

Assessing costs of a hypertension program in primary care: evidence from the HEARTS program in Mexico

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Suggested citation Chivardi C, Hutchinson B, Molina V, Moreno E, Fajardo I, Giraldo-Arcila GP et al. Assessing costs of a hypertension program in primary care: evidence from the HEARTS program in Mexico. *Rev Panam Salud Publica*. 2022;46:e144. <https://doi.org/10.26633/RPSP.2022.144>

ABSTRACT

Objective. In 2021, Mexico launched the HEARTS program to improve the prevention and control of cardiovascular disease (CVD) risk factors in 20 primary care facilities in the states of Chiapas and Yucatán. This study projects the annual cost of program implementation and discusses budgetary implications for scaling up the program.

Methods. We obtained district-level data on treatment protocols, medication costs, and other resources required to prevent and treat CVD. We used the HEARTS Costing Tool to estimate total and per-patient costs. A “partial implementation” scenario calculated the costs of implementing HEARTS if existing pharmacological treatment protocols are left in place. The second scenario, “full implementation,” examined costs if programs use HEARTS pharmacological protocol.

Results. Respectively in the partial and full implementation scenarios, total annual costs to implement and operate HEARTS were \$260 023 (\$32.1 per patient/year) and \$255 046 (\$31.5 per patient/year) in Chiapas, and \$1 000 059 (\$41.3 per patient/year) and \$1 013 835 (\$43.3 per patient/year) in Yucatán. In Chiapas, adopting HEARTS standardized treatment protocols resulted in a 9.7 % reduction in annual medication expenditures relative to maintaining status-quo treatment approaches. In Yucatán, adoption was \$12 875 more expensive, in part because HEARTS hypertension treatment regimens were more intensive than status quo regimens.

Conclusion. HEARTS in the Americas offers a standardized strategy to treating and controlling CVD risk factors. In Mexico, approaches that may lead to improved program affordability include adoption of the recommended HEARTS treatment protocols with preferred medications and task shifting of services from physicians to nurses and other providers.

Keywords

Cardiovascular diseases; costs and cost analyses; hypertension; diabetes mellitus; cholesterol; Mexico

Cardiovascular diseases (CVD) are the leading cause of global mortality and a major contributor to disability (1). The burden of CVD is growing: in 2019, CVD caused 33% of all deaths globally compared to only 26% in 1990 (2).

Development of CVDs is driven by behavioral and metabolic risk factors as well as social determinants. Common behavioral risk factors such as physical inactivity, smoking, and unhealthy diet can be addressed at the individual level via health-provider

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led healthy lifestyle counselling, and at the population level via policies and incentives (3,4). Metabolic risk factors—such as high blood pressure, diabetes, and high cholesterol—can be controlled through both behavioral modification and pharmacological therapy (5–7). Ensuring access to affordable essential medicines and basic health technologies through primary health care facilities is essential to prevent CVD events (8–10).

In Mexico, CVD has been the principal cause of death for over three decades (11). Although it causes one in five deaths in Mexico (12), CVD risk evaluation is offered in fewer than 25% of primary care centers (13). High prevalence of CVD risk factors in the Mexican population suggests a critical need for public health interventions that promote healthy lifestyles and improve control of hypertension, a major CVD risk factor (14).

HEARTS IN MEXICO

The HEARTS Technical Package is the World Health Organization's (WHO) strategic approach for improving CVD prevention in primary health care facilities. It is organized around six modules: H—Healthy Lifestyles, E—Evidence-Based Treatment Protocols, A—Access to Essential Medicines and Technology, R—Risk-Based Management, T—Team Care and Task Sharing, and S—Systems for Monitoring (15). Mexico's Ministry of Health considers HEARTS an essential component of a greater goal to strengthen services at the primary health care level. In February 2020, five states (Campeche, Chiapas, Sonora, Tabasco y Yucatán) in Mexico launched HEARTS. The initial launch focused on training healthcare providers and decision-makers at the facility-, district-, or state-level. Providers were trained on how to administer lifestyle counseling and CVD screening and evaluation, and on medication protocols. Thereafter, implementation was partially interrupted by the COVID-19 pandemic.

At the time of this study (mid-2020), states had not comprehensively implemented the program as planned. To inform existing implementation needs and eventual scale up of the program, we collected data from Chiapas and Yucatán, two states that proceeded with some level of HEARTS implementation. Using collected information, we projected the annual costs of HEARTS in 20 mainly urban health facilities in the states of Chiapas and Yucatán.

