

Community-based interventions for detection and management of diabetes and hypertension in underserved communities: a mixed-methods evaluation in Brazil, India, South Africa and the USA

Luisa S Flor,¹ Shelley Wilson,¹ Paurvi Bhatt,² Miranda Bryant,¹ Aaron Burnett,^{3,4} Joseph N Camarda,¹ Vasudha Chakravarthy,⁵ Chandrashekhar Chandrashekhar,⁶ Nayanjeet Chaudhury,² Christiane Cimini,⁷ Danny V Colombara,⁸ Haricharan Conjeevaram Narayanan,⁹ Matheus Lopes Cortes,¹⁰ Krycia Cowling,¹ Jessica Daly,² Herbert Duber,^{1,11} Vinayakan Ellath Kavinkare,⁶ Patrick Endlich,⁷ Nancy Fullman,¹ Rose Gabert,¹² Thomas Glucksman,¹ Katie Panhorst Harris,¹ Maria Angela Loguercio Bouskela,¹³ Junia Maia,¹⁴ Charlie Mandile,¹⁵ Milena S Marcolino,¹⁴ Susan Marshall,⁴ Claire R McNellan,¹⁶ Danielle Souto de Medeiros,¹⁰ Sóstenes Mistro,¹⁰ Vasudha Mulakaluri,¹ Jennifer Murphree,⁴ Marie Ng,¹⁷ J A Q Oliveira,¹⁴ Márcio Galvão Oliveira,¹⁰ Bryan Phillips,¹⁸ Vânia Pinto,⁷ Tara Polzer Ngwato,¹⁹ Tia Radant,⁴ Marissa B Reitsma,¹ Antonio Luiz Ribeiro,¹⁴ Gregory Roth,¹ Davi Rumel,^{13,20} Gaurav Sethi,⁶ Daniela Arruda Soares,¹⁰ Tsega Tamene,²¹ Blake Thomson,²² Harsha Tomar,⁶ Mark Thomaz Ugliara Barone,^{2,23} Sameer Valsangkar,²⁴ Alexandra Wollum,²⁵ Emmanuela Gakidou¹

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For numbered affiliations see end of article.

Correspondence to

Dr Emmanuela Gakidou;
gakidou@uw.edu

ABSTRACT

Introduction As non-communicable disease (NCD) burden rises worldwide, community-based programmes are a promising strategy to bridge gaps in NCD care. The HealthRise programme sought to improve hypertension and diabetes management for underserved communities in nine sites across Brazil, India, South Africa and the USA between 2016 and 2018. This study presents findings from the programme's endline evaluation.

Methods The evaluation utilises a mixed-methods quasi-experimental design. Process indicators assess programme implementation; quantitative data examine patients' biometric measures and qualitative data characterise programme successes and challenges. Programme impact was assessed using the percentage of patients meeting blood pressure and A1c treatment targets and tracking changes in these measures over time.

Results Almost 60 000 screenings, most of them in India, resulted in 1464 new hypertension and 295 new diabetes cases across sites. In Brazil, patients exhibited statistically significant reductions in blood pressure and A1c. In Shimla, India, and in South Africa, country with the shortest implementation period, there were no differences between patients served by facilities in HealthRise areas relative to comparison areas. Among participating patients

with diabetes in Hennepin and Ramsey counties and hypertension patients in Hennepin County, the percentage of HealthRise patients meeting treatment targets at endline was significantly higher relative to comparison group patients. Qualitative analysis identified linking different providers, services, communities and information systems as positive HealthRise attributes. Gaps in health system capacities and sociodemographic factors, including poverty, low levels of health education and limited access to nutritious food, are remaining challenges.

Conclusions Findings from Brazil and the USA indicate that the HealthRise model has the potential to improve patient outcomes. Short implementation periods and strong emphasis on screening may have contributed to the lack of detectable differences in other sites. Community-based care cannot deliver its full potential if sociodemographic and health system barriers are not addressed in tandem.

INTRODUCTION

Hypertension and diabetes account for increasingly more early death and illness worldwide,¹⁻³ particularly in places where rapid sociodemographic changes have

Key questions

What is already known?

- ▶ Cardiovascular disease and diabetes represented 17.4% of the global burden of disease in 2017, however, only 2% of overall development assistance for health was dedicated to combating non-communicable disease (NCD) in that same year.
- ▶ Prior research suggests that community-based interventions can be both cost saving and associated with improved outcomes among patients with hypertension and diabetes in countries and communities across a broad range of socioeconomic settings.

What are the new findings?

- ▶ Patients affiliated with HealthRise programmes in Brazil and the USA showed progress in meeting diabetes and hypertension treatment targets and declining blood pressure and haemoglobin A1c since programme enrolment.
- ▶ In India and South Africa, no detectable differences in blood pressure or A1c levels were observed between patients being served by facilities involved in the HealthRise programme and facilities that were not affiliated with HealthRise.
- ▶ Existing health systems infrastructure and social determinants of health limit the potential effect of community-based programmes aimed at improving the detection, treatment and care of hypertension and diabetes.

What do the new findings imply?

- ▶ Continued work is needed to understand which community-based NCD interventions may work best given local contexts and needs.
- ▶ Health system strengthening, increased financing for NCDs and a locally driven focus on how interventions and community factors together, may contribute to improving health for individuals.

spurred shifts in diet, physical activity and other key risk factors for non-communicable diseases (NCDs). Despite cardiovascular diseases and diabetes resulting in 17.4% of the global disease burden in 2017,² these conditions and NCDs more broadly remain severely underfunded by national governments and donors alike, with only 2% of overall development assistance for health dedicated to NCDs in 2017.⁴

Challenges in implementing models of care that address chronic diseases persist in low-income and middle-income countries (LMICs),^{5–7} where many health systems are not equipped to reliably diagnose and treat NCDs,^{8–11} and also in high-income countries, where medication affordability and health insurance can be major obstacles to high-quality care.^{12–13} As a result, sizeable gaps observed along the cascade of care—diagnosing, treating and controlling disease—emphasise the need to better reach patients, retain them in care and promote effective interventions for disease management.^{5–14–19}

Community-based programmes, which bridge communities and health systems and include a range of interventions such as education and outreach, self-management and home-based care, have emerged as a promising approach to filling gaps in access.^{20–22} Past research suggests community-based interventions focused on hypertension and diabetes detection and case management can be both cost saving and associated with

improved outcomes.^{23–26} Specifically, results from LMICs include lower blood pressure (BP) associated with mobile technology-supported primary healthcare interventions in Indonesia²⁷; decreased BP related to a community health worker (CHW)-led chronic disease programme in rural Uganda²⁸; reduced BP and blood glucose associated with Iran's rural Behvarz system²⁹; better hypertension control for patients receiving CHW home visits in Gauteng, South Africa³⁰ and higher odds of hypertension or diabetes control related to CHW-led interventions in Chiapas, Mexico.³¹ Some studies indicate community-based screening for hypertension and diabetes can be effective,^{32–35} but how well these activities identify undiagnosed or at-risk individuals across underserved communities is less well known.

To strengthen the evidence base for community-based NCD interventions, HealthRise was developed to implement and evaluate pilot programmes aimed to improve screening, diagnosis, management, and control of hypertension and diabetes among underserved communities.^{36–37} HealthRise was launched in 2014 and pilot programmes were implemented in nine communities in Brazil, India, South Africa and the USA between 2016 and 2018 and were composed of interventions tailored to local needs and contexts. A prospective evaluation of these initiatives at each site sought to assess whether these community-based programmes could increase the proportion of patients meeting treatment targets for diabetes and hypertension compared with usual care. This study presents the main cross-country findings, aiming to provide insights for community-based NCD programmes targeting underserved populations globally.

METHODS

Study design

A global evaluation framework was designed prior to intervention implementation at all sites and is presented in online supplementary file 1 and described elsewhere.^{36–37} Briefly, we used a mixed-methods quasi-experimental approach, drawing from process indicators to assess programme implementation; quantitative data to measure changes over time and/or differences in patient outcomes associated with programme participation and qualitative data to contextualise patients, providers and stakeholders' experiences with HealthRise. Process and endline evaluation methods and indicators ultimately varied across sites due to data availability, resource constraints and government regulations; however, each location's study design aligned with the global evaluation framework.

