BMJ Open  Cost of primary care approaches for hypertension management and risk-based cardiovascular disease prevention in Bangladesh: a HEARTS costing tool application

Muhammad Jami Husain 1, Mohammad Sabbir Haider 2, Renesa Tarannum 3, Shamim Jubayer 4, Mahfuzur Rahman Bhuiyan 3, Deliana Kostova 4, Andrew E Moran, Sohel Reza Choudhury 3

ABSTRACT

Objective To estimate the costs of scaling up the HEARTS pilot project for hypertension management and risk-based cardiovascular disease (CVD) prevention at the full population level in the four subdistricts (upazilas) in Bangladesh.

Settings Two intervention scenarios in subdistrict health complexes: hypertension management only, and risk-based integrated hypertension, diabetes, and cholesterol management.

Results The total annual cost for the hypertension control programme was estimated at US$3.2 million, equivalent to US$0.2 per capita or US$8.9 per eligible patient. The largest cost share (43%) was attributed to the cost of medications, followed by the cost of provider time (38%).

Conclusion Expanding the HEARTS hypertension management and CVD prevention programme to provide services to the entire eligible population in the catchment area may face constraints in physician capacity. A task-sharing model involving shifting of select tasks from doctors to nurses and local community health workers would be essential for the eventual scale-up of primary care services to prevent CVD in Bangladesh.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study uses the HEARTS costing tool to assess the expected cost of scaling up the programme to all eligible adults in the participating subdistricts (upazila).
⇒ The study assesses two programme scenarios: a hypertension management programme and an integrated risk-based hypertension, diabetes and cholesterol management programme.
⇒ The study disaggregates costs by function, identifying areas for efficiency improvements, such as task-sharing and bridging programme delivery from the upazila level to more localised community facilities.
⇒ Due to lack of data at a local level, the cost projections rely on assumptions regarding population coverage, risk factor prevalence, primary care attendance rate, distribution of cardiovascular disease (CVD) risk among the population, distribution of patients by treatment protocols and frequency of patient visits by CVD risk.
⇒ The study uses average medicine prices, unit costs of supplies, wages and provider time, which may vary across subdistricts depending on the procurement arrangements and operational efficiency.

BACKGROUND

Hypertension is a major and preventable risk factor for cardiovascular disease (CVD). An estimated 1.13 billion people (1 in 4 men and 1 in 5 women) worldwide have hypertension. Among people with hypertension worldwide, fewer than one in five have it under control. High blood pressure (BP) is a leading global risk factor for premature death and disability, accounting for about 10 million (or 1 in 6) deaths worldwide each year. Uncontrolled hypertension significantly increases the risk of stroke, myocardial infarction, heart failure, dementia,
renal failure, retinopathy and other diseases.4-7 Almost half of all CVD events are attributable to uncontrolled hypertension.2,3

Reducing the prevalence of hypertension is a standing global health objective.8-11 This objective complements the 2030 Sustainable Development Goal of reducing premature deaths from non-communicable diseases (NCDs) by 25%.12 Low-income and middle-income countries (LMICs), where two-thirds of all hypertension cases reside, are increasingly cognizant of the long-term benefits of addressing hypertension in their populations. However, implementing population-level measures targeting hypertension may present challenges for many LMICs where health systems have traditionally focused on infectious diseases and where the capacity for NCD care may be limited.

Bangladesh is among lower-middle-income countries with a high burden of hypertension. In 2018, the prevalence of elevated BP (SBP and/or DBP ≥ 140/90 mm Hg) among adults in Bangladesh was 21%.13-15 According to the 2011 Bangladesh National Demographic and Health Survey, of 14.4 million hypertensive people (adults aged 35 and above), only 7.3 million (51%) were aware of their condition, 41% were treated and 18% had their BP levels under control.16 The burden of hypertension in Bangladesh is expected to grow alongside increased population ageing, rapid urbanisation with commensurate increases in sedentary lifestyle and processed food consumption, and other socioeconomic and lifestyle changes. However, only less than 5% of the health sector programme budget is allocated for NCDs control.16 This demonstrates the need for an effective, low-cost and efficient population-level approach in addressing hypertension.

In 2016, WHO introduced the HEARTS technical package as a framework for CVD prevention at the primary care level.17 The HEARTS technical package consists of guidelines for implementing a primary care approach to CVD management, focusing on screening and management of CVD risk factors, including lifestyle modification and pharmacological treatment of metabolic risk factors such as hypertension, diabetes and hyperlipidaemia. In this paper, we describe the local budgetary impact of implementing the HEARTS programme at the population level for four subdistricts in Bangladesh, based on programme cost data obtained from a representative healthcare facility in each subdistrict. Although the initial focus of the programme in the four subdistricts is presently limited to hypertension control, scaling-up of the initiative may include screening, diagnosis and treatment of diabetes and high cholesterol. Understanding the cost drivers of CVD prevention approaches in the Bangladesh primary care system can support budgeting, procurement, evaluation and planning for scale-up.

METHODS

Setting

In 2018, the Directorate General of Health Services and the National Heart Foundation of Bangladesh collaborated with Resolve to Save Lives (an initiative of Vital Strategies, a non-profit global public health organisation) to implement a pilot programme to strengthen the detection, treatment and follow-up management of hypertension in primary care. The programme was introduced in four health complexes in four subdistricts (upazilas) in the Sylhet district: Golapganj, Fenchuganj, Beanibazar and Bishwanath. In Bangladesh, hospitals and health facilities that are in the subdistrict (upazila) level or below are termed as primary health complexes. A typical upazila health complex is a 50-bed hospital with service coverage in the range of 100 000–400 000 population and plays a pivotal role in the provision of primary healthcare through a three-tier system consisting of the ward level, union level and upazila level. The upazila health complex performs a wide range of functions that includes prevention, promotion, treatment (inpatient, outpatient, limited diagnostic services), management, technical support, training, coordination and patient referral services. The outpatient service is usually staffed with five outpatient general practitioners including one resident medical officer, two medical officers and two medical assistants. An ‘NCD corner’ was set up in the outpatient with necessary logistics and personnel for screening and treatment. We project programme costs under two intervention scenarios: a hypertension-focused programme, and a risk-based integrated hypertension, diabetes and cholesterol management programme.

Patient and public involvement

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

Hypertension management program

The HEARTS Technical Package for CVD prevention in primary care is organised around six modules: H—Healthy-lifestyle counselling, E—Evidence-based treatment protocols, A—Access to essential medicines and technology, R—Risk-based CVD management, T—Team-based Care and S—Systems for monitoring.18 Components of these modules are described in figure 1. In the four upazila primary care complexes in Bangladesh, programmed activities included: training of staff in following a standard treatment protocol, record keeping and reporting; ensuring adequate supply of necessary drugs; community outreach to increase awareness of the need for hypertension screening; introduction of patient monitoring tools and a monthly reporting system; and establishing a mechanism for patient referral from primary care to secondary care and tertiary care at MAG Osmani Medical College. The clinical management protocol for adults with hypertension (defined as systolic blood pressure (SBP)/diastolic blood pressure (DBP) ≥ 140/90 mm Hg, or SBP/DBP ≥ 130/80 mm Hg with comorbidity or high CVD-risk)
entailed a first line of treatment with amlodipine 5 mg daily; a second line of treatment using amlodipine 5 mg plus losartan 50 mg daily; and a third line of treatment using amlodipine 5 mg plus losartan 50 mg plus hydrochlorothiazide 12.5 mg daily. Online supplemental appendix 1 depicts the hypertension treatment protocol. The prescribed medicines are typically obtained by public health facilities, generic, domestically manufactured and provided free of charge to patients. The national drug policy recommends that 70% of the public sector medicines be purchased from the state-owned Essential Drug Company Limited (EDCL), 25% from the Central Medical Stores Depot (CMSD) and 5% from local sources. In order to provide continuous care more sustainably and to reduce burden on physicians, a team-based care strategy was implemented. The healthcare providers were trained to acquire the necessary skills to provide brief interventions to record patients’ medical history, measuring BP, point-of-care testing to assess fasting blood glucose and cholesterol levels and urine dipstick for proteinuria, encourage behaviour change, assess CVD risk or initiate treatment protocol. The training sessions were conducted in one setup with a pool of selected doctors, nurses and community health workers (CHWs) trained with relevant modules. In this approach, CHWs were trained to provide counselling and some screening services along with the doctors and nurses. For the costing estimate, equal burden sharing in terms of provider time was assumed.

