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Landscape of team-based care to manage hypertension: results from two surveys in low/middle-income countries

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ABSTRACT

Objectives Team-based care is essential for improving hypertension outcomes in low-resource settings. We assessed perceptions of country representatives and healthcare workers (HCWs) on team-based hypertension care in low/middle-income countries.

Design Two cross-sectional surveys.

Setting The first survey (Country Profile Survey) was conducted in 17 countries and eight in-country regions: Algeria, Bangladesh, Burundi, Chile, China (Beijing, Henan, Shandong), Cuba, Ethiopia, India (Kerala, Madhya Pradesh, Maharashtra, Punjab, Telangana), Nepal, Nigeria, Philippines, Saint Lucia, Sri Lanka, Thailand, Turkey, Uganda and Vietnam. The second survey (HCW Survey) was conducted in four countries: Bangladesh, China, Ethiopia and Nigeria.

Participants Using convenience sampling, participants for the Country Profile Survey were representatives from 17 countries and eight in-country regions, and the HCW Survey was administered to HCWs in Bangladesh, China, Ethiopia and Nigeria.

Outcome measures Country-level use of team-based hypertension care framework, comprising administrative, basic and advanced clinical tasks. Current practices of different HCW cadres, perspectives on team-based management of hypertension, barriers and facilitators.

Results In the Country Profile Survey, all (23/23, 100%) countries/regions surveyed integrated team-based care for basic clinical hypertension management tasks, less for advanced tasks (7/23, 30%). In the HCW Survey, 854 HCWs participated, 47% of whom worked in rural settings. Most HCWs in the sample acknowledged the value of team-based hypertension care. Although there were slight variations by country in the study sample, overall, barriers to team-based hypertension care were identified as inadequate training (83%); regulatory issues (76%); resistance by patients (56%), physicians (42%) and nurses (40%). Facilitators identified were use of treatment algorithms (94%), telehealth/m-health technology (92%) and adequate compensation for HCWs (80%).

Conclusions Our findings revealed key lessons for health systems and governments regarding team-based care implementation. Specifically, policies to facilitate additional training, optimise HCWs' roles within care teams, use of hypertension treatment protocols and telehealth/m-health technology will be essential to promote team-based care.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Findings from our study provide evidence from healthcare workers (HCWs) from multiple low/middle-income countries (LMICs) on the state of team-based hypertension care in low-resource settings.
⇒ Our surveys were translated into the different languages of use in participating countries to allow for more nuanced interpretation of contextual factors regarding team-based hypertension care.
⇒ Our study provides further evidence and justification for investing in HCW training and remuneration to enhance implementation of team-based care.
⇒ The surveys were limited to a non-random sampling of HCWs and country representatives from LMICs; the sample may not be representative of team-based care practices in these countries, which may impact the generalisability of the findings.
⇒ The Country Profile Survey relied on responses from country representatives, and it is difficult to ascertain whether these representatives have complete knowledge of country-level use of team-based care for hypertension management.

INTRODUCTION

Low/middle-income countries (LMICs) are undergoing an epidemiological transition with a double burden of communicable and non-communicable diseases (NCDs), particularly cardiovascular disease (CVD).[1] Hypertension is a major risk factor for CVD, such as myocardial infarction, stroke and kidney disease, globally.[2] In addition, LMICs are experiencing an increased burden of

hypertension.[3] Despite knowledge and availability of evidence-based treatment of hypertension, the prevalence of controlled blood pressure (BP) is extremely low (<10%) in LMICs, especially for countries in Africa, central and south Asia and eastern Europe.[4 5]

Tackling the burden of hypertension requires a robust healthcare workforce to diagnose, treat and control hypertension. However, LMICs commonly have an insufficient workforce, that is, few physicians,[6] which presents a major barrier in efforts to control hypertension. There is also a shortage of other healthcare workers (HCWs), such as nurses and pharmacists.[6] The World Bank estimates (2018–2020 data) that there were 0.7 physicians, 1.7 nurses and midwives per 1000 people in India, while in Nigeria, there were 0.4 physicians, 1.5 nurses and midwives per 1000 people.[6] These estimates are in stark contrast to the higher ratios in the USA (2.6 physicians, 15.7 nurses and midwives per 1000 people) and the UK (3.0 physicians, 7.2 nurses and midwives per 1000 people).[6] The COVID-19 pandemic has further strained the healthcare workforce, which was already limited in these countries. The WHO projects that 18 million HCWs will be needed in LMICs by 2030. Team-based care, defined as a health systems-level, and organisational intervention that relies on multidisciplinary teams to improve the quality of hypertension care for patients,[7] has been proposed as a potential solution to workforce shortage challenges in LMICs. The WHO Team-Based Care Module of the HEARTS technical package[8] provides training materials on team-based care, including steps in implementation, and sample workflow charts that may be tailored to different settings. Through the HEARTS technical package, the WHO advocates that its member countries consider implementing team-based care interventions to improve the accessibility and quality of healthcare services.