HealthRise programme

HealthRise involved several partners for each site in Brazil (Teófilo Otoni and Vitória da Conquista), India (Udaipur and Shimla), South Africa (uMgungundlovu and Pixley ka Seme) and the USA (Minnesota's Rice, Hennepin and Ramsey Counties) to support programme

implementation and evaluation. Online supplementary file 2 details the programme organisational structure and additional detail also can be found elsewhere.^{36 37} Countries were selected by the Medtronic Foundation, the funder of HealthRise, prior to programme implementation and evaluation onset, and pilot sites were determined by a combination of factors (ie, range of underserved populations with existing health service gaps, high NCD burden, interest of government and nongovernmental partners). A summary description of the health system in each of the selected countries is presented in online supplementary file 3. Programme implementation and monitoring duration varied by site, as shown in online supplementary file 4, with India and USA having the longest implementation periods (2016–2018), and Brazil and South Africa having the shortest (2017–2018). The Institute for Health Metrics and Evaluation (IHME) conducted the evaluation, and was not involved in pilot programme design or implementation.

Table 1 summarises each site's target population, health demands and challenges (as identified by baseline needs assessments conducted by IHME^{38–41}), and programme implementation dates and main interventions; greater detail on each intervention can be found elsewhere.³⁶ Intervention composition and implementation inherently varied by HealthRise site, as they sought to explicitly address gaps and barriers identified through the needs assessments. Across sites, interventions were implemented alongside usual care and services provided previously, and involved healthcare worker training, health education, patient empowerment activities and regular monitoring of programme enrollees. Individual sites often had unique interventions and implementation approaches (eg, interventions focusing on lifestyle modification included building three outdoor public gyms at primary healthcare units in Vitória da Conquista and building a full-service grocery store with an in-house interdisciplinary wellness team in Hennepin County), as well as main locations of implementation. While most sites' interventions occurred at primary care clinics or units, others extended to secondary care (eg, increased availability of specialised tests in Teófilo Otoni) and the workplace (eg, workplace-based screening in Vitória da Conquista and uMgungundlovu).

Case definitions

The following case definitions were used across all sites: for hypertension, (1) prevalent cases were patients with a reported or documented diagnosis of hypertension based on country-specific guidelines, or those without a previous or current diagnosis but had systolic BP (SBP) ≥ 140 mm Hg or diastolic BP (DBP) ≥ 90 mm Hg at the time of data collection; (2) diagnosed cases were patients with a reported or documented diagnosis of hypertension and (3) patients meeting treatment targets were prevalent cases with SBP < 140 mm Hg and DBP < 90 mm Hg. For diabetes, (1) prevalent cases were patients with a reported or documented diagnosis of diabetes based on

country-specific guidelines, or those without a previous diagnosis but had haemoglobin A1c $\geq 6.5\%$ at the time of data collection; (2) diagnosed cases were patients with a reported or documented diagnosis of diabetes and (3) patients meeting treatment targets were prevalent cases with A1c $< 8\%$.

Data collection

All survey instruments were designed by IHME with input from local evaluation partners and translated to the appropriate languages and are available at <http://www.healthdata.org/healthrise-evaluation/data-collection-tools>

Process indicators (eg, screening, health workers training indicators) and endline quantitative and qualitative data collection varied by programme site, a result of the variability in site-specific programme activities, intervention populations, and existing data infrastructure. In brief, de-identified patient or medical record extractions were available for Brazil and the USA while patient exit surveys were performed at facilities in Shimla and South Africa. Where possible, comparison group data were collected or drawn from available databases on comparable patient populations. Details on site-specific endline data collection processes and sources are available in online supplementary file 5, including descriptions of sampling procedures for exit surveys. Qualitative data consisted of key informant interviews with facility administrators, clinic- and home-based providers, and policy-makers as well as focus group discussions with patients, which were facilitated by either IHME (US only) or independent local data collection professionals contracted by IHME (Brazil, India and South Africa). Endline data for Udaipur, India are not currently available due to delays in government approval for data collection. Table 2 summarises data availability and sample sizes by site and data type.

Endline evaluation analysis

Quantitative data

We used two main outcome indicators for both diabetes and hypertension across sites: (1) the proportion of HealthRise patients (Brazil and USA) or those surveyed at facilities (Shimla and South Africa) meeting defined treatment targets and (2) average change in biometric measures among enrolled patients (Brazil and USA). We limited all analyses to patients who were prevalent cases and had corresponding biometric data.

For Brazil, at least two biometric readings were needed: one at HealthRise enrolment (baseline) and the most recent measure by endline. We ran paired-sample t-tests to assess whether statistically significant changes in hypertension and diabetes measures—per cent meeting treatment targets and average biometric readings—occurred for HealthRise patients from baseline to endline readings.

For the USA, where we had biometric readings at baseline and endline for HealthRise patients and for comparison groups at each site, we conducted

Table 1 Overview of interventions by HealthRise site

Site	Implementation	Key characteristics/challenges of communities served by HealthRise	Key HealthRise interventions and activities
Brazil			
Teófilo Otoni region (comprises 10 municipalities), Minas Gerais State	May 2017 to December 2018	<ul style="list-style-type: none"> ▶ Target population: 30–69 years. ▶ Sociodemographic characteristics: high illiteracy rates; low per capita income. ▶ Healthcare challenges: poor access to laboratory testing despite high coverage of primary healthcare; low rates of self-management of conditions; inefficient communication among care team members. 	<ul style="list-style-type: none"> ▶ Screening and follow-up: hosted health fairs in collaboration with primary care providers in each municipality; targeted home visits by CHWs for screening and follow-up; ▶ Technologies for care coordination: equipped basic health units (BHUs) with computers, notebooks, tablets and Wi-Fi for patient consultations with Central Telehealth Units; implementation of a Clinical Decision Support System; increased availability of specialised tests, including A1c point-of-care strategy; ▶ Workforce development: developed online courses focused on providing routine HTN and DM care, including strategies for disease management and healthy nutrition; ▶ Clinical and non-clinical patient support: created association for people with HTN and DM; coordinated patient support and educational activities, like cooking workshops and physical education sessions.
Vitória da Conquista, Bahia State	March 2017 to December 2018	<ul style="list-style-type: none"> ▶ Target population: ≥30 years. ▶ Sociodemographic characteristics: 40% of population living under the poverty line; ▶ Healthcare challenges: inadequate chronic disease management at the primary care level, including limited staffing (eg, 1 physician per 8000 people); lack of electronic medical records (EMRs); 	<ul style="list-style-type: none"> ▶ Screening and follow-up: hosted 23 health fairs in collaboration with primary care providers in urban areas; industry worker screening; targeted follow-up home visits by CHWs; ▶ Technologies for care coordination: implemented EMRs in 16 BHUs; developed digital screening and job aid tools on promoting healthy lifestyles for CHWs; increased availability of specialised tests, including A1c point-of-care strategy; ▶ Workforce development: trained healthcare professionals on digital tools and care management; ▶ Clinical and non-clinical patient support: CHWs surveyed patients at each BHU for adherence to follow-up care; educated patients on self-care, adherence to treatment and healthy behaviours; produced educational cartoons for CHWs to show patients on tablets and at waiting rooms; three outdoor gyms built at strategic primary healthcare units.
India			

