%) and aged 60 and above (N=40 554, 47.91%). Female patients accounted for most of the hypertension patient visits across all age groups and mobile centres, with 55 767 (65.88%) female visits and 28 759 (33.97%) male patient visits. Only 122 visits were identified as others (table 1).

Across our MHCs, we have implemented a range of strategies to support our patients' well-being. These initiatives include telephonic and appointment reminders, support from Aarogya Mitra, group discussions, personalised counselling sessions, health cards, referral network assistance, adherence counselling and more. Notably, the actions that have proven most effective are those involving Aarogya Mitra, particularly their comprehensive follow-up efforts. Male-specific counselling has also shown a significant impact, alongside the implementation of health cards for patients. These initiatives have contributed significantly to our patients' overall health and treatment adherence within our MHCs (figure 1).

Before the initiative, the average percentage of patient visits with controlled BP was 55.94%. To break down by gender, females tend to better control their BP. 60.14% of female patient visits showed controlled BP as only 48.24% of male patient visits showed controlled BP.

Due to the COVID lockdown, the PDSA cycle was divided into two segments. The first PDSA cycles were executed from June to December 2021, followed by the second PDSA cycles from February to April 2022. During the first PDSA cycles, an average of 68.83% of patient visits had controlled BP. Both genders showed improvement in BP control. 71.72% of female and 63.33% of male patient visits showed controlled BP. The gender gap reduced from 11.91% to 8.39% (p<0.001). In the second PDSA cycles, the average percentage of hypertensive patients with controlled BP increased from the first PDSA cycles of 68.83%–89.86% (p<0.001), and the gender gap also reduced from 8.39% to 2.19% (p<0.001). Our analysis also revealed a reduction in the gender gap in hypertension control over time and the improvement continued 6 months after the initiative ended.

In OR analysis, having exposed to the first PDSA cycles had 1.88 times higher chance to have controlled BP than preintervention (p<0.001). The consistent significances were shown throughout the study period. Hypertensive patients have 6.43 times higher chance to have controlled BP compared with the preintervention after the 9-month intervention (table 2).

DISCUSSION

Our study demonstrates significant improvements in controlling BP among hypertensive patients following the implementation of QI measures. Additionally, after 9 months of implementation, we observed a notable reduction in the gender gap. During the baseline period from January to June 2021, only 55.94% of hypertensive patients had their BP under control, with a mere 48.24% of male hypertensive patients achieving controlled BP. Despite initiating the QI measures in June, no specific changes were observed in the first 3 months. Possible explanations for this could be attributed to two factors: (1) healthcare providers at the MHC were in the process of familiarising themselves with the implementation of PDSA cycles and (2) the occurrence of national festivals starting from mid-August may have influenced patient adherence and engagement with the intervention.[5–7]

The PDSA method is used to explore and learn how interventions function in specific settings. By making iterative adjustments, it enhances the likelihood of achieving desired improvements.[9 16 17] QI initiatives with PDSA cycles have proven successful in improving population outcomes in rural settings.[18–20] However, implementing PDSA cycles in a mobile clinic setting is a rarity, with only a limited number of research projects being published on the topic in the past. The HEWG and QI team organised PDSA training sessions to introduce a novel concept to the MHC staff. Although the idea showed promise,