Teams can include patients, primary care physicians and other HCWs such as nurses, pharmacists, counsellors, social workers, nutritionists, community health workers, etc.[9] In team-based care, these cadres share tasks to manage patients with hypertension (eg, community health workers measuring BP and nurses refilling antihypertensive medications).[10] Randomised controlled trials and meta-analyses of team-based hypertension care involving nurse or pharmacist intervention have demonstrated reductions in systolic (5.4 mm Hg reduction) and diastolic BP (1.8 mm Hg reduction) and greater achievement of BP goals (12% increase) when compared with usual care.[7 11 12] There is also strong evidence that team-based care is a cost-effective strategy, which is relevant to resource-constrained settings. Despite a body of evidence,[13–15] uptake of team-based care is still limited, particularly in LMICs, and barriers and facilitators of team-based care have not been systematically studied in LMICs.[16]

To assist LMICs with developing strategies to implement team-based hypertension care, this study aims to understand the current landscape of team-based care from the perspective of healthcare administrators and HCWs currently practicing in LMICs. The first survey (Country Profile Survey) assessed country-level use of team-based care for hypertension management. The second survey (HCW Survey) explored team-based care management of hypertension through current practices and perspectives of different HCWs, including barriers and facilitators to implementation.

METHODS

Two anonymous online surveys with different objectives, questions and sampling frames were administered from September 2020 to October 2021 (Country Profile Survey) and July 2021 to December 2021 (HCW Survey). The first survey (Country Profile Survey) aimed at understanding the current tasks of HCWs and was administered to country representatives from 23 countries and in-country regions. The second survey (HCW Survey) aimed to understand their perspectives on team-based management of hypertension, and the barriers they face and facilitators, was administered to HCWs currently practicing in four RTSL (Resolve to Save Lives) priority LMICs (Bangladesh, China, Ethiopia and Nigeria). The surveys collected sociodemographic and employment characteristics of respondents, current roles and responsibilities of HCWs, HCWs' perceptions of team-based hypertension care, and barriers and facilitators to team-based hypertension care. The surveys were developed with contributions from hypertension, epidemiology and health systems experts at Johns Hopkins and RTSL, including its leaders and country representatives who live or work in LMICs.

The study conduct and reporting of findings followed the Strengthening the Reporting of Observational Studies in Epidemiology guideline for cross-sectional studies.

Data collection

The first survey was administered in English between September 2020 and October 2021 among countries with ongoing RTSL-supported programmes. RTSL is a global non-profit organisation that supports countries in their efforts to reduce morbidity and mortality from hypertension.[17] The study was also administered among the LINKS community,[18] a global community for cardiovascular health comprising 1061 individuals from 94 countries. Members belong to over 600 organisations, including ministries of health, academic institutions, non-governmental organisations (NGOs)/civil society organisations, RTSL's partner organisations such as WHO and NCD Alliance, private practices and government hospitals. The inclusion criteria for this survey were persons that are country representatives of hypertension management programmes within RTSL, WHO or persons employed by an academic organisation, government, healthcare organisation or public health organisations in LMICs. We advised our partners to ensure only one representative per country was selected to participate; if the selected representative was unable to complete the survey, an alternative person was recommended.

The second survey administered between July 2021 and December 2021 was translated into Chinese, Bangla and four Ethiopian languages (Amharic, Somali, Sidama and Oromo) and was administered to HCWs employed as physicians, nurses, pharmacists and community health workers in Bangladesh, China, Ethiopia and Nigeria. The back translation of the surveys was done to ensure accuracy of translation and was approved by the principal investigator (YC-M). Participants were recruited through healthcare facilities and healthcare organisations that have established relationships and existing collaborations with RTSL and the LINKS community within the countries. We distributed the survey link to these organisations, who then distributed the survey to their constituents, encouraging interested HCWs to participate. Due to the convenience sampling strategy, we were unable to pre-specify a response rate because we could not reliably determine those who received a link to the survey and persons who declined to participate.