Risk-based integrated hypertension, diabetes and hyperlipidaemia management programme

To further strengthen CVD prevention, the HEARTS programme in Bangladesh also planned to integrate diabetes and hyperlipidaemia management in addition to hypertension management in primary care patients. The programme entails assessment of target population by total CVD risk estimation to categorise their risk for CVD. The risk stratification is based on WHO and International Society of Hypertension cardiovascular risk prediction charts and expressed as the probability of developing CVD over 10 years: low CVD risk (0 to <10%); medium CVD risk (10% to 20%) and high CVD risk (≥20%). The treatment protocol for patients with uncomplicated type two diabetes (defined as fasting plasma glucose ≥ 7.0 mmol/L or routine plasma glucose ≥ 11.1 mmol/L or HbA1C ≥ 6.5%) managed at the primary care level included metformin (500 mg), metformin (1000 mg), then metformin (1000 mg) and gliclazide (80 mg) as the first, second and third lines of treatments, respectively. The protocol is based on the WHO guidance on diagnosis, classification and management of diabetes (HEARTS-D), which is aligned with the WHO Package of Essential Noncommunicable Disease Interventions in Primary Healthcare. For managing plasma lipid levels (ie, high cholesterol), the use of statins as the primary therapy is widely recommended, however, the WHO is yet to offer any specific guidance. For costing, the local consultants and experts proposed a statin-based treatment protocol for hyperlipidaemia including simvastatin (10 mg) as first, atorvastatin (20 mg) as second and atorvastatin (40 mg) as the third line of treatment. Costs associated with implementing integrated hypertension, diabetes and hyperlipidaemia treatment protocols include provider time spent on estimating CVD risk using risk charts during an annual primary care visit; training in CVD risk estimation, in addition to time spent collecting patient history; medication costs and diagnostic test costs including provider (technician) time, complete blood count panel, fasting blood glucose and blood lipid panel tests.

HEARTS costing tool

Programme costs were assessed using the HEARTS costing tool, an Excel-based instrument to collect, track and evaluate the incremental annual cost of implementing the HEARTS programme from the health system perspective. The tool is organised by HEARTS modules. In July–August 2020, we obtained unit costs from four upazila complexes and used these to project annual resource

Figure 1 Cost components of the HEARTS programme in Bangladesh.
needs for implementing the CVD prevention programme at the subdistrict population level. The researchers completed in-person collection of data from the four facilities on human resource and time costs, diagnostic prices, time-motion on laboratory diagnostics, market price of medicines and others.

Figure 1 shows major cost categories within HEARTS modules. Once programme costs and other inputs such as population coverage, risk factor prevalence and planned provider numbers were entered into the costing tool, the cost calculations were allocated across different HEARTS modules.

The cost elements in the Healthy-lifestyle counselling module ‘H’ included costs of training providers in lifestyle counselling and costs of community awareness programmes and training. Counselling is based on the Assess, Advise, Agree, Assist, Arrange model, which is an evidence-based approach for promoting healthy behavioural changes to prevent NCD risk factors.25 26

Total provider time to administer brief counselling was equal to the average time that the health provider spends to counsel a patient to change behaviour multiplied by the total number of patients who would receive counselling. The cost of total provider time was calculated as the total provider time, multiplied by the weighted average salary of the health providers who have been trained to provide counselling.

The cost elements in module ‘E’ included provider time devoted to assessing patient history, conducting physical exams and diagnostic tests, and return visits. The costs of diagnostic tests (complete blood count panel, blood lipid panel, fasting blood glucose), medications (hypertension, diabetes and cholesterol) and on-site diagnostic technologies and supplies were assessed under module ‘A’. Module ‘R’ reports the costs of training providers in conducting risk-based management and the cost of provider time for estimating patient CVD risk using risk charts. Module ‘T’ reports cost savings from task-sharing by comparing the cost that could have been incurred if the tasks were performed solely by the physicians with costs incurred through task-sharing among physicians, nurses and CHWs. Therefore, in the baseline scenario (ie, in the absence of task-sharing allocation), the costing tool assumes a physician-led programme. In our cost projections, we assumed that doctors, nurses and CHWs will equally share the tasks (ie, provider time) when applicable. For instance, CHWs would only provide behavioural counselling and screening service, but they would not assess CVD risk (using risk-cart), or prescribe patients with pharmacologic treatments. Accordingly, the provider time allocated for behaviour counselling and screening will be shared equally among doctors, nurses and CHWs. Nurses will be trained to do major tasks (ie, counselling, screening and assessing CVD risk, and treating according to CVD risk), therefore, providers’ time for performing hypertension/CVD risk-assessment, prescribing suitable treatment and return-visits were allocated equally between doctors and nurses. While the ‘T’ module reports the cost savings from team-based care, the accrued cost of provider time (inclusive of doctors, nurses and CHWs) spent on various tasks is included in the corresponding ‘H’, ‘E’ and ‘R’ modules. Module ‘S’ reports costs related to human resources, technology (software and hardware), supplies and training for patient monitoring.

Data

Data on salaries of government healthcare providers and programme staff were collected from in-person interviews and/or records. Total salary was calculated according to the Government of Bangladesh National pay scale. Size of the population in the examined subdistricts was obtained from census and imputed based on Bangladesh Bureau of Statistics estimates. Other population parameters (eg, primary care attendance rate and risk factor prevalence) were obtained from the nationally representative NCD Risk Factor Survey 2018.15 Medicine prices were collected from the medicine outlets in the public hospitals. The unit prices represent the average price of domestically manufactured generic medicines procured by health facilities from EDCL or CMSD. Prices of laboratory diagnostics were collected from diagnostic labs at the district (Sylhet district) and subdistrict (upazila) levels. Data on time needed to conduct laboratory tests were collected from in-person interviews of laboratory personnel. Training data, including number of training and participants, per-diem costs of staff, costs related to rent, transport, refreshments and other logistics, were collected from the respective project records.

Table 1 presents the prevalence of CVD risk factors as well as cost inputs used to populate the HEARTS costing tool. Fifteen per cent of the adult population was estimated to be at medium and high risk for CVD. The leading risk factors were tobacco use (43.7%), hyperlipidaemia (28.4%) and hypertension (21%), followed by physical inactivity (12.3%), diabetes (8.3%) and alcohol consumption (4.4%); The primary care attendance rate was assumed to be 47.9% in each upazila.15 The distributions of patients by CVD risks and for the pharmacological treatment of hypertension, diabetes and cholesterol by different treatment lines were adopted from the literature and/or based on local physician consensus.27–30

Local currency was converted to US dollars using the Bangladesh Bank official conversion rate in June 2020.