METHODS

The HEARTS Costing Tool

Understanding resources required for program implementation is crucial for implementation decisions. The Excel-based HEARTS Costing Tool is designed to assist decision makers to plan and budget for the HEARTS program. The tool is available online and its structure and methods are described in detail in an accompanying user guide (16–18). Using a health-care system perspective, the tool calculates the HEARTS costs over a one-year time horizon. Estimates are guideline costs, meaning that they reflect costs of the program in a scenario where the program's protocols are directly applied out in the real world. The tool uses a bottom-up costing approach that lists individual resources required to implement and operate HEARTS. Users enter data, reporting the price of a given

resource and the required quantity. The tool aggregates the costs of individual resources to estimate the total costs.

The tool considers costs to screen and diagnose patients' 10-year CVD risk, as well as costs to treat patients (i.e., through healthy lifestyle counselling and/or pharmacological treatment). It provides structures to estimate health and non-health human resource costs; the cost of medicines, diagnostics, equipment, and supplies; health-provider training costs; and other supportive program services such as monitoring and evaluation. It also contains a framework to estimate potential savings in human resource costs due to task shifting to non-physician health providers.

Data collection

Users input background data in the tool, including the size of the target population, prevalence rates of CVD risk factors (e.g., tobacco use), the number of employed health providers, annual salaries of health providers, purchasing prices of medicines and diagnostic tests, and the amount of provider time to administer specific CVD services (e.g., screen for total 10-year CVD risk). To collect data, in July, 2020, analysts remotely administered two data questionnaires to district and health-facility level staff who shared their expert opinion and entered relevant data from 2019 and 2020 records to answer questions.

The *District-level instrument* sought to identify participating HEARTS health facilities; learn the structure of work teams in the unit; collect information on staff salaries and the costs of medications and diagnostic tests; describe planned or delivered training sessions and materials; identify staff who directed training sessions; and identify and describe the target population (i.e., the number of patients registered in health facilities and risk-factor prevalence). There was not any outreach or promotion to visit health clinics. The number of visits comes from regular statistics compiled by health facilities.

A *Health-facility-level instrument* was designed to collect data on the type and distribution of healthcare providers within facilities; average durations of patient visits; provider time to administer HEARTS interventions; resources used to train health providers; and pharmacological treatment regimens and diagnostic tests currently being prescribed to patients.

Costing framework by HEARTS component

Module H (Healthy-lifestyle counseling) promotes training healthcare providers to administer healthy lifestyle counselling to patients who use tobacco, use alcohol harmfully, and/or who are physically inactive. Within the costing tool, the H module estimated the cost of 1) training health providers and 2) human resource time to administer the counselling to patients.

We estimated the cost of a one-time training for health personnel identified in the survey instruments (203 in Chiapas and 327 in Yucatán, see Table 1). Each training session was assumed to last four hours with 20 trainees in attendance. The cost of training sessions reflected only the cost of trainer time. Other costs to attend (e.g., travel per diems) and host (e.g., meeting room rental costs) the training was not included based on the assumption of digital delivery during the COVID-19 pandemic.

For intervention delivery, we estimated the cost of human resource time and the cost of informational materials provided to patients. The proportion of patients receiving counseling was

TABLE 1. Facility-level data: Patient load, provider capacity, and prevalence of risk factors among the population of Chiapas and Yucatán, Mexico, 2020

Category	Chiapas	Yucatán
Contextual variables		
Geographic location	Southwest	Southwest
Population size	5 534 000	2 301 000
Surface area	73 311 km ²	43 379 km ²
Facility background		
Total health facilities (n)	639	165
Health facilities participating in HEARTS (n)	10	10
Adult population in facility catchment areas (n)	24 421	73 182
Adult population registered in the health facilities (n)	8 083	24 223
Risk factor status		
Among patients, prevalence of hypertension, diabetes, hyperlipidemia*	16.2%, 7.8%, 19.5%	21.7%, 10.7%, 19.5%
Adult prevalence of low, medium, and high CVD risk**	83.7%, 13.1%, 3.7%	83.7%, 13.1%, 3.7%
HEARTS health providers within facilities (n)		
	327	203
Physicians (% of all providers, annual salary in USD)	38.0% (\$15 061)	36.0% (\$18 595)
Nurses (% of all providers, annual salary in USD)	38.0% (\$11 715)	59.0% (\$12 997)
Social workers (% of all providers, annual salary in USD)	8.0% (\$11 565)	N/A
Health promoters (% of all providers, annual salary in USD)	5.0% (\$8 957)	N/A
Nutritionists (% of all providers, annual salary in USD)	6.0% (\$12 002)	3.0% (\$12 615)
Psychologists (% of all providers, annual salary in USD)	5.0% (\$11 830)	2.0% (\$11 830)

* Hypertension is defined as systolic blood pressure $\geq 140/90$ mm/Hg, diabetes is fasting blood glucose ≥ 126 mg/dl, and hyperlipidemia is self-reported as "yes/no".