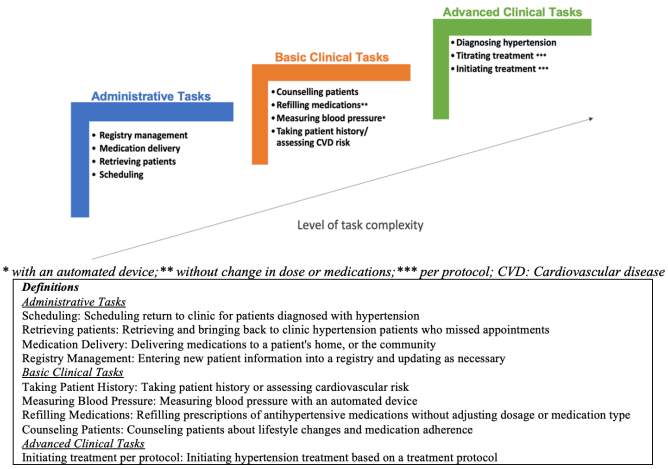
The two surveys were constructed and administered via Research Electronic Data Capture (REDCap). Two unique links were created, and RTSL disseminated the online survey links to potential respondents for both surveys. Where RTSL was not the main hypertension programme implementer, the survey was disseminated through RTSL's in-country implementation partners. Where internet connectivity was limited for the HCW survey, paper copies of the surveys were administered in person, followed by manual data entry into REDCap by a data clerk. The survey instruments are available in the online supplemental material.

Study population and sample size

A convenience sample of country representatives and HCWs was used to complete this survey. There was no target recruitment goal for country representatives in the first survey, as the goal was to collect responses from as many LMICs as possible. The recruitment targets for HCWs in the second survey in each country were established based on the size of the HCW workforce in each country (online supplemental table 1).

Statistical analysis

All survey data were exported from REDCap and analysed using StataI/C 16.1 (StataCorp). A two-sided p< 0.05 was considered statistically significant. Missing data were excluded from the analysis. Continuous and categorical variables were summarised using mean (±SD) and frequencies and percentages, respectively. Responses on hypertension management task assignment were presented using graphs for visualisation and stratified by WHO regions and participating countries. χ^2, Fisher's exact, Wilcoxon rank-sum and Student's t-tests were used as appropriate to compare HCWs' perceptions of team-based care across the LMICs. Tasks of HCWs related to hypertension management were summarised using descriptive analysis summary techniques and categorised based on the Team-Based Hypertension Care conceptual framework the research team developed (figure 1).[19] In this framework, hypertension tasks are categorised into three task complexity levels: (1) administrative tasks that can be completed with limited clinical knowledge and involve a low level of decision making (eg, scheduling); (2) basic clinical tasks that require a higher degree of clinical knowledge and decision-making capacity, but that can be performed mostly independently from direct physician supervision (eg, taking patients' history) and (3) advanced clinical tasks that require the highest level of clinical knowledge, decision-making capacity and support such as a standard treatment protocol, or phone call with a physician (eg, initiating treatment). For the first survey, data were grouped according to WHO regions and then reported at the level of individual countries.



* *with an automated device;*** *without change in dose or medications;**** *per protocol; CVD: Cardiovascular disease*

Definitions

Administrative Tasks

Scheduling: Scheduling return to clinic for patients diagnosed with hypertension

Retrieving patients: Retrieving and bringing back to clinic hypertension patients who missed appointments

Medication Delivery: Delivering medications to a patient's home, or the community

Registry Management: Entering new patient information into a registry and updating as necessary

Basic Clinical Tasks

Taking Patient History: Taking patient history or assessing cardiovascular risk

Measuring Blood Pressure: Measuring blood pressure with an automated device

Refilling Medications: Refilling prescriptions of antihypertensive medications without adjusting dosage or medication type

Counseling Patients: Counseling patients about lifestyle changes and medication adherence

Advanced Clinical Tasks

Initiating treatment per protocol: Initiating hypertension treatment based on a treatment protocol

Figure 1 Team-based care conceptual framework for hypertension management.[19]

Reflexivity

The first author, an early career researcher (OO), and the senior author (YC-M) are both originally from a lower middle-income country. Majority of the collaborators and co-authors (ZH, LT, GAD, AW, SRC, SJ, MRB, SI, KO, JO, ECO, DO) who assisted with coordinating translations, recruitment and data collection from participating countries were from LMICs. Research team members from high-income countries were involved (DC, AEM, DN, CDH, AE, GWP, LA, KM, MDH) in project implementation and contributed to data interpretation. All authors contributed to the design, results interpretations and critical revision of the manuscripts. All authors approved the final version for submission.

Patient and public involvement

None.

RESULTS

Team-based hypertension care country profile survey (first survey)

Respondents of the Country Profile Survey represented 17 countries and eight in-country regions across six WHO regions (ie, Algeria, Bangladesh, Burundi, Chile,

China (Beijing, Henan, Shandong), Cuba, Ethiopia, India (Kerala, Madhya Pradesh, Maharashtra, Punjab, Telangana), Nepal, Nigeria, Philippines, Saint Lucia, Sri Lanka, Thailand, Turkey, Uganda and Vietnam) (online supplemental table 2). Most country representatives had at least a master's degree, and had primary affiliations in hospitals or health centres, NGOs or the WHO Country Office. According to the country representatives, health insurance was mandatory in 5 (21.7%) countries and opt-in insurance in 13 (56.5%) of the countries. There was evidence of published hypertension guidelines in 20 countries/regions; in 10 countries/regions, there were team-based care recommendations or guidelines. Telehealth was used in 12 countries/regions and six of these had existing guidelines for telehealth use in primary care.