RESULTS

Population coverage

The total population in the four subdistricts was 1.12 million, of which 749,000 were adults aged 18 and above (table 2). The total number of people eligible to receive counselling, screening, diagnosis and treatment under the two types of HEARTS intervention packages (ie, hypertension control and risk-based integrated approach) in the four subdistricts was determined by the primary care attendance rate, the prevalence of low-CVD, medium-CVD and high-CVD risk in the population, the
Table 1  Costing inputs and unit costs

| Input description                                      | Units     | Value     |
|-------------------------------------------------------|-----------|-----------|
| Eligible population (adult population, age 18+)       |           |           |
| Golapganj                                             | Persons   | 261 098   |
| Fenchuganj                                            | Persons   | 86 503    |
| Beanibazar                                            | Persons   | 209 454   |
| Bishwanath                                            | Persons   | 192 075   |
| Primary healthcare attendance rate (annual)            | Per cent  | 47.9%     |
| Adult population with risk factors                    |           |           |
| Use of tobacco products                               | Per cent  | 43.7%     |
| Hazardous or harmful use of alcohol                    | Per cent  | 4.4%      |
| Physical inactivity                                   | Per cent  | 12.3%     |
| Hypertension (≥140/90 mm Hg)                          | Per cent  | 21.0%     |
| Diabetes (≥7.0 mmol/L or 126 mg/dL)                   | Per cent  | 8.3%      |
| Hyperlipidaemia (≥6 mmol/L or 190 mg/dL)              | Per cent  | 28.4%     |
| Low CVD risk (0 to <10%)                              | Per cent  | 85.1%     |
| Medium CVD risk (10 to <20%)                          | Per cent  | 14.4%     |
| High CVD risk (≥20%)                                  | Per cent  | 0.5%      |
| Annual wage (in LCU (BDT) and USD, including benefits)|           |           |
| Doctors                                               | BDT (USD)/year | 1 399 452 (16 484) |
| Nurses                                                | BDT (USD)/year | 726 360 (8555)   |
| CHWs                                                  | BDT (USD)/year | 486 568 (5731)   |
| Lab technicians                                       | BDT (USD)/year | 576 720 (6793)   |
| Accountant                                            | BDT (USD)/year | 576 720 (6793)   |
| Administrative assistant                             | BDT (USD)/year | 446 242 (5256)   |
| Clerical officer                                      | BDT (USD)/year | 446 242 (5256)   |
| Custodian                                             | BDT (USD)/year | 446 242 (5256)   |
| IT personnel                                          | BDT (USD)/year | 446 242 (5256)   |
| Programme director                                    | BDT (USD)/year | 1 399 452 (16 484) |
| Programme manager                                     | BDT (USD)/year | 726 300 (8555)   |
| Secretary                                             | BDT (USD)/year | 446 242 (5256)   |
| Security officer                                      | BDT (USD)/year | 400 196 (4714)   |
| Pharmacist/chemist                                    | BDT (USD)/year | 576 720 (6793)   |
| Statistician                                          | BDT (USD)/year | 576 720 (6793)   |

Continued
Table 1  Continued

| Input description                                                                 | Units          | Value       |
|-----------------------------------------------------------------------------------|----------------|-------------|
| Supplies manager                                                                  | BDT (USD)/year | 486 568 (5731) |
| **Purchasing price (in LCU (BDT) and USD) of pharmaceutical drugs**                |                |             |
| **Hypertension medicine**                                                         |                |             |
| Amlodipine 5 mg                                                                    | BDT (USD)/tablet | 1 (0.012)  |
| Losartan 50mg                                                                      | BDT (USD)/tablet | 8 (0.094)  |
| Hydrochlorothiazide                                                                | BDT (USD)/tablet | 0.35 (0.004) |
| **Diabetes medicine**                                                              |                |             |
| Metformin 500mg                                                                    | BDT (USD)/tablet | 4 (0.047)  |
| Metformin 1000mg                                                                   | BDT (USD)/tablet | 9 (0.106)  |
| Gliclazide                                                                         | BDT (USD)/tablet | 3.5 (0.041) |
| **Cholesterol medicine**                                                           |                |             |
| Simvastatin 10mg                                                                   | BDT (USD)/tablet | 7 (0.082)  |
| Atorvastatin 20 mg                                                                 | BDT (USD)/tablet | 10 (0.118) |
| Atorvastatin 40 mg                                                                 | BDT (USD)/tablet | 28 (0.330) |
| **Purchasing price (in LCU) of diagnostic tests**                                 |                |             |
| Diabetes (complete blood count panel)                                             | BDT (USD)/test | 400 (4.71) |
| Diabetes (fasting blood glucose)                                                   | BDT (USD)/test | 120 (1.41) |
| Diabetes and cholesterol (blood lipid panel)                                       | BDT (USD)/test | 800 (9.42) |
| **Counselling patients to change behaviour**                                       |                |             |
| Time to counsel a patient to change behaviour                                      | Minutes | 10 |
| # of 'How to quit' informational materials disseminated per person, annually (print) | Print | 5 |
| Cost of 'How to quit' informational materials, per unit (print materials)         | BDT (USD)/print | 20 (0.24) |
| LCU to USD exchange rate                                                           | BDT/USD       | 84.9        |
| 'Safety stock' required to be on hand for medicines                                | Percent | 3.0 |
| **No of health providers in need of training**                                     |                |             |
| Counsel patients to change behaviour                                               | Persons        | 30          |
| Assess patients' total CVD risk                                                    | Persons        | 10          |
| **Training to counsel patients to change behaviour (5A's)***                        |                |             |
| Classroom size                                                                     | Persons        | 30          |
| Hours of training needed                                                           | Persons        | 16          |
| **Training to screen/diagnosis/treat patients hypertension/CVD patients**         |                |             |
| Classroom size                                                                     | Persons        | 30          |
Table 1 Continued

| Input description                              | Units     | Value     |
|-----------------------------------------------|-----------|-----------|
| Hours of training needed                      | Persons   | 8         |
| No of trainers                                |           |           |
| Professional trainer(s)                       | Persons   | 2         |
| Administrative staff                          | Persons   | 1         |
| Input costs for training                      |           |           |
| Hourly wage                                   |           |           |
| Professional trainer                          | BDT (USD)/hour | 500 (5.89) |
| Administrative staff                          | BDT (USD)/hour | 250 (2.94) |
| Per unit cost of materials                    |           |           |
| Instructive handbooks                         | BDT (USD)/book | 1000 (11.8) |
| Facility rental for training (1 day)          | BDT (USD)/day | 9000 (106) |
| Refreshments                                  | BDT (USD)/day | 6000 (70.7) |
| Per diem for staff                            | BDT (USD)/day | 3500 (41.2) |
| Per diem and/or salary of trainees            | BDT (USD)/day | 5000 (58.9) |
| Transportation stipend for staff              | BDT (USD)/training | 3165 (37.3) |
| CVD risk screening and diagnosis              |           |           |
| Time (in minutes) a health provider spends to:|           |           |
| Screen patients for total CVD risk            | Minutes   | 5         |
| Provide a physical exam to assess patients' total CVD risk | Minutes | 5 |
| Assess patient risk using a CVD risk chart    | Minutes   | 5         |
| Time (in minutes) a lab technician spends to: |           |           |
| Administer and analyse a blood test           | Minutes   | 10        |
| Administer and analyse a urine test           | Minutes   | 10        |
| Treatment for high CVD risk                   |           |           |
| # follow-up visits for a person annually with the following levels of CVD risk annually | Visits | 2 |
| Low CVD risk (≥0% to <10%)                    |           |           |
| Medium CVD risk (≥10% to <20%)                | Visits    | 3         |
| High CVD risk (≥20%)                          | Visits    | 4         |
| Time health providers spend with a patient during a visit? | Minutes | 5 |
| Generalists/primary care doctors              | Minutes   | 5         |
| Nurses                                        | Minutes   | 5         |
| Screen for CVD risk: Diagnostics cost in LCU (BDT) and USD |           |           |
| Input description                                                                 | Units                        | Value       |
|----------------------------------------------------------------------------------|-----------------------------|-------------|
| Diabetes (complete blood count panel)                                            | BDT (USD)/test              | 400 (4.7)  |
| Diabetes (fasting blood glucose)                                                 | BDT (USD)/test              | 120 (1.4)  |
| Diabetes and cholesterol (blood lipid panel)                                     | BDT (USD)/test              | 80 (0.9)   |