** No data from facilities was received on the distribution of total CVD risk among patients, nor was data available nationally or sub-nationally. Thus, the analysis assumed that patient CVD risk profiles reflected averages from other middle-income countries (31).

calculated based on existing prevalence of risk factors within the analysis population. The cost of provider time was equal to the average number of minutes the healthcare provider spent counselling a patient multiplied by the total number of patients receiving counselling multiplied by the provider's pro-rated full-time salary.

Module E (Evidence-based treatment protocols) outlines treatment schedules, including pharmacological regimens and follow-up primary care visits. We assessed the cost of human resource time to assess CVD risk—i.e., learn patient health history, provide a physical examination (including blood pressure measurement)—and to oversee patient follow-up visits to manage CVD risk. We also estimated the cost of laboratory technician time to obtain and process diagnostic samples (e.g., lipid panels). The total cost of provider time is equal to the average number of minutes the healthcare provider spends on each task, multiplied by the number of patients projected to receive the health service multiplied by the provider's pro-rated full-time salary.

Module A (Access to essential medicines and technology) focuses on ensuring availability of medications and basic technology. Because, due to the pandemic, one state was not able to fully train providers to implement HEARTS pharmacological protocols, we considered two comparative scenarios for costs in Module A. First, we estimated the costs of pharmacological treatment with status quo treatment regimens. To do so, we used real-world data from administered district- and facility-level surveys on the proportion of patients receiving specific medication regimens and the purchasing prices of medications. We call this scenario "partial implementation" because it presumes that facilities implement all HEARTS components except for its pharmacological protocols. In a second scenario, we estimated annual pharmacological treatment costs of applying HEARTS

pharmacological protocols for hypertension¹ and diabetes, and the American Heart Association's protocol for treatment of hyperlipidemia (19). (See Tables A1 and A2, in supplementary material). The scenario applies the same per unit medication costs reported within the survey instrument, but if a different medication strength was specified in the protocols than had been reported in the survey instrument (e.g., amlodipine 10 mg instead of 5 mg), medication cost is increased by 50% following published assumptions (20). To determine the percent of patients with a given risk factor who receive low- medium- and high-intensity treatment regimens, we drew on risk-factor-severity distribution data (e.g., for those with hypertension, the percent with systolic blood pressure levels 140 to <150 mmHg, 150 to <160 mmHg, or >160 mmHg) from Mexico's 2018 National Health and Nutrition Survey (ENSANUT) and mapped it against pharmacological regimen intensity recommendations from published literature or protocols (19,21,22).

Module R (Risk-based CVD management) promotes using pre-established WHO risk charts to assist providers to diagnose a patient's total 10-year CVD risk and to define appropriate thresholds for treatment and referral. Within this module, costs included those for a one-time training of healthcare providers to assess and treat patients based on CVD risk, and the cost of provider time to diagnose a patient during an annual primary care consultation. In the analysis, we assumed training sessions take four hours and are attended by 20 participants. We estimated the cost of training for the same health providers specified in the Module H. The cost of training sessions consisted only of the human resource time of trainers.

¹ Specifically, for hypertension, using HEARTS "ACE-I or ARB + diuretic" protocol.

Module T (Team-based care). HEARTS encourages team-based care, in which non-physician healthcare providers take on important roles in providing HEARTS services. To provide insight on the extent to which team-based care may reduce human resource costs, the tool's Module T calculated the difference in the total cost of provider time between an assumed scenario where physicians manage all tasks (e.g., assessing CVD risk and providing lifestyle counseling) versus a scenario where tasks are distributed across a team of health providers. Simply, the module takes the total amount of human resource time estimated as needed to operate the HEARTS program and multiplies it by 1) a physician salary rate, and 2) a weighted rate of provider salaries (physician and non-physician) among those trained to undertake HEARTS tasks.

Module S (Systems for monitoring) promotes monitoring and evaluation of the HEARTS program, including through use of information technology and human resources necessary to deploy and maintain a monitoring system. We estimated the cost of part-time staffing for monitoring the program, consisting of a physician (allocating 25 % of their annual labor to monitoring the program), an administrative assistant (25 % of their annual labor) and an administrative officer (33 % of their annual labor). Costs of other technologies or supplies were not included.

All costs within the analysis are enumerated in 2020 US dollars (USD), converted from Mexican Pesos (MXN) at an exchange rate of MXN 21.37 to 1 USD (23).