Hypertension management task assignment in participating countries

Most countries had evidence of team-based care for basic clinical tasks in which community health workers, nurses and pharmacists measured BP, refilled medication and counselled patients (table 1, online supplemental table 3). Some countries indicated that team-based care existed at the advanced clinical tasks level such that nurses and pharmacists could diagnose hypertension, initiate and titrate hypertension treatment. This was evident in Burundi, Ethiopia, Chile, Saint Lucia, India (Madhya Pradesh), Nepal and Nigeria. In fewer countries, community-health workers performed these advanced-level tasks, namely, China (Beijing and Shandong), India (Madhya Pradesh) and Nigeria.

Team-based hypertension care survey among HCWs (second survey)

In the HCW survey, 854 HCWs from four countries completed the survey; 274 were from Bangladesh, 268 were from China, 63 were from Ethiopia (limited responses due to social unrest) and 249 were from Nigeria. Most respondents from China were from Beijing (98%), and most respondents from Bangladesh were from Sylhet Division (49%). The mean (±SD) age was 34.9 (10.2) years, 67% were women, 23% were general medical practitioners and 31% were nursing professionals (online supplemental table 4). Many worked in rural areas (47%), hospitals or health centres (83%), and 38% held a managerial role.

Characteristics of HCW survey respondents

The mean (±SD) age of HCWs respondents by country was 31.7 (5.9) years in Bangladesh, 34.9 (12.4) years in China, 30 (5.8) years in Ethiopia and 33.8 (9.8) years in Nigeria (online supplemental table 4). Across the countries, most respondents were females, except for Ethiopia, where 57% of HCW respondents were men. In terms of HCW cadre, many respondents from Bangladesh were nursing professionals (36%), general medical practitioners for China (37%), nursing professionals for Ethiopia (32%) and community health workers for Nigeria (41%). Report of use of telehealth was highest in China (74%), while less than half of respondents indicated use of telehealth in Bangladesh (46%), Ethiopia (29%) and Nigeria (11%).

Perspectives on team-based hypertension care, facilitators and barriers

Barriers to team-based care were identified; this included inadequate training of HCWs such as nurses, pharmacists and community health workers (83%), regulatory issues such as the scope of practice laws and practice standards (76%), resistance by patients (56%) and professional opposition by physicians (42%) or nurses (40%) (figure 2A). Most HCWs from China, Ethiopia and Nigeria listed regulatory issues as a main barrier (75%, 87% and 79%, respectively) (online supplemental figures 1–3). The majority of the HCWs in Bangladesh identified inadequate training as a major barrier (88%) (online supplemental figure 4). HCW respondents indicated that team-based hypertension care could be improved by the following: use of hypertension treatment algorithms (94%), use of technology such as telemedicine and mobile health technology to ease management of hypertension (92%) and adequate compensation for HCWs who are not physicians (80%) (figure 2B).

Most HCWs acknowledged the value of team-based hypertension care (figure 2C). Specifically, they revealed that team-based hypertension care could quickly increase patient care capacity (96%), improve healthcare coverage and human resource efficiency (92%), result in similar patient outcomes (88%), reduce the cost of care for patients (87%), is necessary for their country (94%). They also indicated that team-based hypertension care should be included in the hypertension training curriculum of HCWs (94%), and there should be compensation for any additional responsibilities taken on by HCWs (88%).

Hypertension management task assignment

Task assignments related to hypertension management for HCWs differed across countries (online supplemental figure 5). HCWs were asked to identify which HCW cadre performed the advanced hypertension management in practice (figure 3). The task assignment was classified according to the hypertension task-sharing conceptual framework (figure 1)[19]: advanced clinical tasks which include initiating and titrating hypertension treatment and diagnosing hypertension were mostly performed by physicians in Bangladesh and China, by nurses in Ethiopia and by community health workers (including community nurses and community health extension workers) in Nigeria.