Pharmacological treatment for hypertension

Hypertension Protocol Step #1 (Amlodipine 5 mg, 1 per day, 365 days)

% of all individuals with high blood pressure who receive this treatment regimen

| % of all individuals with high blood pressure who receive this treatment regimen | Percent | 62% |

Hypertension protocol step #2 (Amlodipine 5 mg + Losartan 50 mg)

% of all individuals with high blood pressure who receive this treatment regimen

| % of all individuals with high blood pressure who receive this treatment regimen | Percent | 34% |

Hypertension protocol step #3 (Amlodipine + Losartan + Hydrochlorothiazide)

% of all individuals with high blood pressure who receive this treatment regimen

| % of all individuals with high blood pressure who receive this treatment regimen | Percent | 4%  |
| Unit price of amlodipine 5 mg in LCU (Taka or BDT) and USD | BDT (USD)/tablet | 1 (0.012) |
| Unit price of losartan 50 mg in LCU (Taka or BDT) and USD | BDT (USD)/tablet | 8 (0.094) |
| Unit price of hydrochlorothiazide in LCU (Taka or BDT) and USD | BDT (USD)/tablet | 0.35 (0.004) |

Pharmacological treatment for diabetes

Diabetes protocol step #1 (metformin 500 mg)

% of all individuals with diabetes who receive this treatment regimen

| % of all individuals with diabetes who receive this treatment regimen | Percent | 75% |

Diabetes protocol step #2 (metformin 1000 mg)

% of all individuals with diabetes who receive this treatment regimen

| % of all individuals with diabetes who receive this treatment regimen | Percent | 15% |

Diabetes protocol step #3 (metformin 1000 mg + Gliclazide 8 mg)

% of all individuals with diabetes who receive this treatment regimen

| % of all individuals with diabetes who receive this treatment regimen | Percent | 10% |
| Unit price of metformin 500 mg in LCU (Taka or BDT) and USD | BDT (USD)/tablet | 4 (0.047) |
| Unit price of metformin 1000 mg in LCU (Taka or BDT) and USD | BDT (USD)/tablet | 9 (0.106) |
| Unit price of gliclazide 80 mg in LCU (Taka or BDT) and USD | BDT (USD)/tablet | 3.5 (0.041) |

Pharmacological treatment for high cholesterol (default regimens)

High cholesterol protocol step #1 (low intensity, simvastatin 10 mg)

Percent of all individuals with high cholesterol who receive this treatment

| Percent of all individuals with high cholesterol who receive this treatment | Percent | 85% |

High cholesterol protocol step #2 (moderate intensity, atorvastatin 20 mg)

Percent of all individuals with high cholesterol who receive this treatment

| Percent of all individuals with high cholesterol who receive this treatment | Percent | 10% |

High cholesterol protocol step #3 (high intensity, atorvastatin 40 mg)

Percent of all individuals with high cholesterol who receive this treatment

| Percent of all individuals with high cholesterol who receive this treatment | Percent | 5%  |
prevalence of hypertension, diabetes and high cholesterol. The estimated number of eligible persons in the catchment area of the four subdistricts was 359,000, of which 305,000, 52,000 and 1800 were projected to be low-CVD, medium-CVD and high-CVD risk patients. The estimated number of persons undergoing treatment for hypertension, diabetes and high cholesterol was 75,000, 30,000 and 102,000, respectively (Table 2). Unit costs and other cost inputs were applied to these population parameters to project total programme costs.

**Hypertension management programme cost**

Table 3 reports the estimated annual costs, in 2020 USD and Bangladesh Taka (BDT), of implementing the HEARTS hypertension management programme in four upazilas at the population level (adults aged 18 and above). Figure 2 presents the distribution of costs by HEARTS components and subcomponents. The total annual cost was estimated at US$3.2 million, equivalent to US$2.8 per capita, US$4.3 per adult and US$8.9 per eligible participant. Module ‘A’ (Access to medicines and technology) constitutes the largest cost share (US$1.36 million; 43%), followed by module ‘E’ (Evidence-based treatment protocols; US$1.22 million; 38%). The projected medication expenditure per patient treated with medications for hypertension was US$18.

Most of the projected annual cost (95%) of implementing module ‘H’ (Healthy-lifestyles counselling) was attributable to the cost of provider time and information materials for counselling patients (US$433,000). The estimated cost for module ‘E’ (Evidence-based treatment protocols) was attributable to provider time across three major activities: asking patient history (US$180,000; 15%), patient assessment via physical exam and diagnostic tests (US$180,000; 15%), and conducting return visits (US$856,000; 70%). The projected cost to implement module ‘S’ (Systems for monitoring) was US$147,000, primarily attributed to administration staff labour costs (95%), with the remaining cost allocated to technology (software/hardware).

Table 4 highlights an important programmatic aspect by describing health providers’ time needed to implement the hypertension control programme. Implementing the programme at the full population level in all four subdistricts was estimated to require the full-time equivalent of 51 doctors, 51 nurses and 6 CHWs. The largest time requirement activities included providing initial screening and diagnosis and conducting return visits.

**Risk-based integrated hypertension, diabetes and high cholesterol management programme cost**

Table 5 reports the estimated costs of implementing the risk-based hypertension, diabetes and high cholesterol management programme in four upazilas at the population level (adults aged 18 and above). Figure 2 presents the distribution of costs by HEARTS components. The total annual cost was estimated at US$14.4 million, equivalent to US$12.9 per capita, US$19.3 per adult and
US$40.2 per eligible participant. Module ‘A’ (Access to medicines and technology) constitutes the largest cost share (US$11.7 million; 81%), followed by module ‘E’ (Evidence-based treatment protocols, US$1.9 million; 13%). Within module ‘A’, the projected costs of diagnostic tests, hypertension medications, diabetes medications and cholesterol medications were US$5.7 million (49% of module costs), US$1.4 million (12%), US$0.9 million (7%) and US$3.8 million (32%), respectively. The projected medication expenditure per patient treated with medications for hypertension, diabetes and cholesterol was US$18, US$29 and US$37, respectively.

The adoption of task-sharing approach would save US$865 000, of which US$803 000 comes from using nurses to complete tasks customarily performed by doctors (ie, counselling, screening and assessing CVD risk, and treating according to CVD risk) and US$62 000 comes from using CHWs to provide counselling to change behaviour. Implementing the risk-based hypertension, diabetes and high cholesterol management programme at the full population level in all four subdistricts was estimated to require the full-time equivalent of 58 doctors, 58 nurses, 6 CHWs and 101 lab technicians (table 6). The largest time requirement activities included providing initial screening and diagnosis and conducting return visits.