RESULTS

Survey instrument data: program and participants

Table 1 shows important data collected from the district- and facility-level survey instruments, including on facility patient loads, patient risk factor status, and employed health providers within the facilities. Other survey results included estimates of the average time health providers need to screen for total 10-year CVD risk: 7 minutes to obtain patient health history, 8 minutes for a physical examination, and 6 minutes to calculate risk using CVD risk charts. The average time required to administer and analyze blood and urine tests was reported at 20 minutes in Chiapas and 15 minutes in Yucatán. The analysis assumptions on patient primary care visits follow guidelines from Mexico's Centro Nacional de Programas Preventivos y Control de Enfermedades (CENAPRECE) which indicate required visits by CVD risk level: respectively 3, 6 and 12 visits for low-, medium-, and high-risk patients. Facilities reported the average time per visit at 71 minutes, with care split between doctors (11 minutes), nurses (8 minutes), nutritionists (12 minutes), and psychologists (40 minutes).

Survey instrument data: the distributions and cost of treatments in Chiapas and Yucatán

Tables 2 and 3 summarize the treatment regimens that facilities reported are administered to patients with hypertension, diabetes and hyperlipidemia (informing the estimated resources and costs in the "partial implementation" scenario). For comparison, Tables A1 and A2 in supplementary material summarize treatment regimens from HEARTS and American

Heart Association (AHA) protocols ("full implementation" scenario).

In Chiapas, (Table 2) eight unique drug treatment regimens were reported to be prescribed to hypertension patients at an average cost of almost \$18 per year. Most patients with hypertension (83%) took two or more medications (single pill combination therapy). For patients with diabetes, Chiapas facilities prescribed eight unique regimens, with most (84%) patients administered metformin and glibenclamide in some combination at an average cost of USD \$10.6 per year. No patients were reported to take insulin at the Chiapas facilities. Finally, patients with hyperlipidemia were administered five different treatment regimens at an average per patient annual cost of \$8.1. Almost all patients (96%) were on monotherapy.

More pharmacological regimens were administered in Yucatán compared to Chiapas, across all risk factors. In Yucatán (Table 3), 14 different treatment regimens were administered to hypertension patients (average cost \$15 per year). Four in five patients took only one medication (monotherapy). Fifteen different treatment regimens were prescribed to diabetes patients in the Yucatán clinics, at \$34 annually; 34% of the patients were prescribed metformin and glibenclamide (850 mg/5 mg) at \$55 per patient annually, a cost almost five times more expensive than in Chiapas using the same scheme. Unlike in Chiapas, some patients took insulin (9%). Finally, Yucatán prescribed eight different regimens for patients with hyperlipidemia, with per patient medication costs of about \$6 per year.

The cost of HEARTS in Chiapas and Yucatán

Tables 4 and 5 show the estimated annual program costs for HEARTS in Chiapas and Yucatán using two alternative pharmaceutical treatment strategies. Alternative 1, designated as "partial implementation," refers to an implementation scenario where status quo treatment regimens are administered to patients. Alternative 2, "full implementation," assumed adoption of new HEARTS and AHA treatment protocols.

In Chiapas, total annual costs of the HEARTS program were estimated at USD \$260 023 or \$32.2 per patient/year for partial implementation and \$255 046 or \$31.6 per patient/year for full implementation. In Yucatán, total annual costs were estimated at \$1 000 059 or \$41.3 per patient/year for partial implementation and \$1 013 835 or \$41.8 per patient/year for full implementation.

Evidence-based treatment protocols (Module E)—which reflects the cost of provider time used for obtaining patient health histories and diagnostic tests during an initial consultation, plus health provider time devoted to follow-up visit—represented most program implementation costs (>70%) in both Mexican states. Expenditures on medication and diagnostics represented the next largest cost share, comprising between 18% to 24% of all costs—depending on the state and scenario examined. In Chiapas, the annual cost of administering status-quo treatment protocols were \$51 234 or 20% of estimated program costs, while following protocols outlined in HEARTS was \$46 257, a potential savings of about of \$5 000. In Yucatán, annual medication and diagnostic expenditures were estimated at \$230 546 under status-quo treatment protocols and were about \$13 000 more expensive under the new treatment protocols.