DISCUSSION

We undertook this study to examine team-based care for hypertension care in LMICs. Guided by a team-based care conceptual framework for hypertension management,[19] we observed similarities as well as heterogeneity in the

Table 1 Hypertension management task allowed by countries, level of task complexity and type of healthcare provider (basic and advanced clinical tasks)

Tasks level	Taking patient history				BP measurement				Refilling medications				Counselling patients				Initiating treatment*				Titrating treatment*				Diagnosing hypertension			
HCW cadre	P	N	Ph	C	P	N	Ph	C	P	N	Ph	C	P	N	Ph	C	P	N	Ph	C	P	N	Ph	C	P	N	Ph	C
Africa																												
Algeria	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•				•				•			
Burundi	•				•	•			•				•	•			•				•	•			•	•		
Ethiopia	•	•			•	•			•	•						•	•				•	•			•			
Nigeria	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•		•	•	•	•	•
Uganda		•				•			•					•			•				•				•			
Americas																												
Chile	•	•			•	•			•				•	•			•				•	•			•			
Cuba	•				•	•		•			•		•	•		•	•				•				•			
Saint Lucia	•	•			•	•					•		•	•			•				•	•			•			
Europe																												
Turkey	•	•			•	•			•	•			•	•			•				•				•			
Southeast Asia																												
Bangladesh		•			•	•		•		•			•	•		•	•				•				•			
India																												
Kerala	•	•			•	•			•				No one				•				•				•			
Madhya Pradesh	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•				•				•	•	•	•
Maharashtra		•	•	•		•	•	•	•		•				•	•	•				•				•			
Punjab	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•				•				•			
Telangana		•				•		•		•		•		•		•	•				•				•			
Nepal	•	•			•	•			•	•	•	•	•	•	•		•	•	•		•	•	•		•	•	•	
Sri Lanka	•				•				No one				•	•		•	No one				•				•			
Western Pacific																												
China																												
Beijing	•				•	•		•	•			•	•	•		•	•			•	•			•	•			•
Henan	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•				•				•			
Shandong	•			•	•			•	•			•	•		•	•	•			•	•			•	•			•
Philippines	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•				•				•			
Thailand	•				•	•		•	•	•			•	•		•	•				•				•			
Vietnam	•				•	•		•	•				•	•		•	•				•				•			

Continued

Table 1 Continued

Tasks level	Taking patient history			BP measurement			Refilling medications			Counselling patients			Initiating treatment*			Titrating treatment*			Diagnosing hypertension		
HCW cadre	P	N	Ph	C	P	N	Ph	C	P	N	Ph	C	P	N	Ph	C	P	N	Ph	C	P	N	Ph	C

Definitions: *Administrative tasks*: Scheduling: scheduling return to the clinic for patients diagnosed with hypertension; Retrieving patients: retrieving and bringing back to clinic hypertension patients who missed appointments; Medication delivery: delivering medications to a patient's home, or the community; Registry management: entering new patient information into a registry and updating as necessary. *Basic clinical tasks*: Taking patient history: taking patient history or assessing cardiovascular risk; Measuring blood pressure: measuring blood pressure with an automated device; Refilling medications: refilling prescriptions of antihypertensive medications without adjusting dosage or medication type; Counselling patients: counselling patients about lifestyle changes and medication adherence. *Advanced clinical tasks*: Initiating treatment per protocol: initiating hypertension treatment based on a treatment protocol; Titrating treatment per protocol: adjusting a patient's dosage of antihypertensive medication based on a treatment protocol; Diagnosing hypertension: diagnosing hypertension based on blood pressure measured or clinical examination.

*Initiating and titrating hypertension treatment per protocol.

BP, blood pressure; C, community health workers; HCW, healthcare worker; N, nursing professionals; No one, no one performed this task; P, physicians, including general and specialists medical practitioners; Ph, pharmacists.

Figure 2 (A) Perceived barriers, (B) perceived facilitators and (C) healthcare workers' perspectives on team-based hypertension care.

practice of team-based care across the six WHO regions and 19 countries that were represented in the Country Profile Survey. Overall, country representatives indicated that non-physicians performed administrative and basic clinical tasks but not advanced tasks in their respective countries and that nurses and pharmacists engaged in advanced clinical tasks in just seven countries and in-country regions (Burundi, Ethiopia, Chile, Saint Lucia, India (Madhya Pradesh), Nepal, Nigeria), and community health workers in only four countries/in-country regions (China (Beijing and Shandong), India (Madhya Pradesh) and Nigeria). In the HCW survey, advanced clinical tasks were mostly performed by physicians in Bangladesh and China, by nurses in Ethiopia and by community health workers. HCWs noted that inadequate training of