Continued

Table 1 Continued

Site	Implementation	Key characteristics/challenges of communities served by HealthRise	Key HealthRise interventions and activities
Udaipur, Rajasthan	June 2016 to November 2018	<ul style="list-style-type: none"> ▶ Target population: 15–70 years. ▶ Sociodemographic characteristics: 80% of population is rural and considered tribal; among India's most underdeveloped districts for sociodemographic indicators. ▶ Healthcare challenges: challenges in physical access to facilities; low health literacy for NCDs; public health facilities are overburdened, with inadequate resources and staff for chronic care. 	<ul style="list-style-type: none"> ▶ Screening and follow-up: conducted multipronged campaigns to increase awareness about screening camps; involved outreach workers, accredited social health activists (ASHAs) and auxiliary nurse midwives (ANMs) in screening and postscreening activities, follow-up visits and follow-up calls; ▶ Technologies for care coordination: developed electronic management information system (MIS); tracked NCD diagnoses and treatment data through NCD registries; developed referral system for government health centres. ▶ Workforce development: implemented trainer of the trainers curriculum of NCD skills and HealthRise approaches to ASHAs, ANMs and medical officers to facilitate sustained NCD care practices; ▶ Clinical and non-clinical patient support: set up support groups for patients and families; implemented the SALT approach (Stimulate, Appreciate, Learn, and Transfer) in five pilot villages to empower communities to understand and improve their health.
Shimla, Himachal Pradesh	June 2016 to November 2018	<ul style="list-style-type: none"> ▶ Target population: 15–70 years. ▶ Sociodemographic characteristics: 75% of population in rural areas; 84% literacy rate in 2011; 22% unemployment rate in 2016. ▶ Healthcare challenges: challenges in physical access to facilities; insufficient human resources for health, equipment and infrastructure for chronic disease management; competing priorities among patients, hindering NCD diagnosis and treatment adherence. 	<ul style="list-style-type: none"> ▶ Screening and follow-up: conducted multipronged campaigns to increase awareness about screening camps; involved outreach workers, ASHAs, and ANMs in screening and post-screening activities, follow-up visits and follow-up calls; ▶ Technologies for care coordination: established e-clinics for rural patients to access advanced care; strengthened data collection capacity at sub-centres and primary health centres (PHCs); developed electronic MIS for sub-centres; developed and implemented electronic Health Card, a tablet application for ASHAs to catalogue individual risk factors and facilitate referral follow-up at PHCs; ▶ Workforce development: delivered trainer of the trainers curriculum on NCD skills and HealthRise approaches to ASHAs, ANMs, and medical officers to facilitate sustained NCD care practices; ▶ Clinical and non-clinical patient support: set up support groups for patients and families that met quarterly; implemented SALT approach in 14 villages to empower communities to understand and improve their health;
South Africa			

Continued

Table 1 Continued

Site	Implementation	Key characteristics/challenges of communities served by HealthRise	Key HealthRise interventions and activities
Pixley ka Seme, Northern Cape	March 2017 to August 2018	<ul style="list-style-type: none"> ▶ Target population: Emthanjeni municipality; populations living in this area identify as 57.7% coloured, 32.2% black African and 8% white. ▶ Sociodemographic characteristics: primarily rural population; 43.5% poverty rate; 28% employment rate in 2016. ▶ Healthcare challenges: long distances to health facilities; limited transportation options; compounding health issues and socioeconomic vulnerabilities pose additional challenges to an overburdened local health system. 	<ul style="list-style-type: none"> ▶ Screening and follow-up: promoted awareness of and screening for DM and HTN in partnership with the extensive CHW network of Nightingale Hospice; conducted screenings and NCD education at community health events, targeted door-to-door campaigns, HIV and Tuberculosis (TB) support groups, retirement homes and shelters, and farms and solar plants; conducted follow-up via phone or in-person as needed, and facilitated patient visits (eg, arrange for transportation); ▶ Technologies for care coordination: supported the creation of a database of DM and HTN patients; enabled tablet-based data collection at community screening events and door-to-door visits; ▶ Workforce development: trained CHWs in DM and HTN screening processes; provided screening equipment to CHWs; provided 4 day trainings on DM and HTN management for clinic-based providers; ▶ Clinical and non-clinical patient support: clinic nurses ensured confirmatory diagnoses and follow-up with patients who failed to attend appointments, pick up medications, or meet control targets; organised patient support groups for patient empowerment and self-care; set up gardening, via the Department of Agriculture and Forestry, and village savings and loans programmes.
uMgungundlovu, KwaZulu-Natal	February 2017 to August 2018	<ul style="list-style-type: none"> ▶ Target population: those in Msunduzi, uMshwathi, and Mkhambathini subdistricts. Msunduzi has the provincial capital. ▶ Sociodemographic characteristics: uMshwathi and Mkambathini have unemployment rates of 25% and over 15% of the population has no formal schooling; ▶ Healthcare challenges: long distances to health facilities; low adherence to prescribed medications; high comorbidities with chronic infectious diseases make clinical management complex. 	<ul style="list-style-type: none"> ▶ Screening and follow-up: conducted screenings through household visits, workplace screenings, and health education campaigns by community caregivers (CCGs) and in collaboration with the provincial Department of Health; established health teams of a professional nurse or doctor and CCG to provide clinical support at public health clinics and community follow-up by CCGs; ▶ Workforce development: provided trainings on DM and HTN to CCGs; equipped CCGs with digital blood pressures and glucometers, as well as bicycles for reaching patients; trained clinicians and health professionals on diagnostics, clinical support, and ongoing follow-up at public health clinics; ▶ Clinical and non-clinical patient support: established Central Chronic Medicine Dispensing Distribution system to enable patients to be able to pick up their medications closer to their community; hosted support/adherence groups to provide education on the importance of medication adherence, healthy nutrition and exercise, and discussing problems such as medication side effects with providers.

USA

Continued

Table 1 Continued

Site	Implementation	Key characteristics/challenges of communities served by HealthRise	Key HealthRise interventions and activities
Hennepin County, Minnesota	July 2016 to September 2018	<ul style="list-style-type: none"> ▶ Target population: North Minneapolis, where the population is 50% African American, 20% Asian, 15% Caucasian, and 15% Hispanic/Other; ▶ Sociodemographic characteristics: 40% of households are at or below the 200% poverty level; unemployment is 21.6% among working age adults; ▶ Healthcare challenges: low trust in local health systems by patients; poor access to high-quality education, healthcare and nutritious foods; inadequate data integration of EMR records across community healthcare sites. 	<ul style="list-style-type: none"> ▶ Follow-up: community paramedics (CPs) and/or CHWs visited patients to provide wrap-around care, including medication management, health education, food/cooking demonstrations, home safety checks, and broader support for social needs (eg, insurance, care coordination, transportation, housing); ▶ Workforce development: hired and trained CHWs and CPs to work in providing home-based care for high-risk patients, leveraging the medical expertise and ambulatory primary care capacity of CPs alongside the cultural context and language skills of CHW; ▶ Clinical and non-clinical patient support: coordinated home-based care with clinic-based service team of doctors, nurses, pharmacists, clinical care coordinator, and diabetes educators; established a full-service grocery store with linkages to an interdisciplinary wellness team (eg, CHWs, nutritionist, pharmacy liaison, coordinator) and a Wellness Resource Centre ▶ Community-based activities: community or CHW-led activities offered by Oak Park community centre or other community spaces, including healthy eating education sessions, food demonstrations, grocery store tours, walking/exercise programmes, nutritious family meals.
Ramsey County, Minnesota	June 2016 to September 2018	<ul style="list-style-type: none"> ▶ Target population: patients receiving care at Minnesota Community Care (MCC) clinics in Saint Paul, Minnesota; ▶ Sociodemographic characteristics: 97% of MCC patients live below the 200% federal poverty line; 30%–65% are non-English speaking; ▶ Healthcare challenges: Data systems between hospitals and MCC clinics not well integrated. 	<ul style="list-style-type: none"> ▶ Follow-up: CPs and/or CHWs visited patients at home 1–4 times per month, monitoring health status, reinforcing clinic education, and addressing social determinants of health (eg, CHW-led patient empowerment and connecting to community resources); tailored frequency of in-home visits to patient care plans and based on trends in clinical targets for blood pressure and A1c; ▶ Technologies for care coordination: used Pathways tool from Care Coordination Systems to ensure coordinated care and updates from CHWs and CPs and clinic-based care teams for patients; ▶ Workforce development: hired and trained CHWs and CPs to provide in-home care and linkages to clinic-based providers in MCC; ▶ Community-based activities: developed and implemented a nutrition-focused programme, in both English and Spanish, wherein sessions focused on nutrition education, effects of non-nutrition factors on blood sugar, and grocery store tours highlighting ways to shop for healthy and affordable foods.