Table 1 Demographic and outcomes

	Preintervention	First PDSA cycles	COVID-19 lockdown	Second PDSA cycles	Postintervention	
	N=12 180	N=16 551	N=8467	N=8766	N=34 050	P value
Gender						
Male	4255 (34.93%)	5771 (34.87%)	2873 (33.93%)	2996 (34.18%)	11 260 (33.07%)	
Female	7909 (64.93%)	10 752 (64.96%)	5584 (65.95%)	5756 (65.66%)	22 746 (66.8%)	
Other	16 (0.13%)	28 (0.17%)	10 (0.12%)	14 (0.16%)	44 (0.13%)	
Age						
Under 18	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	
18–39	469 (3.85%)	685 (4.14%)	379 (4.48%)	353 (4.03%)	1337 (3.93%)	
40–59	5783 (47.48%)	7986 (48.25%)	4073 (48.1%)	4158 (47.43%)	16 345 (48%)	
60 and above	5928 (48.67%)	7880 (47.61%)	4015 (47.42%)	4255 (48.54%)	16 368 (48.07%)	
Smoking						
Yes	1468 (12.05%)	1733 (10.47%)	772 (9.12%)	811 (9.25%)	2893 (8.5%)	
No	10 712 (87.95%)	14 818 (89.53%)	7695 (90.88%)	7955 (90.75%)	31 157 (91.5%)	
Drinking						
Yes	238 (1.95%)	183 (1.11%)	68 (0.8%)	67 (0.76%)	284 (0.83%)	
No	11 942 (98.05%)	16 368 (98.89%)	8399 (99.2%)	8699 (99.24%)	33 766 (99.17%)	
BMI						
<18.5	516 (4.24%)	587 (3.55%)	263 (3.11%)	265 (3.02%)	912 (2.68%)	
18.5–25	4464 (36.65%)	6472 (39.1%)	3178 (37.53%)	3083 (35.17%)	11 886 (34.91%)	
25–30	4596 (37.73%)	6274 (37.91%)	3319 (39.2%)	3408 (38.88%)	13 719 (40.29%)	
30–35	1912 (15.7%)	2364 (14.28%)	1275 (15.06%)	1462 (16.68%)	5614 (16.49%)	
35–40	541 (4.44%)	704 (4.25%)	354 (4.18%)	422 (4.81%)	1461 (4.29%)	
>40	151 (1.24%)	150 (0.91%)	78 (0.92%)	126 (1.44%)	458 (1.35%)	
% controlled hypertension	55.94%	68.83%	76.45%	89.86%	89.23%	<0.001
Female	60.14%	71.72%	79.35%	90.62%	90.24%	<0.001
Male	48.24%	63.33%	70.85%	88.43%	87.11%	<0.001
Gap	11.91%	8.39%	8.50%	2.19%	3.14%	<0.001

*** = P ≤ 0.001
BMI, body mass index; PDSA, Plan-Do-Study-Act.

it took some time for front-line healthcare providers to fully embrace it and incorporate it into their practices. To overcome resistance, we encouraged the front-line healthcare providers to take ownership of the PDSA cycles through multiple engaging sessions with the programme team, emphasising the importance of community well-being. These interactive sessions focused on fostering a participative leadership approach, wherein the voices of the healthcare providers were heard and valued, moving away from a directive approach. These efforts helped in creating a sense of ownership and collaboration, leading to increased acceptance and successful implementation of the new concept.

Due to the COVID lockdown, our PDSA cycles were divided into two phases. The first phase ran from June to December 2021, in which an average of 68.83% of total hypertensive patients showed controlled BP during their visits, representing an increase of 12.89% compared with the baseline. Especially at the end of the first PDSA cycles, we observed that 10 successive points are above the average line, indicating improvement occurred at the end of the first PDSA cycles. The OR also indicated that hypertensive patients in the first PDSA cycles had a 1.88 times higher likelihood of controlling BP compared with the preintervention period (p<0.001).

As soon as lockdown was announced, many patients/people tried to shift to their hometowns as the cost of living was high in Mumbai (people were jobless or offices were closed). During that time, we tried to implement intervention like telephonic reminders, WhatsApp group interaction or Aarogya Mitra support through home visits. However, the percentage of controlled hypertensive visits dropped at the beginning of 2022, we believe it is because the medical adherence reduced due to the holiday season