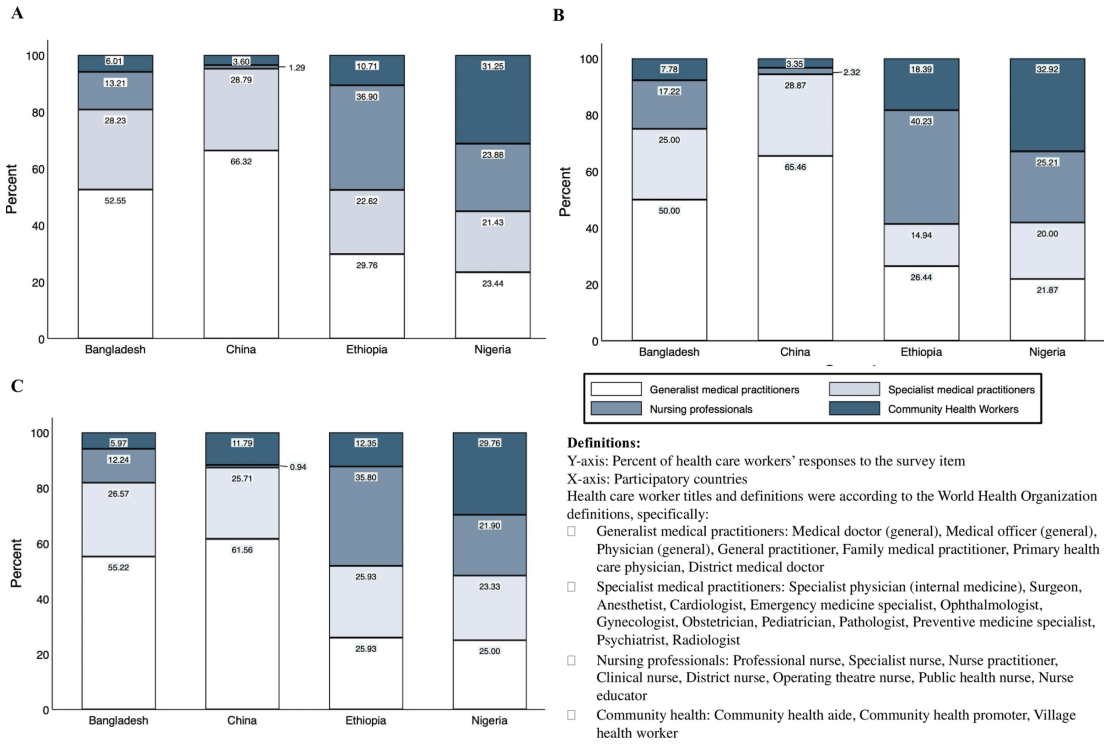


Figure 3 Advanced clinical tasks assignment in practice, by participating country. (A) Initiating treatment per protocol. (B) titrating treatment per protocol and (C) diagnosing hypertension.

HCWs, regulatory issues such as the scope of practice laws and practice standards and possible resistance by patients were barriers to implementing team-based care. Our survey of country representatives and HCWs revealed key lessons that may inform future interventions to implement team-based care in LMICs.

Importantly, barriers to team-based care implementation identified by HCW participants present implementation opportunities for countries, health organisations and health systems. Although HCWs overwhelmingly perceived that team-based care increases patient care capacity and improves healthcare resource efficiency, barriers such as professional opposition by nurses and physicians, regulatory issues, and inadequate training may significantly hamper this process. The benefits of team-based care are well-established, and prior studies have shown that lack of ready acceptance by physicians remains a major obstacle,[9 20] while other studies have found that physicians and non-physicians embrace team-based care.[21]

To address these barriers and enhance the adoption of team-based care in LMICs, ongoing and in-service training of non-physicians should be prioritised to enable them to acquire the requisite knowledge and skills to perform basic and advanced clinical tasks. The effectiveness of these kinds of training has been demonstrated, for instance, in rural districts of northwest Ethiopia, where a 3-day training for the health extension workers and other HCWs improved their BP measurement technique.[22] The WHO Team-Based Care Module of the HEARTS technical package[8] provides training materials on team-based care, including steps in implementation, and sample workflow charts that may be tailored to different settings. Other resources include 'Fundamentals for Implementing a Hypertension Programme in Resource-Constrained Settings', a course developed by Johns Hopkins Bloomberg School of Public Health, International Society of Hypertension and other organisations,[23] which also include open access YouTube training videos.[24–26] The type and duration of training that is provided should be tailored to the specific tasks that are performed. More experienced HCWs and physicians could be engaged in the training to enhance acceptance of team-based care and optimise the roles of the healthcare team.

To address the barrier of scope of practice laws and practice standards in LMICs, there is a need for increased advocacy for policy and regulatory changes that allow non-physicians to contribute to efforts to improve hypertension control meaningfully. Professional organisations, especially physician organisations, are well-positioned to advocate on behalf of their HCW colleagues for training opportunities and changes to the scope of practice laws to optimise the HCW workforce needed to curb the burden of hypertension.[27–29] Concerns about quality of training can be mitigated through additional training and supervision of non-physician HCWs. In addition, reforms of outdated scope of practice policies are needed to enhance the capacity of non-physicians in LMICs. Advocacy efforts should also include ensuring fair wages, payment for services and safe working conditions

for all HCWs who engage in team-based care. This includes primary healthcare financing reforms that incentivise multidisciplinary team approaches to primary care services.[30] Additionally, the implementation of comprehensive national policies on team-based care across LMICs as part of the national policy on task-sharing and task strengthening may improve hypertension control across all levels of care.