TABLE 2. Chiapas facility-level data: status quo treatment schemes, 2020

Risk factor category	Medicines	Chiapas		
		Dose per day	% of people with the risk factor who are administered the treatment regimen	Annual medication cost (USD) per patient
Hypertension	Telmisartan, amlodipine	40 mg / 10 mg	29.0%	\$18.0
	Telmisartan, amlodipine	40 mg / 5 mg	19.0%	\$15.8
	Telmisartan	40 mg	12.0%	\$13.6
	Telmisartan, amlodipine, chlorthalidone	40 mg / 5 mg / 50 mg	11.0%	\$27.9
	Captopril, hydrochlorothiazide	25 mg / 25 mg	9.0%	\$25.6
	Enalapril, hydrochlorothiazide	10 mg / 25 mg	9.0%	\$14.3
	Enalapril, hydrochlorothiazide, losartan	10 mg / 25 mg / 50 mg	6.0%	\$14.0
	Losartan	50 mg	6.0%	\$6.8
Average annual per patient medication costs, hypertension →				\$17.59
Diabetes	Metformin, glibenclamide	500 mg / 5 mg	39.0%	\$11.21
	Metformin, glibenclamide	850 mg / 5 mg	21.0%	\$12.29
	Metformin, glibenclamide	850 mg / 10 mg	9.0%	\$5.47
	Metformin, glibenclamide	850 mg / 15 mg	8.0%	\$10.19
	Metformin, glibenclamide	850 mg / 10 mg	7.0%	\$8.88
	Metformin	500 mg	7.0%	\$10.23
	Metformin	850 mg	6.0%	\$10.23
	Metformin	850 mg	2.0%	\$3.41
Average annual per patient medication costs, diabetes →				\$10.38
Hyperlipidemia	Pravastatin, bezafibrate	10 mg / 200 mg	4.0%	\$13.83
	Bezafibrate	200 mg	2.0%	\$5.09
	Pravastatin	10 mg	16.0%	\$3.41
	Pravastatin	20 mg	55.0%	\$6.82
	Pravastatin	40 mg	24.0%	\$13.64
Average annual per patient medication costs, hyperlipidemia →				\$8.14

Table A3 in supplementary material, breaks down how medication costs differ by treatment scenario by risk factor. In Chiapas, treatment using HEARTS protocols was cost-saving for hypertension and diabetes (total savings \$7 163) while AHA treatment guidelines were more costly than existing status quo treatment regimens (\$2 187). In Yucatán, treatment using HEARTS protocols was cost-saving for diabetes (total savings \$35 712) while the new protocols were more costly for hypertension (\$26 835) and hyperlipidemia (\$21 752).

Program elements that represent smaller fractions (4% or less) of total costs were the H, R, and S modules. Finally, annual human resource expenditures were estimated to decrease with task-sharing of program activities (Module T). Potential cost savings were estimated at about \$222 000 (\$28 529 in Chiapas and \$197 024 in Yucatán).

DISCUSSION

This analysis estimated the costs of the HEARTS program in 20 health facilities in Chiapas and Yucatán, with implications for budgeting the HEARTS program as well as insights into cost-related efficiencies that may potentially be gained under care structures that embrace team-based care or cost-saving medication protocols.

Understanding the cost drivers of the program is crucial for continued service delivery at the primary care level. Most of the costs of the HEARTS program were human resource costs to carry out evidence-based treatment protocols (module E). This stems from national recommendations that patients present for primary healthcare visits between 3 and 12 times annually, depending on their CVD risk level, and reports from facilities that health providers' average engagement time with patients is 71 minutes per visit. Opportunities may exist to reduce human resource costs while improving or maintaining patient health outcomes. Evidence shows that team-based provider care systems can reduce the number of needed visits while improving care outcomes. Team-based care has been cited as cost-saving in infectious-disease care settings (24,25) and we calculated \$220 000 in potential savings with a degree of team-based care in place around the HEARTS program. This analysis identified that annual human resource expenditures would be nearly \$8 000 higher in Chiapas and \$197 000 higher in Yucatán if doctors take on all HEARTS tasks instead of sharing tasks with trained non-physician providers.

Costs of diagnostics and medications ranged from 18 to 24 % of all costs depending on the state and scenario. The analysis identified potential cost-efficiencies to using HEARTS