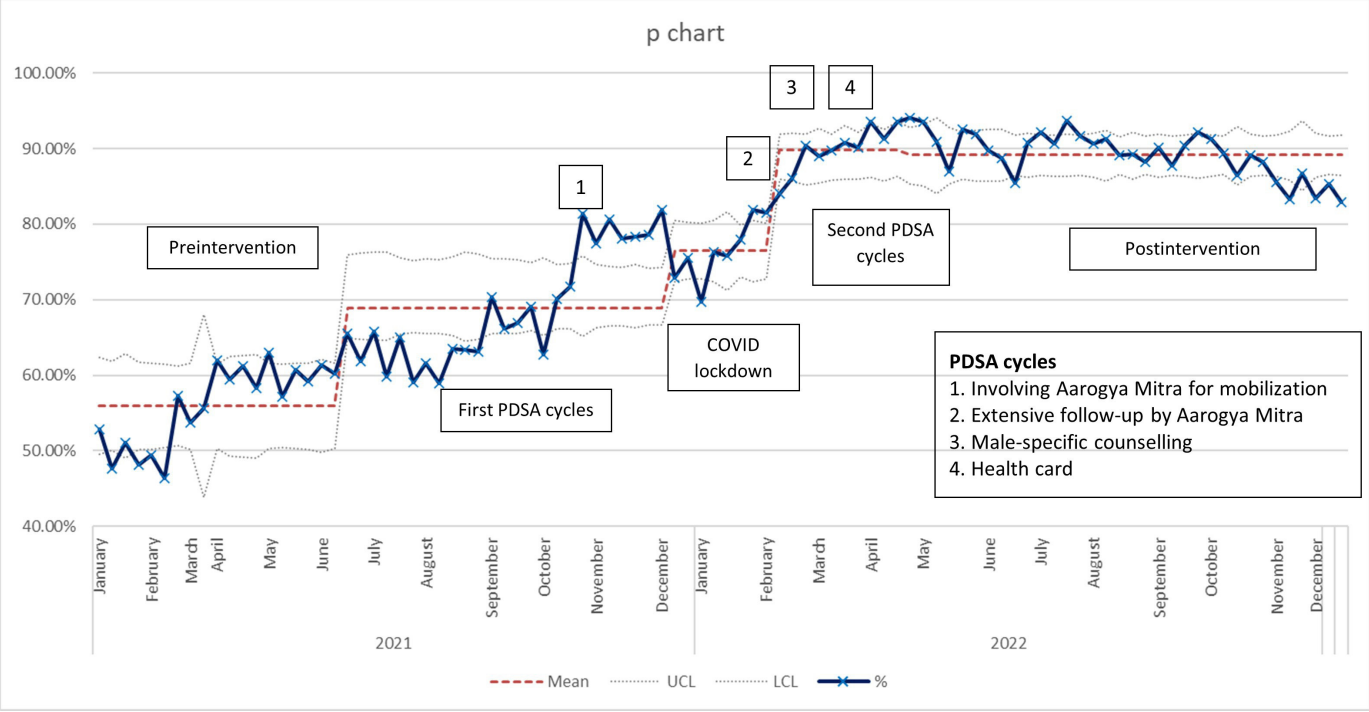

Figure 1 The percentage of hypertensive patient visits with controlled blood pressure. PDSA, Plan-Do-Study-Act. (UCL: upper control limit; LCL: lower control limit)

and COVID lockdown. Patients were paying less attention to medicine and diet control.[21–23]

During the second part of PDSA cycles, 89.86% of hypertensive patients achieved controlled BP. The gender gap narrowed to 2.19%, with 90.62% of female patients and 88.43% of male patients reporting controlled BP. Compared with the baseline, hypertensive patients in the second PDSA cycle had a 6.20 times higher likelihood of controlling BP (p<0.001). This improvement can be attributed to the implementation of various activities, including extensive follow-up by Aarogya Mitra, gender-specific consultations and the utilisation of health cards.

On the conclusion of the PDSA cycles, the QI team and MHC staff identified four activities that proved particularly effective in improving hypertension management across all MHCs. These activities included mobilisation by Aarogya Mitra, the establishment of a referral network, the use of health cards and male-specific counselling. After 8 months of observation, the average rate of hypertensive patients with controlled BP stands at 89.23%, slightly reduced by 0.66% from the second PDSA cycle. These outcomes underscore the significance of the implemented measures in successfully managing hypertension within the community.

Around each of these approaches, there are significant bodies of literature that align with these results.[24] For instance, in a randomised control trial conducted by Neupane *et al* in Nepal, a community health volunteer programme to promote hypertension management was associated with reduced systolic BP in hypertensive patients and a reduction in relative risk of developing hypertension.[25–29] Meanwhile, effective referral networks have been shown to be both cost-effective and successful in achieving better health delivery for chronic diseases including cardiovascular disease in both high-income countries and LMICs.[29–32] Finally, treatment cards, used primarily to help patients track and communicate with other providers about their hypertension and treatment