Our study has limitations. First, the two surveys were limited to a non-random sampling of HCWs and country representatives from 23 LMICs and in-country regions, which may not be representative of team-based care practices in all LMICs. The generalisability of study findings is also limited; given the convenience sampling and inability to pre-determine a response rate, the representativeness of the samples in the HCW Survey cannot be determined. Additionally, the survey was administered in only some of the states and provinces in India and China, further limiting the generalisation of results within those countries. Also, due to the non-random sampling, responses could have been biased toward cadres of HCWs that participated in the surveys. In addition, the Country Profile Survey relied on responses from country representatives, and it is difficult to ascertain whether these representatives have complete knowledge of country-level use of team-based care for hypertension management. Considering the important role of dieticians in non-pharmacologic management of hypertension, they could have been included as one the HCWs of focus involved in team-based hypertension care in the participating countries.[31 32] Although we note that in many of the countries surveyed, there are shortages of registered dieticians and many facilities may not have a registered dietician on staff.[33 34]

Despite these limitations, our study has some strengths. The findings from our study provide evidence from HCWs from multiple LMICs on the state of team-based hypertension care in low-resource settings. Second, our surveys were translated into the different languages of use in participating countries to allow for more nuanced interpretation of contextual factors to be considered when implementing team-based hypertension care. In addition, many HCWs worked in rural settings with severe shortages of physicians, specialists and middle-level HCWs, where team-based care strategies may be most beneficial. Urban areas with higher patient volume are not spared from the physician shortage challenges either, and will greatly benefit from the implementation of team-based care approaches to manage hypertension. Finally, our study provides further evidence and justification for investment in HCW training and remuneration to enhance team-based care implementation, based on interest among HCW groups to ultimately improve hypertension control at the community level.

In summary, although most HCW respondents acknowledged that team-based care increases patient care capacity and improves healthcare resource efficiency, major barriers hamper the implementation of team-based care in LMICs. Indeed, only a few participating countries endorsed the performance of advanced clinical hypertension management tasks by HCWs who were not physicians. Our survey revealed key lessons for health systems and governments regarding team-based care implementation. Comprehensive national policies on team-based care across LMICs may improve hypertension control across all levels of care. Regulatory and supervision support mechanisms may need to be instituted to support HCWs, including consideration for capitated funds, per-service payments, or reimbursements to the facility team rather than one HCW cadre. In addition, training and systematic supervision of non-physician HCWs should be prioritised to enable them to acquire the requisite knowledge and skills to perform basic and advanced clinical tasks for effective hypertension management and control.