TABLE 3. Yucatán facility-level data: status quo treatment schemes, 2020

Treatment for	Medicines	Dose per day	Yucatán	
			% of people with the risk factor who are administered the treatment regimen	Annual medication cost (USD) per patient
Hypertension	Captopril	25 mg	22.0%	\$5.09
	Losartan	50 mg	11.0%	\$10.75
	Amlodipine	5 mg	10.0%	\$5.65
	Losartan, hydrochlorothiazide	25 mg / 25 mg	10.0%	\$47.06
	Captopril	25 mg	8.0%	\$1.73
	Losartan	50 mg	7.0%	\$21.50
	Amlodipine	10 mg	4.0%	\$7.34
	Nifedipine	5 mg	4.0%	\$17.57
	Losartan, chlorthalidone	50 mg / 12.5 mg	4.0%	\$27.62
	Enalapril, nifedipine, chlorthalidone	10 mg / 10 mg / 12.5 mg	3.0%	\$29.67
	Telmisartan, nifedipine	40 mg / 30 mg	3.0%	\$38.22
	Telmisartan	40 mg	3.0%	\$13.64
	Captopril	25 mg	3.0%	\$3.41
	Nifedipine	10 mg	3.0%	\$17.76
	Enalapril	10 mg	1.0%	\$14.63
Average annual per patient medication costs, hypertension				\$15.15
Diabetes	Metformin, glibenclamide	850 mg / 5 mg	34.0%	\$54.77
	Metformin	850 mg	14.0%	\$16.03
	Glibenclamide	5mg	13.0%	\$10.23
	Metformin	850 mg	7.0%	\$8.01
	Metformin	850 mg	7.0%	\$24.07
	Insulin	13.2 IU	5.0%	\$12.90
	Insulin	13.2 IU	4.0%	\$6.45
	Metformin, glibenclamide	850 mg / 5 mg	3.0%	\$34.30
	Insulin, metformin	13.2 UI / 850 mg	3.0%	\$20.93
	Metformin, glibenclamide	850 mg / 5 mg	3.0%	\$36.54
	Metformin	850 mg	2.0%	\$32.10
	Glibenclamide	5 mg	1.0%	\$30.75
	Metformin, glibenclamide	850 mg / 5 mg	1.0%	\$18.22
	Linagliptin	5 mg	1.0%	\$137.94
	Metformin, linagliptin	850 mg / 5 mg	1.0%	\$153.97
Average annual per patient medication costs, diabetes				\$32.47
Hyperlipidemia	Pravastatin	10 mg	40.0%	\$3.60
	Bezafibrate	200 mg	39.0%	\$5.14
	Pravastatin	10 mg	11.0%	\$7.20
	Bezafibrate	200 mg	6.6%	\$10.23
	Bezafibrate, pravastatin	200 mg / 10 mg	3.0%	\$17.38
	Bezafibrate	200 mg	1.0%	\$15.37
	Bezafibrate, pravastatin	200 mg / 10 mg	0.4%	\$18.93
	Bezafibrate, pravastatin	200 mg / 10 mg	0.3%	\$18.93
	Average annual per patient medication costs, hyperlipidemia			

Note: The total cost of drugs that have the same dose may vary due to the number of times of consumption per day.

pharmacological treatment protocols. For example, in Chiapas, adopting new treatment protocols reduced annual medication expenditures relative to maintaining status quo prescription practices. Much of this reduction stemmed from treating patients with hypertension using HEARTS ACE-I or ARB + diuretic protocols. The protocols' dose regimens and preferred medications provided some cost advantages. For

example, in the Chiapas facilities, many patients with hypertension are administered medications such as telmisartan and hydrochlorothiazide, which are more expensive—as reported in the Chiapas district survey—compared to some other hypertension medications such as chlorthalidone, amlodipine, lisinopril. Within the analysis, we estimated the costs of the HEARTS protocol using the latter medications, and identified

TABLE 4. Chiapas: estimated annual cost of HEARTS by program module and implementation type

HEARTS module	Partial implementation		Full implementation	
	USD	% of total	USD	% of total
H: Healthy-lifestyle counseling	\$8 751	3.4%	\$8 751	3.4%
E: Evidence-based treatment protocols	\$187 406	72.1%	\$187 406	73.5%
A: Access to essential medicines and technology	\$51 234	19.7%	\$46 257	18.1%
R: Risk-based CVD management	\$4 983	1.9%	\$4 983	2.0%
S: Systems for monitoring	\$7 649	2.9%	\$7 649	3.0%
Total cost	\$260 023	100%	\$255 046	100%
Total cost per patient	\$32.2		\$31.6	
T: Team-based care - cost savings derived across modules		(\$28 529)		

Notes: Partial implementation assumes continuation of pre-existing treatment regimens. Full implementation assumes the adoption of HEARTS treatment protocols. Total cost per patient = Total cost/number of patients (8 083). Exchange rate was obtained from (23).

TABLE 5. Yucatán: estimated annual cost of HEARTS by program module and implementation type

HEARTS module	Partial implementation		Full implementation	
	USD	% of total	USD	% of total
H: Healthy-lifestyle counselling	\$36 529	3.7%	\$36 529	3.6%
E: Evidence-based treatment protocols (annual mean cost)	\$708 166	70.8%	\$708 166	69.9%
A: Access to essential medicines and technology	\$230 546	23.1%	\$243 421	24.0%
R: Risk-based CVD management	\$17 948	1.8%	\$17 948	1.8%
S: Systems for monitoring	\$7 770	0.8%	\$7 770	0.8%
Total cost	\$1 000 059	100%	\$1 013 835	100%
Total cost per patient	\$41.3		\$41.8	
T: Team-based care - cost savings derived across modules		(\$197 024)		

Notes: Partial implementation assumes continuation of pre-existing treatment regimens. Full implementation assumes the adoption of HEARTS treatment protocols. Total cost per patient = Total cost/number of patients (24 232). Exchange rate was obtained from (23).

almost \$7 000 in savings compared to status quo hypertension treatment practices.