**DISCUSSION**

The HEARTS pilot project in four Bangladesh subdistricts launched a framework for hypertension management in primary care, with a potential for expanding into a comprehensive CVD prevention approach that incorporates hypertension, diabetes and cholesterol management. This study projects the expected cost of scaling up the programme to all eligible adults in the participating subdistricts. We assessed two programme scenarios: a hypertension management programme and an integrated risk-based hypertension, diabetes and cholesterol management programme. The total annual cost was estimated at US$3.2 and US$14.4 million for the hypertension and risk-based comprehensive approach,
Table 3  Total annual cost of HEARTS hypertension control programme in four subdistricts

|                          | Golapganj  | Fenchuganj  | Beanibazar  | Bishwanath  | Total       |
|--------------------------|------------|-------------|-------------|-------------|-------------|
|                          | BDT        | USD         | BDT         | USD         | BDT         | USD         |
| H: Healthy lifestyles    | 13335339   | 157071      | 4765107     | 56126       | 10800324    | 127212      |
| H1: Training costs       | 418990     | 4935        | 418990      | 4935        | 418990      | 4935        |
| H1.1: Facility rental (% of H1) | 18000     | 212         | 18000       | 212         | 18000       | 212         |
| H1.2: Human resources    | 20000      | 236         | 20000       | 236         | 20000       | 236         |
| H1.3: Instructive handbooks | 35000     | 412         | 35000       | 412         | 35000       | 412         |
| H1.4: Per diem/transportation | 339990   | 4005        | 339990      | 4005        | 339990      | 4005        |
| H1.5: Refreshments       | 6000       | 71          | 6000        | 71          | 6000        | 71          |
| H2: Brief counselling costs | 12816349  | 150958      | 4246117     | 50013       | 10281334    | 121099      |
| H2.1: Tobacco            | 9272756    | 109220      | 3072108     | 36185       | 7438647     | 87617       |
| Provider time to administer 5A's | 3807347  | 44845       | 1261401     | 14857       | 3054293     | 35975       |
| Informational materials (print) | 5465382  | 64374       | 1810707     | 21328       | 4384354     | 51641       |
| H2.2: Alcohol            | 933641     | 10997       | 309320      | 3643        | 749871      | 8822        |
| Provider time to administer 5A's | 383351   | 4515        | 127006      | 1496        | 307526      | 3622        |
| Informational materials (print) | 550290   | 6482        | 182314      | 2147        | 441445      | 5200        |
| H2.3: Physical inactivity | 2609952   | 30741       | 864689      | 10185       | 2093715     | 24661       |
| Provider time to administer 5A's | 1071641  | 12622       | 355040      | 4182        | 859675      | 10126       |
| Informational materials (print) | 1538311  | 18119       | 509650      | 6003        | 1234040     | 14535       |
| H3: Other programme costs | 100000     | 1178        | 100000      | 1178        | 100000      | 1178        |
| Community awareness meetings | 50000     | 589         | 50000       | 589         | 50000       | 589         |
| Provider time to administer 5A's | 35959415  | 423550      | 11913524    | 140324      | 28846806    | 339774      |
| Informational materials (print) | 5317334  | 62631       | 1761658     | 20750       | 4265589     | 50243       |
| Community health workers training | 50000     | 589         | 50000       | 589         | 50000       | 589         |
| Provider time to administer 5A's | 500000    | 589         | 50000       | 589         | 50000       | 589         |
| Informational materials (print) | 5317334  | 62631       | 1761658     | 20750       | 4265589     | 50243       |
| E: Evidence-based treatment protocols | 35959415  | 423550      | 11913524    | 140324      | 28846806    | 339774      |
| E1: Ask about patient history - provider time | 5317334  | 62631       | 1761658     | 20750       | 4265589     | 50243       |
| E2: Assess via physical exam and diagnostic tests - provider time | 5317334  | 62631       | 1761658     | 20750       | 4265589     | 50243       |
| E3: Return visits - Counsel and treat per protocol - provider time | 25324748  | 298289      | 8390209     | 98825       | 20315628    | 239289      |
| A: Access to Essential Medicines and Technologies | 40197017  | 473463      | 13429971    | 158186      | 32279509    | 380206      |
| A1: Hypertension medications | 40028765  | 471481      | 13261719    | 156204      | 32111257    | 378224      |
| Amlodipine 5 mg | 9873894 | 116300       | 3271268     | 38531       | 7920882     | 93297       |
| Losartan 50 mg | 30016637  | 353553      | 9944653     | 117134      | 24079482    | 283622      |
| Hydrochlorothiazide 12.5 mg | 138235   | 1628        | 45798       | 539         | 110892      | 1306        |
| A2: Diagnostic technologies, machines and supplies | 168253    | 1982        | 168253      | 1982        | 168253      | 1982        |
| Risk-based management | 172334    | 2030        | 172334      | 2030        | 172334      | 2030        |

Continued
| Table 3 Continued | Golapganj | Fenchuganj | Beanibazar | Bishwanath | Total |
|-------------------|-----------|------------|------------|------------|-------|
|                   | BDT       | USD        | BDT        | USD        | BDT   | USD |
| R1: Training costs| 172334    | 2030       | 172334     | 2030       | 172334 | 2030 |
| T: Team-based care Savings from training nurses and CHWs to do tasks customarily performed by doctors | 13815043  | 162721     | 4576989    | 53910      | 11082490 | 130536 | 10162944 | 119705 | 39637467 | 466872 |
| T1: Savings from training nurses | 11976134  | 141062     | 3967750    | 46734      | 9607309 | 113160 | 8810163 | 103771 | 34361355 | 404727 |
| Savings from counselling to change behaviour | 1355873   | 15970      | 449207     | 5291       | 1087688 | 12811 | 997439  | 11748  | 3890208 | 45821 |
| Savings from screening for--and assess--CVD risk | 3367235   | 39661      | 1115581    | 13140      | 2701212 | 31816 | 2477084 | 29176  | 9661112 | 113794 |
| Savings from treating CVD risk | 7253025   | 85430      | 2402961    | 28303      | 5818410 | 68533 | 5335639 | 62846  | 20810036 | 245112 |
| T2: Savings from training CHWs | 1838909   | 21660      | 609239     | 7176       | 1475181 | 17376 | 1352781 | 15934  | 5276112 | 62145 |
| Savings from counselling to change behaviour | 1838909   | 21660      | 609239     | 7176       | 1475181 | 17376 | 1352781 | 15934  | 5276112 | 62145 |
| S: Systems for monitoring | 3114636   | 36686      | 3114636    | 36686      | 3114636 | 36686 | 3114636 | 36686  | 12458546 | 146744 |
| S1: Human resources | 2969636   | 34978      | 2969636    | 34978      | 2969636 | 34978 | 2969636 | 34978  | 11878546 | 139912 |
| S2: Technology | 110000    | 1296       | 110000     | 1296       | 110000  | 1296  | 110000  | 1296   | 440000  | 5183  |
| S3: Supplies | 10000     | 118        | 10000      | 118        | 10000   | 118   | 10000   | 118    | 40000   | 471   |
| S4: Training | 25000     | 294        | 25000      | 294        | 25000   | 294   | 25000   | 294    | 100000  | 1178  |
| Total Programme Cost (H+E+A+R+T+S) | 92778742  | 1092800    | 33395573   | 393352     | 75213609 | 885908 | 69302672 | 816286 | 270690596 | 3188346 |