Continued

Table 1 Continued

Site	Implementation	Key characteristics/challenges of communities served by HealthRise	Key HealthRise interventions and activities
Rice County, Minnesota	September 2016 to October 2018	<ul style="list-style-type: none"> ▶ Target population: patients receiving care or associated with HealthFinders Collaborative, Inc (HFC). ▶ Sociodemographic characteristics: Past HFC patients were comprised of 60% Latino immigrants and 25% Somali refugees. ▶ Healthcare challenges: HFC primarily serves uninsured patients or those with public insurance plans; 	<ul style="list-style-type: none"> ▶ Technologies for care coordination: designed EMR system to document home visits within patient medical records; employed electronic tools for improving contact with patients, including short message service (SMS)/text-based appointment reminders and education programmes (ie, Care Message); ▶ Workforce development: leveraged pre-existing community networks to develop clinic-community care coordination through the use of frontline health workers (including CHW and CP care teams), community wellness programmes, and added services (eg, mental health services, wellness programmes, and on-site lab for easier access to diagnostic tests); ▶ Community-based activities: offered community-based programming tailored to linguistic and cultural needs of participants, including monthly and quarterly diabetes management classes; Somali Health series; patient advocacy; and Pura Vida programmes (ie, wellness and education programmes including exercise classes, local walks and runs, cooking and nutrition classes, etc); partnered with Northfield Hospital and Clinics to expand CP programme; collaborating with the Mayo Clinic and Allina Health System to extend model beyond NCDs (eg, ob/gyn care for Somali populations).

More detailed descriptions of HealthRise interventions in each country, as provided by grantees and compiled by Abt Associates, are published elsewhere.³⁶

CHW, community health worker; DM, diabetes mellitus; HTN, hypertension; NCD, non-communicable disease.

difference-in-difference analyses to quantify the potential effect of intervention exposure. We first ran an unadjusted model, only including binary variables for HealthRise status and timing (ie, baseline or endline) and then an interaction term for HealthRise at endline to capture the effect of HealthRise over time. We also considered an adjusted model, including the following covariates to account for potential systematic differences in US HealthRise and comparison patients: sex (female, male); age (<50 years, 50 years or older); time elapsed from baseline to endline (<12 months, 12 months or more) and comorbidities at baseline (prevalent case of only hypertension or diabetes, prevalent case of both hypertension and diabetes).

In Shimla and both sites in South Africa, we used the average of up to three SBP and DBP measures taken as overall BP status for each patient. Patients also reported treatment status, ever and current (ie, taken medication for hypertension or diabetes as prescribed by a health-care provider in the last 2 weeks), allowing us to assess cascades of care from diagnosis to meeting treatment targets among prevalent cases. We ran Welch's t-tests (ie,

assuming unequal variance between groups) to evaluate whether statistically detectable differences were observed between patients presenting at facilities in implementation and comparison areas.

Qualitative data

Key informant interviews and focus group discussions were audio recorded, and as necessary, translated and transcribed in English. Each transcription was read (or audio file was listened to) multiple times by a single researcher who assessed open-ended questionnaire responses using thematic analysis.⁴² Themes were identified at the semantic level. Data were entered into excel templates for analysis with a focus on data patterns associated with overarching research questions. Data codes were collated to generate themes by site. Qualitative data analysis presented in this study is limited to common themes across intervention sites only.

Patient and public involvement

Patients were not involved in the design or the development of the HealthRise evaluation.



Table 2 Endline data availability and patient sample sizes by HealthRise site and for intervention and comparison patients

Data collection	Brazil			India		South africa		Minnesota, United States		
	Teófilo otoni	Vitória da conquista	Shimla	Pixley ka seme	uMgungundlovu	Hennepin county	Ramsey county	Rice county		
HealthRise (intervention)										
Quantitative	Baseline, endline	Baseline, endline	Endline	Endline	Endline	Baseline, endline	Baseline, endline	Baseline, endline		
Total patients (interviewed or enrolled)*	4210	2610	277	62	88	121	78	217		
Health facilities for patient interviews	-	-	18	7	7	-	-	-		
Total patients enrolled at endline	-	-	-	-	-	104	53	217		
Patients with hypertension	3992	2443	224	45	74	82	21	72		
Patients with hypertension and biometric data	1169	1095	222	38	67	77	21	71		
Patients with diabetes	1028	1052	110	38	42	76	46	120		
Patients with diabetes and biometric data	176	68	110	37	38	60	41	92		
Qualitative										
Total interviews and focus groups	22	15	19	5	10	5	9	6		
Patient focus groups	5	4	5	-	4	-	-	-		
Community health workers (CHWs) and frontline health workers†	10	7	3	-	3	2	3	2		
Facility-based or clinic-based providers	-	-	3	3	2	1	3	2		
Facility or clinic managers and administrators	5	3	4	2	1	2	3	2		
Policy-makers	2	1	-	-	-	3	-	-		
Other‡	-	-	4	-	-	-	-	-		
Comparison										
Quantitative										
Total patients (interviewed or enrolled)*	-	-	Endline	Endline	Endline	Baseline, endline	Baseline, endline	Baseline, endline		
Health facilities for patient interviews	-	-	230	123	149	-	-	-		
Total patients enrolled at endline	-	-	12	12	14	-	-	-		
Patients with hypertension	-	-	165	107	125	84	58	178		
Patients with hypertension and biometric data	-	-	160	91	122	84	58	172		
Patients with diabetes	-	-	109	62	76	28	77	303		
Patients with diabetes and biometric data	-	-	109	62	73	13	71	296		
Qualitative										

Continued

Table 2 Continued

Data collection	Brazil		India		South africa		Minnesota, United States		
	Teófilo otoni	Vitória da conquista	Shimla	Pixley ka seme	uMgungundlovu	Hennepin county	Ramsey county	Rice county	
Total interviews and focus groups	12	8	13	7	11	-	-	-	
Patient focus groups	3	2	4	-	2	-	-	-	
CHWs and frontline health workers†	6	4	3	-	6	-	-	-	
Facility-based or clinic-based providers	-	-	3	3	-	-	-	-	
Facility or clinic managers and administrators	3	2	3	4	3	-	-	-	
Policy-makers	-	-	-	-	-	-	-	-	
Other	-	-	-	-	-	-	-	-	

Total patients for Shimla, India and South Africa reflect patients surveyed at facilities as part of the endline evaluation, and not those formally enrolled in HealthRise. Patients with hypertension or diabetes and biometric data for Brazil and US sites are prevalent cases of hypertension or diabetes and had at least two biometric measure.

*For Shimla and South Africa sites, total patients are those surveyed at facilities as part of endline evaluation data collection, not those enrolled in HealthRise.

†For Shimla, household-based health workers (eg, ASHAs and outreach workers) were included in the CHW and front-line healthworker category.

‡For Shimla, other included HealthRise master trainers and a HealthRise grantee official from MAMTA. ASHAs, accredited social health activists.

RESULTS

Across Brazil, India and South Africa sites, 59342 people without a previous hypertension diagnosis and 56642 individuals not previously diagnosed with diabetes were screened at public screening events, home visits or at health clinics through HealthRise programmes (table 3). The majority of screenings were conducted in India (78.8% for hypertension and 69.7% for diabetes). Of those screened for hypertension, 6439 surpassed diagnostic thresholds for elevated BP and were referred to health facilities for diagnostic confirmation, of which 1464 were newly diagnosed with hypertension. Of those with no previous diabetes, 2563 exceeded diagnostic thresholds for elevated blood glucose and were referred for further testing, resulting in 295 new diabetes diagnoses.

Across all nine sites, 3637 local healthcare professionals were trained on diabetes and hypertension-related topics through HealthRise programmes: 979 in Brazil, 1847 in India, 778 in South Africa and 33 in the USA. CHWs comprised 60.7% of all healthcare professionals trained. A summarised country-specific flow chart of HealthRise participants and additional process evaluation indicators, by site, are in online supplementary file 6.

Endline quantitative findings

Differences or changes in hypertension and diabetes metrics varied across sites. In Brazil and the USA, where patient-level changes since programme enrolment could be tracked, HealthRise patients generally saw progress in reducing biometric measures and meeting treatment targets. In Vitória da Conquista, more patients met treatment targets for hypertension (45.9% (43.0%–48.9%)) and diabetes (61.8% (49.4%–72.7%)) at endline than at baseline (35.4% (32.6%–38.6%), p<0.001; and 36.8% (26.0%–49.1%), p<0.001, respectively), and patients showed declines for SBP (ie, an average decrease of 4.2 mm Hg (3.1–5.2); p<0.001) and A1c (ie, an average reduction of 0.9 (0.5–1.4); p<0.001) since programme enrolment. Teófilo Otoni HealthRise patients also recorded reductions in SBP (ie, an average decrease of 1.9 mm Hg (0.7–3.1); p<0.01) and A1c (ie, an average decline of 0.6 for A1c (0.4–0.9); p<0.001), with more patients meeting hypertension treatment targets at endline (52.2% (49.3–55%)) compared with baseline (48.3% (45.5–51.2%); p<0.05). For diabetes, more patients met treatment targets at endline (59.7% (52.3–67.0%)) than at baseline [49.4% (42.0–56.9%); p<0.01]. Detailed changes in hypertension and diabetes metrics in both Brazilian sites are presented in online supplementary file 7.