However, we found that it was more expensive to implement the HEARTS hypertension protocol in Yucatán,² driven in part by the fact that most (80%) of the hypertension patients in the Yucatán facilities were on monotherapy regimens initially. Changing to the HEARTS ACE-I or ARB + diuretic protocol in which all patients are on at least two medications increases the cost of treating patients, but combination therapy has been demonstrated to significantly increase rates of hypertension control with few adverse side effects compared to monotherapy (26–30). Future analyses examining the cost-effectiveness of treatment regimens could lend insight into how much health benefit is purchased for the additional cost (21), providing decision makers with information that could be used to inform national pharmacological treatment guidelines.

We found that treatment costs can vary significantly based on the medications used and their underlying prices. Table A4 in supplementary material shows that, in general, medicine purchasing prices are higher in Yucatán. As such, average treatment costs per patient with hypertension, diabetes, or hyperlipidemia were higher in Yucatán compared to Chiapas when applying

HEARTS protocols.³ States may look to national institutions or the Strategic Fund of the Pan American Health Organization to use purchasing power to negotiate lower prices. Indeed, Table A4 in supplementary material, shows that in several cases for Yucatán, purchasing from the Strategic Fund is a cost-saving opportunity.

This analysis had strengths and limitations. Strengths included basing the analysis on local data, including district-level data on staff salaries, the costs of medications and diagnostic tests, and NCD risk factor status. We received direct information from facilities on treatment pathways and regimens and levels of effort (e.g., time) to perform certain tasks. The data were reported by local administrators and may be subject to error and may or may not be representative. Some local data were not available, including on inputs such as the prevalence of different levels of CVD risk among the population. The study accounted for a wide range of costs—i.e., training; human resource time to screen and treat patients; costs of medications, diagnostics, and supplies; some programmatic costs—but not all costs were captured, including indirect facility-based costs such as for utilities and rental space and detailed monitoring and evaluation costs. Thus, our estimated costs to implement and operate HEARTS are an underestimate.

HEARTS has been introduced in 1380 primary health centers across 22 countries in Latin America and the Caribbean (29) and it

² We also found that in both Chiapas and Yucatán, using AHA protocols for treatment of hyperlipidemia was more expensive than status quo treatment. AHA protocols indicate higher-intensity forms of treatment, which were more expensive.

³ Chiapas: respective costs per patient with hypertension, diabetes, hyperlipidemia—\$13.4, 7.8, 10.0. Yucatán: respective costs per patient with hypertension, diabetes, hyperlipidemia—\$18.3, \$27.0, \$10.0. See Tables A1 and A2, in supplementary material.

has expanded treatment and improved hypertension control (28). For example, in a primary-care center in Matanzas, Cuba hypertension control among patients receiving medication increased from 59.3% to 68.5% (31). Mexico is the first country in the WHO Region of the Americas to conduct a cost assessment of its HEARTS program. Future analyses may leverage study findings or the HEARTS Costing Tool to compare the costs of the program in Mexico to its impact (e.g., reductions in blood pressure). Comparing the cost-effectiveness of certain HEARTS components to status quo practices could demonstrate efficiencies to HEARTS approach, providing further impetus for scale up.

Findings from this analysis demonstrate the costs of the HEARTS program and identify major cost contributors. In Mexico, approaches that may lead to improved program efficiency and affordability include adoption of the recommended HEARTS treatment protocols with preferred medications and task shifting of services from physicians to non-physician providers. Scaled at the national level, these program features have the potential to increase the cost-effectiveness of primary CVD prevention.

Author contributions. CCH, VMC, DK conceived the original idea. CCH, DK planned the study. RRF, EML, IFN and VMC

collected the data. CCH, BH and RRF analyzed the data. CCH, BH and DK contributed data or analysis tools. CCH, BH and DK interpreted the results and wrote the paper. All authors reviewed the paper, and reviewed and approved the final version.

Acknowledgments. We dedicate this article to the memory of Sandra G. Sosa-Rubí, an excellent researcher and colleague.

Conflicts of interest. None declared.

Funding. This work was supported by Cooperative Agreement number 1NU2HGH000044-01-00 funded by the US Centers for Disease Control and Prevention.

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Manuscript submitted on 30 March 2022. Revised version accepted for publication on 16 June 2022.