BDT, Bangladesh Taka; CHWs, community health worker; CVD, cardiovascular disease.
respectively. The overall per capita cost was approximately US$2.8 per capita for the hypertension control programme and US$12.9 per capita for the risk-based comprehensive approach. These estimates correspond to 0.14% and 0.7% of the 2020 gross domestic product per capita in Bangladesh, respectively. The main cost drivers for the hypertension control programme were medication expenditures (43%) and the cost of provider time for providing care during multiple visits (38%). In the risk-based integrated approach, the combined costs of hypertension, diabetes and cholesterol medications and diagnostic tests make up the largest share of the overall programme cost (81%). Although the main driver of projected programme costs for the integrated approach was expenditure on essential medicines and diagnostic tests, hypertension and diabetes medications contributed a relatively small portion (19%) to this expenditure (ie, module A), whereas cholesterol medications contributed nearly 32%. Hypertension treatment remains among the leading cost-effective ways to combat heart disease. In this study, the annual medication expenditure per patient treated with medications for hypertension, diabetes and cholesterol was US$18, US$29 and US$37, respectively. Though based on observations gathered in one district of Bangladesh, our results are consistent with those reported by past studies. A previous study on Bangladesh by Nugent et al. estimated that hypertension treatment would cost about US$13 (BDT1070) per patient per year. WHO (2011) has estimated the average hypertension screening cost for LMICs at approximately US$4 for LMICs, not including treatment but including the cost of performing CVD risk assessment and BP measurement in primary care settings. Haque estimated the average cost of diabetes screening in Bangladesh at approximately US$5 (BDT411), including glucose screening in primary care, documentation, setting up referrals and organising screening events but excluding treatment. In this study, the cost elements in the Bangladesh HEARTS programme are wide-ranging including screening, diagnosis and treatment for multiple CVD risk conditions (hypertension, diabetes, hyperlipidaemia) and counselling for CVD risk factors (tobacco use, alcohol use and physical inactivity).

The analysis revealed that scaling up the hypertension management programme within the four subdistricts would require an additional full-time equivalent of 51 doctors, 51 nurses and 6 CHWs. Population-level scale-up of the risk-based hypertension, diabetes and high cholesterol management programme in the four subdistricts was estimated to require the full-time equivalent of 58 doctors, 58 nurses, 6 CHWs and 101 lab technicians. To put this in context, a typical 50-bed subdistrict public health complex in Bangladesh employs 20 doctors, 16 nurses and 1 medical assistant. Oftentimes, not all health provider posts are filled. This gap in provider capacity poses a significant barrier to programme expansion. Team-based care using task-sharing among doctors, nurses and CHWs and volunteers can accomplish the activities required by the HEARTS package more affordably, including NCD-related health promotion, prevention, screening and patient navigation through the health system. A systematic review of intervention trials in LMICs by Joshi et al. found that team-based care, including task sharing was effective in improving process outcomes (eg, hypertension and diabetes screening) and health outcomes (eg, hypertension and diabetes control) and achieving treatment concordance with doctors.

Figure 2 Distribution of annual cost by HEARTS components.

| Component                                      | Cost Share |
|------------------------------------------------|------------|
| Healthy Lifestyles Counselling                  | 3.2%       |
| Evidence-based Treatment Protocols              | 13.2%      |
| Access to Essential Medicines and Technologies | 42.7%      |
| Risk-based Management                           | 1.3%       |
| Systems for monitoring                          | 4.6%       |
and lifestyle counselling intervention undertaken by female community health volunteers in Nepal, and assessed the intervention to be highly cost-effective. However, there are several barriers to team-based care with task sharing, including staff attrition and turnover, retention of training, patient perception and acceptance toward non-physician health workers, lack of delegation of work by physicians, legislation and policy etc.

In Bangladesh, of the four entities (ie, the government, for-profit private sector, non-profit nongovernmental organisation and donor agencies) involved in the primary healthcare provision, the government plays the leading role, mainly in rural areas. There are six tiers of public healthcare infrastructure: national, divisional, district, upazila (subdistrict), union and ward levels. To tackle NCDs, the government of Bangladesh introduced ‘NCD Corners’ initiative in 2012 dedicated to providing prevention and care services for common NCDs and related conditions. The government has plans to expand ‘NCD corners’ at the upazila level, and the upazila primary care setting is well positioned to bridge the link the health-care providers down to the union, ward (and community) levels by harnessing community support and delegating suitable activities under task-sharing principles. This will enhance healthcare access among disadvantaged populations and mitigate health disparities. Further, in Bangladesh, according to the 2016 Household Income Expenditure Survey and 2014 Health and Morbidity Status Survey, one in three patients received treatment from a pharmacy or medical shop, while about one in five received treatment from public health providers. This emphasises the need for partnerships with various types of public–private health providers.

The models of care introduced in the Bangladesh national hypertension guidelines and NCD operational plan are encouraging; however, there are capacity challenges to the scaling-up of NCD care in Bangladesh. The fiscal year 2021 budget allocation to the health sector stands just above 5%, which is less than 1% of GDP. Further, less than 5% of public sector funding for health covers NCDs, despite NCDs being responsible for almost two-thirds (63% in 2016) of disability-adjusted life-years in Bangladesh. The per capita NCD allocation is only US$0.08. There is a need for better coordination of non-state stakeholders in NCD control with the public sector with a stronger focus of the public sector on NCD prevention and health promotion. The health sector in Bangladesh is financed 93% from domestic sources (74% out-of-pocket, 17% government health expenditure and 3% other private sources) and 7% from external health expenditures. Domestic general government health expenditure per capita is only US$7 (0.4% of GDP per capita). Due to insufficient public sector funding, out-of-pocket expenditure for NCD care is large in Bangladesh, contributing to the impoverishment of patients and their families. Moreover, a recent policy review by Biswas et al highlights the lack of proper planning, implementation and monitoring of NCD health initiatives. However, the

### Table 4

#### Hypertension control programme: estimated health provider time for counseling, screening, diagnosis and treatment

| Activity               | Golapganj | Fenchugonj | Beanibazar | Total |
|------------------------|-----------|------------|------------|-------|
|                       | Workdays  | Workdays  | Workdays  | Workdays |
| Counselling to change behaviour |           |            |            |        |
| Doctor                 | 524 days, 7 hours 2.0 | 173 days, 6 hours 0.7 | 420 days, 2 hours 3.0 | 385 days, 2 hours 1.5 |
| Nurses                 | 524 days, 7 hours 2.0 | 173 days, 6 hours 0.7 | 420 days, 2 hours 3.0 | 385 days, 2 hours 1.5 |
| CHW                    | 524 days, 7 hours 2.0 | 173 days, 6 hours 0.7 | 420 days, 2 hours 3.0 | 385 days, 2 hours 1.5 |
| Screening and diagnosis|           |            |            |        |
| Doctor                 | 1302 days, 1 hours 5.0 | 431 days, 6 hours 1.7 | 1045 days, 2 hours 4.0 | 958 days, 3 hours 3.7 |
| Nurses                 | 1302 days, 1 hours 5.0 | 431 days, 6 hours 1.7 | 1045 days, 2 hours 4.0 | 958 days, 3 hours 3.7 |
| Return visits - counsel and treat per protocol | 2806 days, 0 hours 10.8 | 929 days, 6 hours 3.6 | 2251 days, 1 hours 8.7 | 2064 days, 2 hours 7.9 |
| Annual total minutes/124 800. |           |            |            |        |