In the USA, unadjusted difference-in-difference model results (figure 1; all model results are included in online supplementary file 8) show that HealthRise programme participation was associated with reductions in SBP compared with comparison patients in Ramsey (14.4 mm Hg decline (2.3–26.4); p<0.05) and Rice (8.4 mm Hg decrease (1.6–15.2); p<0.05) counties. In only Hennepin County, HealthRise participation was associated with an

Table 3 HealthRise screening and diagnosis outputs for programme sites in Brazil, India and South Africa

Data collection	Across HealthRise sites	Brazil		India		South africa	
		Teófilo otoni	Vitória da conquista	Udaipur	Shimla	Pixley ka seme	uMgungundlovu
Hypertension							
Individuals screened*	59 342	3129	2315	26 144	20 606	2366	4782
Individuals screened above threshold†	6439	871	626	835	2214	677	1216
Individuals screened and newly diagnosed	1464	190	233	264	555	93	129
Diabetes							
Individuals screened*	56 642	5396	3609	17 994	21 482	3570	4591
Individuals screened above threshold‡	2563	125	499	839	900	71	129
Individuals screened and newly diagnosed	295	40	44	107	56	24	24

*Individuals with no previously reported diagnosis of hypertension or diabetes and participated in a HealthRise-supported screening activity.

†SBP \geq 140 mm Hg or DBP \geq 90 mm Hg.

‡Random blood glucose (RBG) measure of \geq 140 mg/dL in Vitória da Conquista and both India sites; fasting glucose (FG) \geq 126 mg/dL or blood glucose of 200 mg/dL following a glucose tolerance test in both South Africa sites; and a RBG reading of \geq 200 mg/dL with at least one classical diabetes symptom (polyuria, polydipsia or polyphagia) or a FG \geq 126 mg/dL following a cardiovascular risk assessment (patients with a body mass index \geq 25; or age \geq 45, or at least moderate cardiovascular disease risk were referred to get a FG test at the health facility) in Teófilo Otoni.

DBP, diastolic blood pressure; SBP, systolic blood pressure.

increase in the percent of hypertension patients meeting treatment targets (24.3% point increase (6.8–41.8); $p < 0.01$) relative to comparison patients. For patients with diabetes, HealthRise participation was associated with declines in A1c relative to comparison groups in Hennepin (0.7 decrease in A1c (0.1–1.3); $p < 0.05$) and Ramsey (1.4 decrease in A1c (0.5–2.4); $p < 0.01$) counties. The percentage of HealthRise patients with diabetes meeting treatment targets increased compared with comparison patients in Hennepin (21.7% point rise (6.5–36.9; $p < 0.01$) and in Ramsey county (19.1% point increase (10.2–38.1; $p < 0.05$) but not among patients in Rice county. Unadjusted model results corresponded with adjusted results across outcome measures in all sites except for change in patients meeting treatment targets for diabetes in Ramsey county (19.1% point increase (0.0–38.0; $p = 0.05$)).

For Shimla, India and South African sites, endline analyses focused on differences between patients presenting at facilities in HealthRise implementation and comparison areas (figure 2). In Shimla, patients with hypertension and diabetes at facilities in HealthRise areas generally did not differ from patients in comparison areas in terms of the cascade of care metrics; exceptions were meeting treatment targets for hypertension and percent currently on treatment for diabetes, where the patients in the comparison areas showed higher rates than patients in HealthRise facilities. In Pixley ka Seme and uMgungundlovu, patients attending facilities in HealthRise areas did not differ from those in comparison areas along hypertension and diabetes cascades of care.

Endline qualitative findings

Qualitative analysis identified key themes relevant across sites (table 4). First, respondents expressed positive views of the overarching intervention model—an international programme focused on community-based interventions for NCDs—and opportunities to test new services or structures at their sites. In Brazil, providers specifically identified reorganising patient flows and health unit routines as supportive of more structured care delivery. New training opportunities, intensified group activities for patients, increased availability of some specialised tests, and using tablets to aid in patient record-keeping and care decisions were also viewed as positive developments. In the USA, enabling clinical staff to work with in-home providers for the first time was viewed as beneficial for patient care.

Second, social determinants of health contributing to the risk, onset and management of hypertension and diabetes were consistently reported as substantial challenges. Barriers to healthcare and better health outcomes, including poverty, low levels of health education and limited access to affordable and nutritious food were reported across all sites.

Third, local front-line health workers such as CHWs, ASHAs and community caregivers were viewed by patients and health facility staff and administrators as vital to programmes, as they supported patients facing substantive linguistic, cultural and geographic barriers. For instance, in Shimla, clinic-based providers found CHWs valuable in providing counselling services beyond

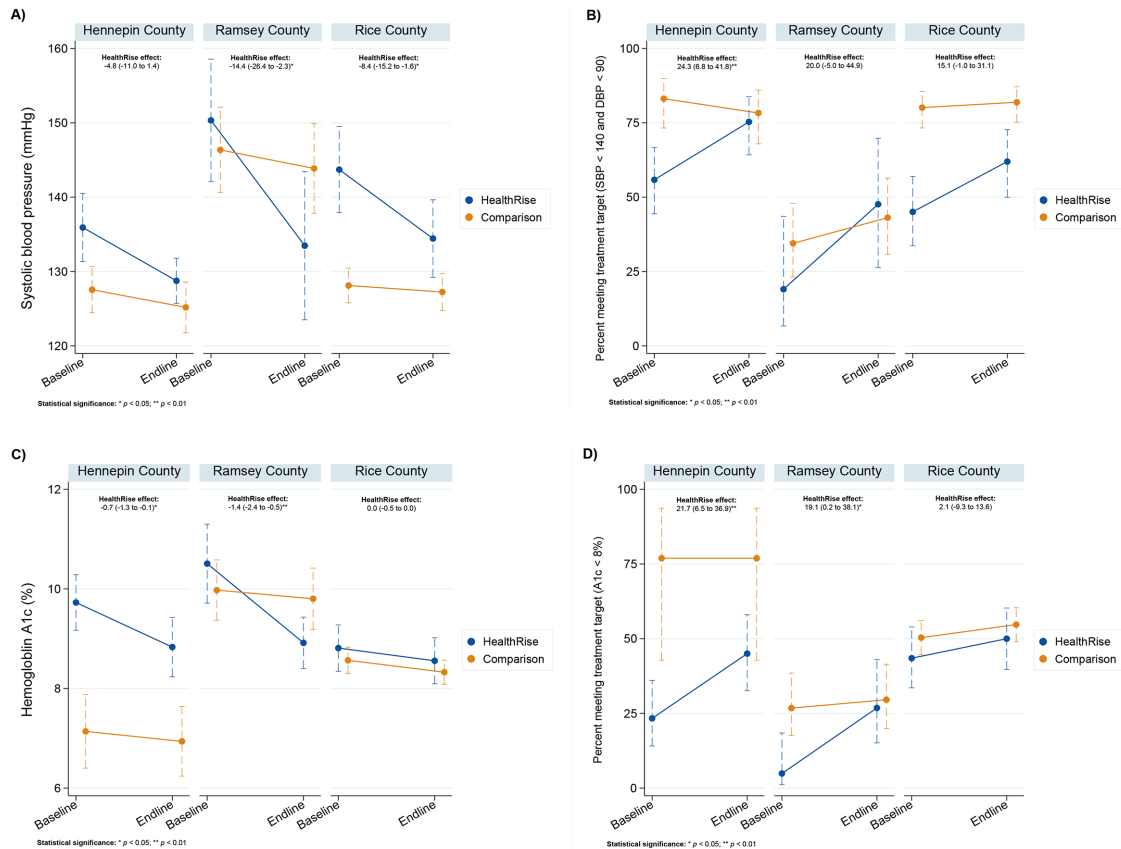


Figure 1 Differences among US HealthRise and comparison patients from baseline to endline for systolic blood pressure (A), percentage of hypertension patients meeting disease treatment targets (B), haemoglobin A1c (C) and percentage of diabetes patients meeting disease treatment targets (D). Included us patients are limited to prevalent cases of hypertension or diabetes at baseline with at least two biometric measures. Treatment targets were <140 mm Hg SBP and <90 mm Hg DBP for hypertension, and <8% A1c for diabetes. The effect of HealthRise was quantified with a difference-in-difference analysis; the effect of HealthRise by endline is reported for each site, with statistical significance denoted by *P<0.05, **P<0.01. DBP, diastolic blood pressure; SBP, systolic blood pressure.

what is possible within the time constraints of typical clinical appointments.