Table 2 The OR of the percentage of controlled hypertensive visits

Reference	Preintervention	First PDSA cycles	COVID-19 lockdown	Second PDSA cycles	Postintervention
Preintervention	Ref	1.88***	2.56***	6.20***	6.43***
First PDSA cycles		Ref	1.36***	3.30***	3.42***
COVID-19 lockdown			Ref	2.42***	2.51***
Second PDSA cycles				Ref	1.04
Postintervention					Ref

***P ≤ 0.001
PDSA, Plan-Do-Study-Act.

regimen, have been regularly implemented in hypertension control efforts in numerous LMIC including India.[33–36] Gender-specific services were particularly important for this project given the emphasis the QI team placed on reducing gender disparities in hypertension management—a well-documented problem in India and much of south Asia.[4 37–42] In the context of this programme, male patients showed lower rates of hypertension management than their female counterparts, thus male-specific counselling involved tailoring and expanding service delivery to better accommodate working male populations including expanding service delivery to weekend and evening hours to address the systemic barriers male patients faced in accessing care.

Assessing sustainability in the future involves ongoing monitoring of hypertension management indicators, evaluating changes in MHCs, conducting feedback sessions with patients and staff, exploring partnerships, leveraging technology for remote monitoring and integrating health education programmes. Proactive monitoring, evaluation and collaboration are essential for long-term sustainability.

Our approach is in line with recent research showing the improved effectiveness of interventions that employ comprehensive strategies—addressing multiple barriers to hypertension control simultaneously—when compared with isolated interventions or individual components. For example, a 2009 study by the Hypertension Improvement Project showed significantly greater improvement in hypertension management when both physician and patient-related barriers were addressed concurrently.[43] Given the complex nature of health behaviours generally and hypertension management specifically, a multipronged approach to improvement is not only justified but necessary for sustainable outcomes.

Limitations

The findings of this study must be seen keeping in view certain limitations. The first limitation is the nature of the study design. The study was designed as a QI project iteratively testing changes to see if they yield improvement and deciding based on the results of each change tested. As such the design was specifically testing the effectiveness of different changes in each context or MHC separately. Also, the process was not in order at the start, which was deliberate as the study was trying to perfect the methodologies for conducting these studies in future at the MHC. The MHC staff was also busy attending to patients (around 50 patients in 3 hours) which made documenting the results parallel to the changes tested and depended on the recall to chart the timeline. For example, the timelines decided for testing changes were done through recall for all MHCs as because of COVID-19 there were disruptions in services. Another important parameter was the turnover rate of doctors or staff was not considered as a factor but was seen as an important factor affecting the health outcomes of patients receiving healthcare at the MHCs. As the study concentrated on the hypertension patients, it cannot be ruled out that the doctors became more sensitive to the data being reported and took special care of the hypertention patients during this period leading to the researcher bias in test results. The hypertension patients also received extra attention and details of the study which may have affected greater compliance leading to participant's bias. The study was done in Mumbai at MHCs hence though the study methodology can be perfected as well as extrapolated, the results cannot be considered or extrapolated for other cities or health institutions with different contexts.

CONCLUSIONS

This improvement project showed that it is possible to apply QI initiatives with PDSA cycles in the mobile health setting to improve the quality of care for patients with hypertension as well as bridge any inequity gaps in the care provided.

Collaborators We do not have collaborators that qualify as group authors.

Contributors SJL acts as guarantor. RM, SJL and TM constructed the concept of the study. RM, HD, CA, TM, SJL and IV led the project implementation and execution. IV, HD, TM and SJL oversight and managed the data collection. IV, TM and SJL conducted the analysis. IV, TM and SJL constructed the manuscript.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants but WCG IRB exempt under 45 CFR § 46.104(d) (4), sponsor protocol no: HCHE V1 07292022, Protocol Title: Hypertension Control: Improving equitable outcomes. Participants gave informed consent to participate in the study before taking part.

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Data availability statement Data are available on reasonable request.