*CHW, community health worker; FTE, full-time equivalent.*
## Table 5  Annual cost of implementing risk-based hypertension, diabetes and high cholesterol management programme in four subdistricts

|                     | Golapganj | Fenchuganj | Beanibazar | Bishwanath | Total       |
|---------------------|-----------|------------|------------|------------|-------------|
|                     | BDT       | USD        | BDT        | USD        | BDT         | USD       |
| **H: Healthy lifestyles counselling** |            |            |            |            |             |
| H1: Training costs  | 418 990   | 4935       | 418 990    | 4935       | 418 990     | 4935      | 1 675 960 | 19 740 |
| H1.1: Facility rental (% of H1) | 35 000    | 412        | 35 000     | 412        | 35 000      | 412       | 140 000   | 16 49 |
| H1.2: Human resources | 20 000    | 236        | 20 000     | 236        | 20 000      | 236       | 80 000    | 942   |
| H1.3: Instructive handbooks | 35 000    | 412        | 35 000     | 412        | 35 000      | 412       | 140 000   | 16 49 |
| H1.4: Per diem/transportation | 6000      | 71         | 6000       | 71         | 6000        | 71        | 24 000    | 283   |
| H1.5: Refreshments   | 6000      | 71         | 6000       | 71         | 6000        | 71        | 24 000    | 283   |
| **H2: Brief counselling costs** |            |            |            |            |             |
| H2.1: Tobacco        | 9 272 756 | 109 220    | 3 072 108  | 36 185     | 7 438 647   | 8 741     | 31 734    | 364   |
| Provider time to administer 5A's | 3 807 374 | 44 845     | 1 261 401 | 14 857     | 3 054 293   | 3 629     | 11 468    | 1 253 |
| Informational materials (print) | 5 465 382 | 64 374     | 1 810 707 | 21 328     | 4 384 354   | 5 164     | 17 571    | 1 939 |
| H2.2: Alcohol        | 38 335    | 4514       | 127 006    | 1496       | 307 526     | 36 222    | 282 010   | 322   |
| Provider time to administer 5A's | 38 335    | 4514       | 127 006    | 1496       | 307 526     | 36 222    | 282 010   | 322   |
| Informational materials (print) | 5 502 909 | 64 821     | 182 314    | 2147       | 444 445     | 5 200     | 404 817   | 478   |
| H2.3: Physical inactivity | 2 609 995 | 30 741     | 86 489    | 10 185     | 2 093 715   | 24 661    | 1 919 994 | 22 615 |
| Provider time to administer 5A's | 1 071 641 | 12 622     | 355 040    | 418         | 8 596 75    | 10 126    | 788 345   | 926   |
| Informational materials (print) | 1 538 311 | 18 119     | 509 650    | 6003       | 12 340 04   | 14 535    | 1 131 648 | 13 299 |
| **H3: Other programme costs** |            |            |            |            |             |
| Community awareness meetings | 50 000    | 589        | 50 000     | 589        | 50 000      | 589       | 200 000   | 256   |
| Community health workers training | 50 000    | 589        | 50 000     | 589        | 50 000      | 589       | 200 000   | 256   |
| **E: Evidence-based treatment protocols** |            |            |            |            |             |
| Provider time to administer 5A's | 53 173 34 | 62 631     | 1 761 658 | 20 750     | 4 265 589   | 5 024     | 391 166   | 467   |
| Informational materials (print) | 25 513 18 | 300 509    | 8 452 638  | 9 9560     | 20 466 790  | 241 069   | 18 768 620 | 221 067 |
| **A: Access to Essential Medicines and tech.** |            |            |            |            |             |
| Provider time to administer 5A's | 25 324 74 | 298 289    | 8 390 209  | 9 8825     | 20 316 628  | 239 289   | 18 629 982 | 219 434 |
| Informational materials (print) | 25 324 74 | 298 289    | 8 390 209  | 9 8825     | 20 316 628  | 239 289   | 18 629 982 | 219 434 |
| **Complete blood count (panel)** | 34 710 29 | 408 837    | 115 109 353 | 135 823   | 278 480 830 | 328 104   | 255 388 440 | 308 109 |
| Blood lipid panel | 10 030 43 | 121 382    | 34 142 288 | 402 148   | 8 267 056 6 | 9 737 42 | 75 811 234 | 929 474 |
| Fasting blood glucose | 15 458 15 | 182 075    | 5 121 358  | 60 322    | 12 400 598  | 146 061   | 113 716 85 | 133 942 |
| A2: Hypertension medications | 40 028 76 | 471 481    | 1 326 179  | 156 204   | 3 121 125 7 | 372 224   | 29 446 893 | 346 842 |
| Amlodipine 5mg | 9 873 894  | 116 300    | 3 271 268  | 38 531   | 7 920 882  | 93 297   | 7 263 664  | 85 556 |

Continued
Table 5 Continued

|                         | Golapganj | Fenchuganj | Beanibazar | Bishwanath | Total |
|-------------------------|-----------|------------|------------|------------|-------|
|                         | BDT       | USD        | BDT        | USD        | BDT   | USD   |
| Losartan 50 mg          | 3001663   | 353553     | 9944653    | 117134     | 24079482 | 283622 |
| Hydrochlorothiazide 12.5 mg | 138235  | 1628       | 45798      | 539        | 110892  | 1306   |
| A3: Diabetes medications | 25366503 | 298781     | 8404042    | 98988      | 20394124 | 239683 |
| Metformin 500mg         | 11707617  | 137899     | 3878789    | 45687      | 9391903 | 110623 |
| Metformin 1000mg        | 12929988  | 144794    | 407427     | 52108      | 9861498 | 116154 |
| Gliclazide              | 1365898   | 16088     | 452525     | 5330       | 1095722 | 12906  |
| A4: Cholesterol medications | 111499768 | 1313307   | 36940399   | 435105     | 89445620 | 1053541 |
| Simvastatin 10 mg       | 79451930  | 935830     | 26322800   | 310045     | 63736699 | 750727 |
| Atorvastatin 20 mg      | 13353266  | 157282     | 4424000    | 52108      | 10712050 | 126173 |
| Atorvastatin 40 mg      | 18694572  | 220195     | 6193600    | 72952      | 14996870 | 176642 |
| A5: Diagnostic tech. machines and supplies | 168253 | 1982     | 168253     | 1982       | 168253  | 1982   |
| R: Risk-based management | 5489668  | 64660     | 1933992    | 22780      | 4437923 | 52272  |
| R1: Training costs      | 172334    | 2030      | 172334     | 2030       | 172334  | 2030   |
| R2: Estimate risk using risk charts | 5317334 | 62631     | 1761658    | 20750      | 4265589 | 50243  |
| T: Team-based care: Savings from training nurses and CHWs to do tasks customarily performed by doctors | 25600367 | 301536    | 8481523    | 99900      | 20536731 | 241893 |
| T1: Savings from training nurses | 23761458 | 279876    | 7872283    | 92724      | 19061549 | 224518 |
| Savings from screening for—and assess—CVD risk | 15152559 | 178475    | 5020114    | 59130      | 12155452 | 143174 |
| Savings from assessing CVD risk | 7253025 | 85430     | 2402961    | 28303      | 5818410 | 68533  |
| T2: Savings from training CHWs | 1838909 | 21660     | 609239     | 7176       | 1475181 | 17376  |
| Savings from counselling to change behaviour | 1838909 | 21660     | 609239     | 7176       | 1475181 | 17376  |
| S: Systems for monitoring | 3114636 | 36686     | 3114636    | 36686      | 3114636 | 36686  |
| S1: Human resources     | 2969636   | 34978     | 2969636    | 34978      | 2969636 | 34978  |
| S2: Technology          | 110000    | 1296      | 110000     | 1296       | 110000  | 1296   |
| S3: Supplies            | 10000     | 118       | 10000      | 118        | 10000   | 118    |
| S4: Training            | 25000     | 294       | 25000      | 294        | 25000   | 294    |
| Total programme cost (H+E+A+R+T+S) | 425197850 | 5008220 | 143527592 | 1690549 | 341881725 | 4026875 | 313844568 | 3696638 | 1,224,451,735 | 14422,282 |