Care coordination (ie, linkages between different types of providers; homes, communities and clinics; and myriad information systems) also was viewed as critical for supporting more efficient and effective care. Overall, integrated care was viewed positively by participants; however, substantive challenges also emerged, many of which were related to incorporating in-home providers in care teams in the USA. For example, some clinical providers showed initial scepticism about the added value of in-home providers, and most administrators did not have prior experience managing CHWs and community paramedics. In Brazil, interviewees often indicated preferences for health professionals beyond doctors and nurses to be more involved in their care.

Some patients and providers also reported improved patient empowerment through knowledge gained about NCDs and greater confidence in managing these conditions. Further, as highlighted by CHWs in Shimla, providers also learnt more about NCDs and disease management practices. In Brazil, health providers requested more regular opportunities for in-person

training, particularly in-depth technical trainings on measuring blood glucose and BP during home visits.

Finally, interviewees across sites stressed the importance of strong health systems, particularly since interventions relied on the availability of necessary staff, facility capacities and services. For instance, in Brazil, Shimla and South Africa, patients and providers identified several long-standing challenges related to core health system functions, particularly adequate medication supplies, sufficient staffing and reliable referral processes. Many of these challenges were outside the scope of HealthRise intervention; nonetheless, they played a role in how interviewees viewed the implementation strengths and issues of the programme.

DISCUSSION

The prospective evaluation of the multisite, global HealthRise programme, a community-based programme seeking to improve hypertension and diabetes care among underserved populations, demonstrates the complexity of assessing community-based interventions across diverse settings and variable data environments.

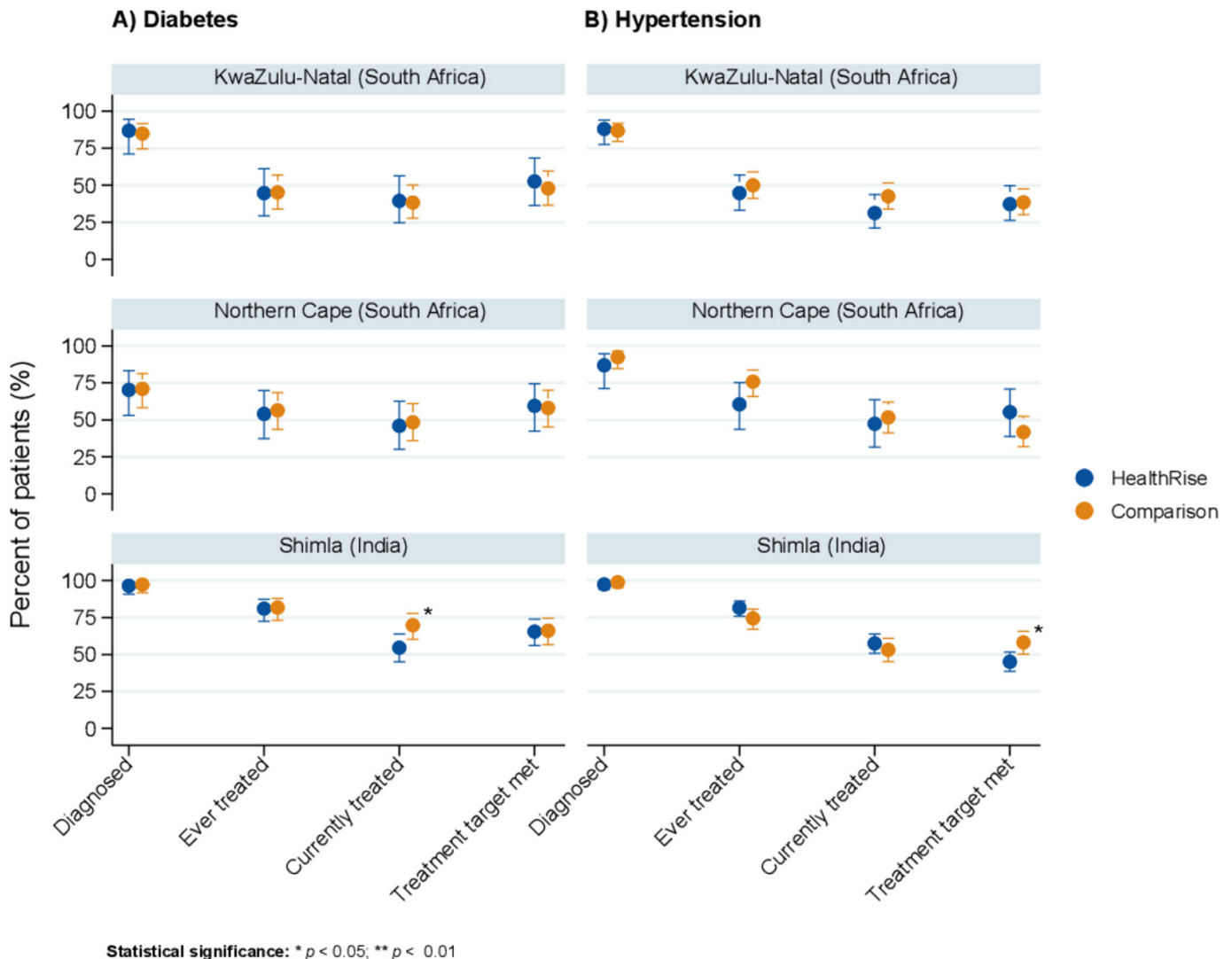


Figure 2 Cascade of care for diabetes (A) and hypertension (B) based on patient interviews at facilities located in HealthRise implementation and comparison areas in Shimla, India and in South Africa sites. Included patients are limited to prevalent cases of hypertension or diabetes with biometric measures corresponding with prevalent conditions. Treatment targets were <140 mm Hg SBP and <90 mm Hg DBP for hypertension, and $<8\%$ A1c for diabetes. Statistical significance was determined by Welch's t-test, and is denoted by * $P < 0.05$ and ** $P < 0.01$. DBP, diastolic blood pressure; SBP, systolic blood pressure.

The programme's implementation and evaluation faced many challenges, including some associated with establishing and maintaining monitoring efforts, particularly within pre-existing systems in underserved communities. Yet, process evaluation findings indicate that more than 56 000 and 59 000 individuals were screened for diabetes and hypertension, respectively, in Brazil, India and South Africa; however, a much smaller proportion of patients received new diagnoses and were referred to care, highlighting potential limitations of large-scale screening programmes. While Brazil and most US sites showed patient-level progress, with increasingly more hypertension and patients meeting disease control targets since programme enrolment and substantial declines in patients' A1c and SBP decreased since baseline, improved disease management was not detected among patients in HealthRise implementation areas compared with those in comparison areas in Shimla and South Africa. A relatively

short implementation period in some sites, alongside the inherent tension between demonstrating impact within time constraints and properly capturing the often slower or complex changes of health behaviours and systems, may underlie these findings. Limited data availability on intervention adherence and fidelity precludes further assessments of the programmes' implementation quality and its impact on endline findings in each site.