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REFERENCES

1 GBD 2017 Risk Factor Collaborators. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet* 2018;392:1923–94.
2 Roth GA, Abate D, Abate KH. Causes of death collaborators. global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet* 2018;392:1736–88.
3 Zhou B, Bentham J, Di Cesare M. Worldwide trends in blood pressure from 1975 to 2015: a pooled analysis of 1479 population-based measurement studies with 19·1 million participants. *Lancet* 2017;389:37–55.
4 Schutte AE, Srinivasapura Venkateshmurthy N, Mohan S, *et al*. Hypertension in Low- and middle-income countries. *Circ Res* 2021;128:808–26.
5 Zhou B, Carrillo-Larco RM, Danaei G, *et al*. Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. *The Lancet* 2021;398:957–80.
6 World Bank Data. Physicians (per 1000 people). n.d. Available: https://data.worldbank.org/indicator/SH.MED.PHYS.ZS
7 Proia KK, Thota AB, Njie GJ, *et al*. Team-based care and improved blood pressure control: a community guide systematic review. *Am J Prev Med* 2014;47:86–99.
8 World Health Organization. Technical package for cardiovascular disease management in primary health care: team-based care. 2018. Available: https://apps.who.int/iris/bitstream/handle/10665/260424/WHO-NMH-NVI-18.4-eng.pdf [Accessed 12 Dec 2022].
9 World Health Organization. *Hearts: technical package for cardiovascular disease management in primary health care*. 2020.
10 Community Preventive Services Task Force. Team-based care to improve blood pressure control: recommendation of the community preventive services task force. *Am J Prev Med* 2014;47:100–2.
11 Joshi R, Thrift AG, Smith C, *et al*. Task-shifting for cardiovascular risk factor management: lessons from the global alliance for chronic diseases. *BMJ Glob Health* 2018;3:e001092.
12 Santschi V, Chiolero A, Colosimo AL, *et al*. Improving blood pressure control through pharmacist interventions: a meta-analysis of randomized controlled trials. *J Am Heart Assoc* 2014;3:e000718.
13 Jiang X, Sit JW, Wong TK. A nurse-led cardiac rehabilitation programme improves health Behaviours and cardiac physiological risk parameters. *J Clin Nurs* 2007;16:1886–97.
14 Jafar TH, Gandhi M, de Silva HA, *et al*. A community-based intervention for managing hypertension in rural South Asia. *N Engl J Med* 2020;382:717–26.
15 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. *Lancet Glob Health* 2018;6:e66–73.
16 Anand TN, Joseph LM, Geetha AV, *et al*. Task-sharing interventions for cardiovascular risk reduction and lipid outcomes in low- and middle-income countries: a systematic review and meta-analysis. *J Clin Lipidol* 2018;12:626–42.
17 Cazabon D, Farrell M, Gupta R, *et al*. A simple six-step guide to national-scale hypertension control program implementation. *J Hum Hypertens* 2022;36:591–603.
18 Links. Available: https://linkscommunity.org/about [Accessed 14 Sep 2022].
19 Ogungbe O, Cazabon D, Ajenikoko A, *et al*. Determining the frequency and level of task-sharing for hypertension management in LMICs: a systematic review and meta-analysis. *EClinicalMedicine* 2022;47:101388.
20 Mitchell PH, Wynia MK, Golden R, *et al*. Core principles & values of effective team-based health care. *NAM Perspectives* 2012;2. 10.31478/201210c Available: https://www.nam.edu/perspectives
21 Karimi-Shahanjarini A, Shakibazadeh E, Rashidian A, *et al*. Barriers and Facilitators to the implementation of doctor-nurse substitution strategies in primary care: a qualitative evidence synthesis. *Cochrane Database Syst Rev* 2019;4:CD010412.
22 Teshome DF, Balcha SA, Ayele TA, *et al*. Trained health extension workers correctly identify high blood pressure in rural districts of Northwest Ethiopia: a diagnostic accuracy study. *BMC Health Serv Res* 2022;22:375.
23 Johns Hopkins Bloomberg School of Public Health. Global hypertension at Hopkins. 2022. Available: https://globalhypertensionathopkins.org/courses/hypertension [Accessed 28 Jun 2022].
24 Johns Hopkins Welch Center for Prevention E, and Clinical Research: Hypertension. Why is hypertension important? 2019. Available: https://www.youtube.com/watch?v=3EMcIVWSmPk
25 Johns Hopkins Welch Center for Prevention E, and Clinical Research: Hypertension. Preparing an individual for blood pressure

measurement. 2019. Available: https://www.youtube.com/watch?v=T9J3RE4Eins
26 Johns Hopkins Welch Center for Prevention E, and Clinical Research: Hypertension. How to diagnose hypertension. 2019. Available: https://www.youtube.com/watch?v=c8gL5ZGKRxc
27 Community Preventive Services Task Force. Heart disease and stroke prevention: team-based care to improve blood pressure control. Available: https://www.thecommunityguide.org/findings/heart-disease-stroke-prevention-team-based-care-improve-blood-pressure-control.html [Accessed 25 Oct 2022].
28 The surgeon general's call to action to control hypertension. Available: https://www.hhs.gov/sites/default/files/call-to-action-to-control-hypertension.pdf [Accessed 25 Oct 2022].
29 Centers for Disease Control and Prevention. Team-based care to improve blood pressure control. 2022. Available: https://www.cdc.gov/dhdsp/pubs/team-based-care.htm
30 Hanson K, Brikci N, Erlangga D, *et al*. The lancet global health Commission on financing primary health care: putting people at the centre. *Lancet Glob Health* 2022;10:e715–72.
31 Riegel GR, Ribeiro PAB, Rodrigues MP, *et al*. Efficacy of nutritional recommendations given by registered Dietitians compared to other healthcare providers in reducing arterial blood pressure: systematic review and meta-analysis. *Clin Nutr* 2018;37:522–31.
32 Belardo D, Michos ED, Blankstein R, *et al*. Practical, evidence-based approaches to nutritional modifications to reduce atherosclerotic cardiovascular disease: an American society for preventive cardiology clinical practice statement. *Am J Prev Cardiol* 2022;10:100323.
33 Yajie Z, Xiaoli W, Ya L, *et al*. An exploration of registered dietitian accreditation system development in China. *BMC Med Educ* 2022;22:846.
34 Sodjinou R, Bosu WK, Fanou N, *et al*. A systematic assessment of the current capacity to act in nutrition in West Africa: cross-country similarities and differences. *Glob Health Action* 2014;7:24763.