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REFERENCES

1 Anchala R, Kannuri NK, Pant H, *et al*. Hypertension in India: a systematic review and meta-analysis of prevalence, awareness, and control of hypertension. *J Hypertens* 2014;32:1170–7.
2 Deepa R, Shanthirani CS, Pradeepa R, *et al*. Is the "rule of halves" in hypertension still valid?--evidence from the chennai urban population study. *J Assoc Physicians India* 2003;51:153–7.
3 National Family Health Survey (NFHS - 5), 2019–21. Government of India Ministry of health and family welfare. n.d. Available: https://dhsprogram.com/pubs/pdf/FR375/FR375.pdf

4 Rahman M, Williams G, Al Mamun A. Gender differences in hypertension awareness, antihypertensive use and blood pressure control in Bangladeshi adults: findings from a national cross-sectional survey. *J Health Popul Nutr* 2017;36:23.
5 Burt VL, Whelton P, Roccella EJ, *et al*. Prevalence of hypertension in the US adult population: results from the third national health and nutrition examination survey, 1988-1991. *Hypertension* 1995;25:305–13.
6 Choi HM, Kim HC, Kang DR. Sex differences in hypertension prevalence and control: analysis of the 2010-2014 Korea national health and nutrition examination survey. *PLoS ONE* 2017;12:e0178334.
7 Anastos K, Charney P, Charon RA, *et al*. Hypertension in women: what is really known?: the women's caucus, working group on women's health of the society of general internal medicine*. *Ann Intern Med* 1991;115:287–93.
8 Kotchen JM, Shakoor-Abdullah B, Walker WE, *et al*. Hypertension control and access to medical care in the inner city. *Am J Public Health* 1998;88:1696–9.
9 Massoud MR, E. Kimble L. Why is it important to use improvement methods to address chronic care priorities in primary care? *Health Prim Car* 2017;1.
10 Government of India. Key indicators of social consumption in India—health. NSS 75th Round. 2017. Available: http://mospi.nic.in/sites/default/files/ publication_reports/KI_Health_75th_Final.pdf
11 Kaur P, Kunwar A, Sharma M, *et al*. India hypertension control initiative—hypertension treatment and blood pressure control in a cohort in 24 sentinel site clinics. *J Clin Hypertens (Greenwich)* 2021;23:720–9.
12 Ng JJ. n.d. Statistical process control chart as a project management tool. *IEEE Eng Manag Rev*46:26–8.
13 Li Z, Qiu P, Chatterjee S, *et al*. Using P values to design statistical process control charts. *Stat Papers* 2013;54:523–39.
14 Naikan VNA. Statistical process control. In: Misra KB, ed. *Handbook of Performability Engineering*. London: Springer London, 2008: 187–201.
15 Chakraborti S, Human SW, Graham MA. Phase I statistical process control charts: an overview and some results. *Quality Engineering* 2008;21:52–62.
16 Massoud MR, Mensah-Abrampah N, Barker P, *et al*. Improving the delivery of safe and effective healthcare in low and middle income countries. *BMJ* 2012;344:e981.
17 Reed JE, Card AJ. The problem with plan-do-study-act cycles. *BMJ Qual Saf* 2016;25:147–52.
18 Kong K, Kong S. A quality improvement project in a hospital in rural Nepal – improving infection control practice using the 'plan, do, study, act' (PDSA) cycle. *Int j Infect Control* 2013;9.
19 Salman GF. Continuous quality improvement in rural health clinics. *J Gen Intern Med* 2005;20:862–5.
20 Christoff P. Running PDSA cycles. *Curr Probl Pediatr Adolesc Health Care* 2018;48:198–201.
21 Chen H-S, Jap T-S, Chen R-L, *et al*. A prospective study of glycemic control during holiday time in type 2 diabetic patients. *Diabetes Care* 2004;27:326–30.
22 Chen H-S, Wu T-E, Jap T-S, *et al*. Effects of health education on Glycemic control during holiday time in patients with type 2 diabetes mellitus. 2008.
23 Leggett C, Giles L, Anderson JJA, *et al*. Adherence to metformin is reduced during school holidays and weekends in children with type 1 diabetes participating in a randomized controlled trial. *Arch Dis Child* 2019;104:890–4.
24 Pati S, van den Akker M, Schellevis FFG, *et al*. Management of diabetes patients with comorbidity in primary care: a mixed-method study in Odisha, India. *Fam Pract* 2023;40:714–21.