Qualitative data highlighted some positive views of integrating home-based health workers in NCD care to bridge geographical, linguistic and cultural divides, and the importance of effective care coordination across provider types, data platforms and between facilities and communities. Nonetheless, long-standing gaps in system infrastructure likely contributed to continued challenges with care provision and social determinants of health continued to play roles in patients' abilities to access treatment and manage their conditions. In combination,

Table 4 Summary of key themes and sample quotes from qualitative data collected across all HealthRise sites

HealthRise thematic area components and contexts	Sample thematic quotes
Global and cross-cutting	
▶ Innovation in programme design within and across sites	‘E-clinics give the same care as hospitals and time is saved’ – Administrator, India
▶ Impact of social determinants of health on NCD risk, onset and treatment	‘Many of the diagnoses we were seeing were directly related to social determinants of health, particularly healthy food access and access to affordable and culturally appropriate clinical care.’ – Administrator, US
▶ Role of front-line health workers in bridging geographic, linguistic and cultural divides	‘All health-related programmes that were given the ASHA workers, there have been advantages due to it.’ – Clinic provider, India
▶ Importance of care coordination to provide more efficient and effective care	‘Before the programme, there was not much communication with the doctors and the nurses. Our work is usually with people from the community only. The HealthRise programme has helped us in increasing our communication with officials at the clinic...Our rapport with doctors and nurses has improved.’ – CHW, India
▶ Improved patient empowerment through increased knowledge of NCD management	
▶ Importance of strong health systems with basic infrastructure, staffing, and supplies to support effective community-based programmes	‘As you can see, we got here at the clinic at 6am but here we are still waiting for assistance.’ – Patient, South Africa
Brazil	
▶ Improved provider experience from reorganised patient flows, new training opportunities, increased availability of tests, implementation of a clinical decision support system, and introduction of tablets	‘I think the EMR resulted in a better way of communicating about the patient...any professional can now access the information stored in there’ – Frontline health worker
▶ Demand for additional technical trainings and multidisciplinary engagement	‘A more intense multidisciplinary approach...I missed that a lot. A psychologist, a nutritionist...so that we could discuss the cases together.’ – Frontline health worker
▶ Barriers to disease management from local food culture and health system constraints	‘I really like eating rice, but we can’t. But I eat it anyway.’ – Patient
India	
▶ High level of basic awareness of diabetes and hypertension symptoms and risk factors	‘You feel it – sleepy, dizzy, irritable, can’t control yourself.’ – Patient
▶ High exposure to and awareness of HealthRise interventions, except patient support groups	‘From MAMTA for the past 2 years they are coming continuously in our village. They give us information and also tell us precautions about what to do. They do medical check-ups also every month after the health centre was made. Have given us cards as well.’ – Patient
▶ Positive patient and provider experiences with CHWs	‘Initially people think, ‘what do they know, they are just freshly appointed ASHAs,’ but they bring people to us, mobilise people; people do listen to them.’ – Clinic-based provider
▶ Ongoing challenges for NCD management and access to care related to health system constraints (eg, medicine stock outs), competing priorities (eg, family, work and social obligations) and modern lifestyles	‘Life is too fast paced, people pay more attention to electronics, social media and not nutrition and exercise.’ – Patient
South Africa	
▶ Positive views of introducing community-based NCD care and outreach services alongside requests for further expanding community services and health education initiatives	‘Outside the facility, we have adherence club where chronic patients are being taught about exercises and adherence in the community. Then we have collection points where patients fetch their medication, the collection point are at scheduled halls or education institutions. That has helped us...because we take the medication to the people.’ – Frontline health worker

Continued

Table 4 Continued

HealthRise thematic area components and contexts	Sample thematic quotes
<ul style="list-style-type: none"> ▶ Some underlying tensions in patient–provider relationships related to long wait times and lack of trust (from patients' perspective) and reluctance to make necessary changes to diet and exercise (from providers' perspective) 	<p>'It's not good and it's also not bad, it's in between. There are some patients who understanding our working conditions that maybe we have shortage of medication at that particular time and maybe we are busy because this is the only clinic in the community, but there are some patients who do not understand, they would say that we are slow or do not care about the patients.'—Facility manager</p>
<ul style="list-style-type: none"> ▶ Role for traditional medicine alongside more formal health sector 	<p>'If one doesn't have cash, he can't get to the hospital. We then use the services of prophets and traditional healers.'—Patient</p>
<ul style="list-style-type: none"> ▶ Ongoing barriers and constraints to care, including physical accessibility to facilities, medicine stock-outs and staff shortages 	<p>'(Facilities) need to employ more staff and equipment, increase the resources needed and focus on each and every chronic condition....our government is trying but it is not enough.'—Frontline health worker</p>
USA	
<ul style="list-style-type: none"> ▶ Programme strengths from the opportunity for global learning and introduction of home-based providers 	<p>'The global aspect is quite unique...utilising similar strategies in different countries with very different health systems but with a similar population focus and similar workforce approaches.... I'm not aware of other projects that have attempted that across a set of different jurisdictions and landscapes.'—Policymaker</p>
<ul style="list-style-type: none"> ▶ Programme challenges from the lack of experience with home-based providers and issues with patient data accessibility among care team members (ie, electronic medical record system incompatibility) 	<p>'We've learnt that a lot of the hurdle we have to get past is educating other healthcare providers on what we do...what is a CP and how can we be part of their team and help to better serve their patients...the ones who do now understand our role...they are our champions, they get so excited... we definitely see resistance in the beginning.'—Community paramedic</p>
<ul style="list-style-type: none"> ▶ Perceived improvements regarding clinical interactions and patient well-being 	<p>'The home visits contributed to more rational use of clinic time...and improved care on my end. From listening to CHWs, I have a better understanding of what's going on in people's lives.'—Clinic-based provider</p>

CHW, community health worker; NCD, non-communicable disease.

these findings demonstrate the potential for community based, and particularly, CHW led, interventions to improve NCD outcomes, but also underscore how their reach and effectiveness can be hindered by broader health system, infrastructure and policy constraints. Irrespective of their increasingly vital role for underserved populations, community-based programmes cannot fully remedy inadequate prioritisation or investments in strong, well-coordinated primary care and NCD services.

Successes and challenges for HealthRise and broader community-based NCD interventions

HealthRise programmes referred thousands of screened individuals to care, yet relatively few new diagnoses occurred. Low yields from population-based screening activities are not uncommon,^{43 44} and these findings support guidelines recommending more selective screening of high-risk groups to improve cost-effectiveness.⁴⁵ A primary focus on screening may also have contributed minimal community-level effects in India and South Africa. Interventions in Brazil and the USA were more oriented towards improving access to care and medication adherence, which could more

quickly affect health outcomes than screening activities, which only initiate the process of bringing patients into care.

In Brazil, both HealthRise sites exhibited notable progress; nevertheless, since comparison patient data were not collected for Brazil sites, we cannot ascribe these patient-level patterns to HealthRise participation. Despite these positive trends, qualitative data indicated poor adherence to medication for both Brazil sites, as well as patient-reported sociocultural tensions around adopting dietary changes and health system-level obstacles to accessing multidisciplinary care and reliably stocked medication at health facilities. In the USA, HealthRise participation was associated with reductions in A1c or SBP and increases in patients meeting treatment targets at some sites relative to comparison patients. Several factors may have contributed to observable impacts at US sites, which had among the longer programme implementation durations and the most robust evaluation, relative to other sites. Interventions in the USA were targeted to address specific barriers to keeping patients in care; the number of patients reached was small, so each person received substantial

focus; and the US health system is better organised and equipped to deal with NCDs and therefore did not face the same health system challenges experienced in other HealthRise sites. However, as demonstrated by recent analyses of ‘superutiliser’ patients with medically and socially complex conditions,⁴⁶ replicating intervention impact to larger populations may be difficult, especially if the resource intensity and patient attention provided through the US HealthRise programmes are not feasible or sustainable. This is particularly relevant given some of the reported difficulties in early-stage programme implementation in the USA, such as recruiting and retaining CHWs and ensuring all providers could access and update electronic medical records.

Additional data and contextual information are needed to better understand why programme impact was not found in India and South Africa. Unlike the Brazil sites, where HealthRise interventions were incorporated into longstanding community-based healthcare structures and CHW-led service provision, India and South Africa HealthRise grantees often had to build systems—both physical and administrative—from the ground-up to support NCD care coordination, medication logistics and community engagement. This challenge, in combination with relatively short implementation periods, and screening being higher programmatic priorities in these sites, may underlie the negligible community-level effects on outcomes. Further, we could not fully account for other local or national initiatives to expand NCD care in both HealthRise and comparison areas; for instance, India launched national guidelines for NCD screening activities through CHWs and community platforms in 2017,^{47 48} potentially spurring the scale-up of broader community-based NCD programming throughout India after HealthRise began in Shimla. Other studies, including an evaluation of a CHW-managed intervention for patients in India with high cardiovascular disease risk,⁴⁹ indicate patient-level barriers to care like cost, transport and medication availability could affect intervention impact as well. Substantial drop-offs in care cascades also emphasise the need for locally relevant mechanisms for coordinated care.⁵⁰ These findings correspond with larger-scale assessments of diabetes care cascades in India and South Africa,^{14 18} both of which stressed the importance of strengthening NCD case detection and management for more rural, underserved communities.