Evaluación de los costos de un programa de hipertensión en la atención primaria: datos del programa HEARTS en México

RESUMEN

Objetivo. En el año 2021, México puso en marcha el programa HEARTS para mejorar la prevención y el control de los factores de riesgo de las enfermedades cardiovasculares en 20 centros de atención primaria en los estados de Chiapas y Yucatán. En este estudio se estima el costo anual de la ejecución del programa y se abordan las implicaciones presupuestarias para su ampliación.

Métodos. Se obtuvieron datos a nivel de distrito sobre los protocolos de tratamiento, los costos de los medicamentos y otros recursos necesarios para prevenir y tratar las enfermedades cardiovasculares. Se empleó la herramienta HEARTS para el cálculo de costos con el fin de estimar los costos totales y por paciente. En una situación de “implementación parcial”, se calcularon los costos de ejecutar HEARTS si se mantienen los protocolos de tratamiento farmacológico existentes. En un segundo escenario de “implementación completa”, se examinaron los costos de los programas que emplean el protocolo farmacológico de HEARTS.

Resultados. En los escenarios de implementación parcial y total, respectivamente, los costos anuales totales para implementar y poner en marcha el paquete de medidas HEARTS fueron de US\$ 260 023 (US\$ 32,1 por paciente al año) y US\$ 255 046 (US\$ 31,5 por paciente al año) en Chiapas, y US\$ 1 000 059 (US\$ 41,3 por paciente al año) y US\$ 1 013 835 (US\$ 43,3 por paciente al año) en Yucatán. En Chiapas, la adopción de los protocolos de tratamiento estandarizados de HEARTS supuso una reducción de 9,7% en los gastos anuales de medicamentos en comparación con el mantenimiento de los enfoques de tratamiento ya establecidos. En Yucatán, la adopción fue US\$ 12 875 más cara, en parte porque los esquemas de tratamiento para la hipertensión que se proponen en HEARTS fueron más intensivos que los esquemas ya establecidos.

Conclusiones. El programa HEARTS en la Región de las Américas ofrece una estrategia estandarizada para tratar y controlar los factores de riesgo de las enfermedades cardiovasculares. En México, los enfoques que pueden conducir a una mayor asequibilidad del programa incluyen la adopción de los protocolos de tratamiento recomendados de HEARTS con medicamentos de preferencia y la distribución de tareas de los servicios para que pasen del personal médico al personal de enfermería y otros prestadores de atención de salud.

Palabras clave

Enfermedades cardiovasculares; costos y análisis de costo; hipertensión; diabetes mellitus; México.

Avaliação dos custos de um programa de hipertensão na atenção primária: evidências do programa HEARTS no México

RESUMO

Objetivo. Em 2021, o México lançou o programa HEARTS para melhorar a prevenção e o controle dos fatores de risco de doenças cardiovasculares (DCV) em 20 unidades básicas de saúde nos estados de Chiapas e Yucatán. Este estudo projeta o custo anual de implementação do programa e discute as implicações orçamentárias para sua expansão.

Métodos. Foram obtidos dados de nível distrital sobre protocolos de tratamento, custos de medicamentos e outros recursos necessários para prevenir e tratar a DCV. A ferramenta de cálculo de custos do HEARTS foi usada para estimar os custos totais e por paciente. Um cenário de “implementação parcial” calculou os custos de implementação do HEARTS se os protocolos de farmacoterapia existentes forem mantidos em vigor. O segundo cenário, “implementação plena”, examinou os custos se os programas utilizassem o protocolo de farmacoterapia do HEARTS.

Resultados. Respectivamente nos cenários de implementação parcial e plena, os custos anuais totais para implementar e operar o HEARTS foram de US\$ 260 023 (US\$ 32,1 por paciente/ano) e US\$ 255 046 (US\$ 31,5 por paciente/ano) em Chiapas, e \$1 000 059 (US\$ 41,3 por paciente/ano) e US\$ 1 013 835 (US\$ 43,30 por paciente/ano) em Yucatán. Em Chiapas, a adoção de protocolos de tratamento padronizados do HEARTS resultou em uma redução de 9,7% nos gastos anuais com medicamentos em relação à manutenção das condutas atuais (*status quo*). Em Yucatán, a adoção foi US\$ 12 875 mais cara, em parte porque os regimes de tratamento de hipertensão do HEARTS eram mais intensivos do que os regimes atuais.

Conclusão. A HEARTS nas Américas oferece uma estratégia padronizada para tratar e controlar os fatores de risco de DCV. No México, abordagens que podem levar a uma melhor acessibilidade do programa incluem a adoção dos protocolos de tratamento recomendados do HEARTS com medicamentos preferidos e a realocação de tarefas de médicos para enfermeiros e outros profissionais.

Palavras-chave

Doenças cardiovasculares; custos e análise de custo; hipertensão; diabetes mellitus; México.