25 Mills KT, Rubinstein A, Irazola V, *et al*. Comprehensive approach for hypertension control in low-income populations: rationale and study design for the hypertension control program in Argentina. *Am J Med Sci* 2014;348:139–45.
26 Thankappan KR, Sivasankaran S, Mini GK, *et al*. Impact of a community based intervention program on awareness, treatment and control of hypertension in a rural Panchayat, Kerala, India. *Indian Heart Journal* 2013;65:504–9.
27 P Suseela R, Ambika RB, Mohandas S, *et al*. Effectiveness of a community-based education and peer support led by women's self-help groups in improving the control of hypertension in urban slums of Kerala, India: a cluster randomized controlled pragmatic trial. *BMJ Glob Health* 2022;7:e010296.
28 Neupane D, McLachlan CS, Mishra SR, *et al*. Effectiveness of a lifestyle intervention led by female community health volunteers versus usual care in blood pressure reduction (COBIN): an open-label, cluster-randomized trial. *The Lancet Global Health* 2018;6:e66–73.
29 Sweeney B. The referral system. *BMJ* 1994;309:1180–1.
30 Levitt NS, Puoane T, Denman CA, *et al*. Referral outcomes of individuals identified at high risk of cardiovascular disease by community health workers in Bangladesh, Guatemala, Mexico, and South Africa. *Glob Health Action* 2015;8:26318.
31 Grace SL, Chessex C, Arthur H, *et al*. Systematizing inpatient referral to cardiac rehabilitation 2010: CANADIAN ASSOCIATION OF CARDIAC REHABILITATION AND CANADIAN CARDIOVASCULAR SOCIETY JOINT POSITION PAPER. *J Cardiopulm Rehabil Prev* 2011;31:E1–8.
32 Grace SL, Leung YW, Reid R, *et al*. The role of systematic inpatient cardiac rehabilitation referral in increasing equitable access and utilization. *J Cardiopulm Rehabil Prev* 2012;32:41–7.
33 Zou G, Witter S, Caperon L, *et al*. Adapting and implementing training, guidelines and treatment cards to improve primary care-based hypertension and diabetes management in a fragile context: results of a feasibility study in Sierra Leone. *BMC Public Health* 2020;20:1185.
34 Muddu M, Semitala FC, Kimera I, *et al*. Improved hypertension control at six months using an adapted WHO HEARTS-based implementation strategy at a large urban HIV clinic in Uganda. *BMC Health Serv Res* 2022;22:699.
35 Ojji D, Aifah A, Iwelunmor J, *et al*. Building capacity of community nurses to strengthen the management of uncomplicated hypertension in persons living with HIV in low- and middle-income countries. *Glob Heart* 2023;18:38.
36 Humphries C, Jaganathan S, Panniyammakal J, *et al*. Investigating clinical handover and healthcare communication for outpatients with chronic disease in india: a mixed-methods study. *PLoS ONE* 2018;13:e0207511.
37 Devi P, Rao M, Sigamani A, *et al*. Prevalence, risk factors and awareness of hypertension in India: a systematic review. *J Hum Hypertens* 2013;27:281–7.
38 Elnaem MH, Mosaad M, Abdelaziz DH, *et al*. Disparities in prevalence and barriers to hypertension control: a systematic review. *Int J Environ Res Public Health* 2022;19:14571.
39 Salem H, Hasan DM, Eameash A, *et al*. Worldwide prevalence of hypertension: a pooled meta-analysis of 1670 studies in 71 countries with 29.5 million participants. *J Am Coll Cardiol* 2018;71.
40 Defianna SR, Santosa A, Probandari A, *et al*. Gender differences in prevalence and risk factors for hypertension among adult populations: a cross-sectional study in Indonesia. *IJERPH* 2021;18:6259.
41 Grover A, Venkatesh U, Ghai G, *et al*. Prevalence and associated factors for awareness of hypertension in India: findings from national survey-4. *J Family Med Prim Care* 2022;11:5766–75.
42 Elahi A, Ali AA, Khan AH, *et al*. Challenges of managing hypertension in Pakistan - a review. *Clin Hypertens* 2023;29:17.
43 Svetkey LP, Pollak KI, Yancy WS Jr, *et al*. Hypertension improvement project: randomized trial of quality improvement for physicians and lifestyle modification for patients. *Hypertension* 2009;54:1226–33.