Additional challenges were highlighted in qualitative analyses. Despite some indication of heightened patient empowerment, as measured by self-reported knowledge and confidence in at least some sites, adherence to recommended dietary and physical activity behaviour changes emerged as a source of tension between patients and providers, highlighting the difficulty of enacting meaningful cognitive and behaviour change amid strong social and environmental influences. Additional challenges that could negatively affect the adoption and scale-up of community-based NCD interventions in resource-constrained settings included the availability

and quality of technologies for care coordination; minimal experience managing or working with in-home providers as members of care teams; and challenges in securing long-term funding for community-based NCD programmes, as well as broader health system capacities for NCD care (eg, functional diagnostic equipment, reliable stocking of NCD pharmaceuticals, accessible primary care services). Without greater prioritisation of NCDs in health financing—from government sources to development partners alike—the potential impact of community-based NCD programmes could be hindered by the lack of underlying infrastructure and resources.⁴⁹

Potential implications for community-based NCD interventions

Building off of previous work, the present study offers some programmatic considerations, including facility-level and community priorities, as well as for national agendas on NCD prevention and treatment. In Brazil, India and South Africa, pre-existing health system challenges, ranging from medication stock-outs to long travel times to reach health facilities, posed obstacles to patients and providers. To more effectively treat the rising burden of NCDs, it is critical to address deficiencies in facility infrastructure, transportation, staffing and supplies. In the USA, many providers and administrators had limited previous exposure to home-based providers, which made programme implementation challenging at times, especially during the early stages of intervention. Identifying processes and supportive technologies by which care teams may incorporate home-based care more seamlessly, particularly in terms of sharing patient data and informing facility staff about findings from home visits, is likely to be beneficial. Finally, especially for LMICs, there is an urgent need for development partners to dedicate more funding to NCD care and strengthening health systems more broadly.⁴ Without a greater emphasis on these health financing areas, many communities in LMICs will remain ill equipped to provide effective NCD care.⁹

Limitations

Our study’s findings should be interpreted in light of its limitations. First, while HealthRise sites were selected to represent a range of underserved populations worldwide, findings are not generalisable to all underserved communities seeking to improve NCD care. Continued work is needed to understand which community-based NCD interventions may work best given local contexts and needs. Second, despite being incorporated into the initial process evaluation framework, comprehensive information on intervention reach and fidelity (ie, the degree to which interventions were implemented per protocol) were not available across sites and thus could not be included in the present study. To better understand intervention impact, ongoing and future community-based programmes could greatly benefit from ensuring adequate funding, personnel and infrastructure to establish and maintain data collection

for evaluation indicator monitoring. Third, in the USA, comparison groups were constructed retrospectively by each grantee, using available patient record information and were not selected by random assignment. While efforts were made to ensure that included comparison patients generally represented individuals who would have been eligible for HealthRise enrolment, they may have differed from individuals who enrolled. Fourth, in Shimla, India and South Africa, we were limited to cross-sectional patient data at endline, and thus could not directly assess potential differences in cascades of care from baseline to endline among HealthRise implementation and comparison areas. Not being able to explicitly account for pre-intervention differences in these areas and how they changed over time may contribute to some findings in Shimla (ie, patients presenting at facilities in comparison areas having somewhat higher levels of current diabetes treatment and meeting treatment targets for hypertension than patients in HealthRise implementation areas). Also, based on our sampling strategy, we cannot rule out cross-contamination in Shimla and South Africa (ie, patients presenting at facilities in comparison areas engaged in HealthRise activities and/or patients in HealthRise implementation areas were not exposed to HealthRise programming). Fifth, the global evaluation team could not verify monitoring data accuracy for sites in India and South Africa, as only aggregated data were provided by grantees due to government regulations governing data use outside the country. Organisations were assigned by the government in each country to check the validity of data before it was transmitted to IHME. Sixth, for Brazil and the USA, we only included patients who remained enrolled at endline in the endline analyses; by taking this ‘as treated’ analytical approach, which provides insights into programme effects closer to full adherence, these patients may not represent all potential target populations for HealthRise interventions and results may be positively biased. Seventh, while results varied by site, the relative lack of differences for several indicators between patient groups and over time could be related to factors beyond programme effectiveness. It is possible that, on average, HealthRise programme implementation and patient duration in the programme was not long enough to detect positive effects; this may be particularly relevant for sites where community-based care and CHW networks had not previously been longstanding models of service provision and therefore required substantial time to establish. Changes in clinical outcomes also can lag behind intervention exposure and thus improvements may not have been fully realised by endline. Eight, information on the existence of preintervention services or programmes were not available across sites; subsequently, it was not possible to ascertain the potential effects of this factor on endline evaluation results.

CONCLUSION

The global HealthRise programme involved multisite, locally tailored community-based pilot interventions

focused on NCD care among underserved populations and incorporated a prospective evaluation by an independent party—all important steps towards strengthening the knowledge base of what works and what does not for improving NCD service delivery at local levels. Across the nine sites in four countries, some progress on patient-level indicators occurred; nonetheless, constraints on both implementation and evaluation periods and variable comparison groups across sites emphasise the need for longer-term evaluations of community-based NCD programmes in the future. Biological, behavioural and sociocultural factors all contribute to the risk for and development of NCDs, requiring multifaceted approaches to optimally support patients and families coping with these complex conditions. Achieving notable impacts on NCDs will not only require broader health system strengthening and increased financing for NCDs, but also a more locally driven focus on how interventions and community factors together contribute to improving health for all individuals.

Author affiliations

- ¹Department of Health Metrics Sciences, University of Washington, Institute for Health Metrics and Evaluation, Seattle, Washington, USA
- ²Medtronic Foundation, Minneapolis, Minnesota, USA
- ³Department of Emergency Medicine, University of Minnesota, Minneapolis, Minnesota, USA
- ⁴Regions Hospital, Saint Paul, Minnesota, USA
- ⁵Development Solutions, New Delhi, Delhi, India
- ⁶MAMTA Health Institute for Mother and Child, New Delhi, Delhi, India
- ⁷School of Medicine, Federal University of Jequitinhonha and Mucuri Valleys, Teófilo Otoni, MG, Brazil
- ⁸Public Health Seattle and King County, Seattle, Washington, USA
- ⁹ABT Associates Inc, Cambridge, Massachusetts, USA
- ¹⁰Anisio Teixeira Campus, Federal University of Bahia Multidisciplinary Institute in Health, Vitória da Conquista, Bahia, Brazil
- ¹¹Department of Emergency Medicine, University of Washington, Seattle, Washington, USA
- ¹²School of Medicine, University of Washington, Seattle, Washington, USA
- ¹³Research and Teaching Institute, Hospital Sirio-Libanês, Sao Paulo, São Paulo, Brazil
- ¹⁴Telehealth Department, Federal University of Minas Gerais, Belo Horizonte, MG, Brazil
- ¹⁵HealthFinders Collaborative, Northfield, Minnesota, USA
- ¹⁶National CASA/GAL Association for Children, Seattle, Washington, USA
- ¹⁷IBM Watson Health, San Jose, California, USA
- ¹⁸Health Policy and Management, University of California Los Angeles, Los Angeles, California, USA
- ¹⁹Social Surveys Africa, Johannesburg, Gauteng, South Africa
- ²⁰School of Medicine, Municipal University Sao Caetano do Sul, Sao Caetano do Sul, Sao Paulo, Brazil
- ²¹Pillsbury United Communities, Minneapolis, Minnesota, USA
- ²²Nuffield Department of Population Health, University of Oxford, Oxford, UK
- ²³Global Health Leaders, Public Health Institute, Sao Paulo, Sao Paulo, Brazil
- ²⁴Research and Monitoring Systems, The Catholic Health Association of India, Hyderabad, Telangana, India
- ²⁵Ibis Reproductive Health, Cambridge, Massachusetts, USA

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Data availability statement Data are available in a public, open access repository. The datasets generated and/or analysed during the current study are available, when possible, in the GHDx data repository, <http://ghdx.healthdata.org/series/healthrise-evaluation>

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