5 A's, Assess, Advise, Agree, Assist, Arrange; BDT, Bangladesh Taka; CHW, community health worker; CVD, cardiovascular disease.
## Table 6  Integrated risk-based approach: estimated health provider time for counselling, screening, diagnosis and treatment

| Activity                          | Golapganj                  | Fenchugonj                 | Beanibazar                  | Bishwanath                 | Total                      |
|-----------------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
|                                   | Workdays                   | FTE                        | Workdays                   | FTE                        | Workdays                   | FTE                        |
| Counselling to change behaviour   |                            |                            |                            |                            |                            |                            |
| Doctor                            | 524 days, 7 hours          | 2.0                        | 173 days, 6 hours          | 0.7                        | 420 days, 2 hours          | 1.6                        | 385 days, 2 hours          | 1.5                        | 5.8                        |
| Nurses                            | 524 days, 7 hours          | 2.0                        | 173 days, 6 hours          | 0.7                        | 420 days, 2 hours          | 1.6                        | 385 days, 2 hours          | 1.5                        | 5.8                        |
| CHW                               | 524 days, 7 hours          | 2.0                        | 173 days, 6 hours          | 0.7                        | 420 days, 2 hours          | 1.6                        | 385 days, 2 hours          | 1.5                        | 5.8                        |
| Screening and diagnosis           |                            |                            |                            |                            |                            |                            |                            |                            |
| Doctor                            | 1302 days, 1 hours         | 5.0                        | 431 days, 6 hours          | 1.7                        | 1045 days, 2 hours         | 4.0                        | 958 days, 3 hours          | 3.7                        | 14.4                       |
| Nurses                            | 1302 days, 1 hours         | 5.0                        | 431 days, 6 hours          | 1.7                        | 1045 days, 2 hours         | 4.0                        | 958 days, 3 hours          | 3.7                        | 14.4                       |
| Screening and diagnosis by Lab technicians | 9119 days, 3 hours       | 35.1                       | 3021 days, 6 hours         | 11.6                       | 7315 days, 0 hours         | 28.1                       | 6708 days, 1 hours         | 25.8                       | 100.6                      |
| Estimating CVD risk using risk charts |                            |                            |                            |                            |                            |                            |                            |                            |
| Doctor                            | 2658 667                   | 2.5                        | 880 829                    | 0.8                        | 2132 795                   | 2.0                        | 1955 830                   | 1.8                        | 7.2                        |
| Nurses                            | 2658 667                   | 2.5                        | 880 829                    | 0.8                        | 2132 795                   | 2.0                        | 1955 830                   | 1.8                        | 7.2                        |
| Return visits—counsel and treat per protocol |                            |                            |                            |                            |                            |                            |                            |                            |
| Doctor                            | 2806 days, 0 hours         | 10.8                       | 929 days, 6 hours          | 3.6                        | 2251 days, 1 hours         | 8.7                        | 2064 days, 2 hours         | 7.9                        | 31.0                       |
| Nurses                            | 2806 days, 0 hours         | 10.8                       | 929 days, 6 hours          | 3.6                        | 2251 days, 1 hours         | 8.7                        | 2064 days, 2 hours         | 7.9                        | 31.0                       |

CHW, community health worker; CVD, cardiovascular disease; FTE, full-time equivalent.
Bangladesh Copenhagen Project assessed the benefits of managing hypertension through targeted investment and reported a high level of return on investment (BDT 17 benefit for every BDT spent).31

This report has several limitations. Due to lack of data at a local level, the cost projections rely on assumptions regarding population coverage, risk factor prevalence, primary care attendance rate, distribution of CVD risk among the population, distribution of patients by treatment protocols, and frequency of patient visits by CVD risk, which were assumed to be uniform for the four subdistricts and across age or sex groups. Similarly, unit costs of supplies, wages and provider time allocations were assumed to be the same across subdistricts. Since the examined subdistricts are adjacent to each other, these unit costs may not be considerably different. While we used average medicine prices, they may vary in different subdistricts depending on the procurement arrangement and sources. However, in Bangladesh, the price variations are minimal or low in the public health facilities, given the medicines are procured mainly from EDCL and/or CMSD.19 20 The strength of the study lies in its ability to disaggregate costs by function, identifying areas for efficiency improvements, such as task-sharing and bridging programme delivery from the upazila level to more localised community facilities.

In 2018, the Government of Bangladesh introduced a multisectoral action plan for NCD prevention and control, which emphasises NCD risk factors including tobacco use, unhealthy diet, physical inactivity and harmful use of alcohol.12 This study can inform approaches to scaling up this action plan nationally, with the goal of increasing population outreach for CVD prevention at the primary care level. Using the costs reported in this study for future cost-effectiveness analyses can further support evidence-based decision making for CVD prevention programmes in Bangladesh.

CONCLUSION

Expanding the HEARTS hypertension management and CVD prevention programme to provide services to the entire eligible population in the catchment area may face constraints in physician capacity. A task-sharing model involving shifting of select tasks from doctors to nurses and local CHWs would be essential for the eventual scale-up of primary care services to prevent CVD in Bangladesh.

Author affiliations

1 Division of Global Health Protection, Centers for Global Health, Centers for Disease Control and Prevention, Atlanta, Georgia, USA
2 Directorate General of Health Services, Ministry of Health and Family Welfare, Dhaka, Bangladesh
3 Department of Epidemiology and Research, National Heart Foundation Hospital & Research Institute, Dhaka, Bangladesh
4 Resolve to Save Lives, an initiative of Vital Strategies, New York, New York, USA

Contributors MJH and MSH conceptualised the study, led the formal analysis, implemented the methodology and the excel-based costing tool, and wrote the draft manuscript. DK, SRC, MRB and AEM contributed to the study concept, analytical aspects, manuscript write-up and critical review. RT and SJ contributed to data collection and critical review of the manuscript. MJH, MSH, SRC, RT, SJ and MRB contributed to data collection. MJH and MSH are responsible for the overall content as guarantor. All authors provided critical feedback and helped shape the research, analysis and manuscript.

Funding This analysis was conducted on behalf of Resolve to Save Lives, an initiative of Vital Strategies. Resolve to Save Lives is funded by grants from Bloomberg Philanthropies; the Bill & Melinda Gates Foundation; and Gates Philanthropy Partners, which is funded with support from the Chan Zuckerberg Foundation.

Disclaimer The findings and conclusions of this report are those of authors only and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Competing interests None declared.

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

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as online supplemental information.

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ORCID iDs
Muhammad Jami Husain http://orcid.org/0000-0001-6049-0505
Mohammad Sabbir Haider http://orcid.org/0000-0003-0013-0051
Shamim Jubayer http://orcid.org/0000-0002-8595-1993
Mahfuzur Rahman Bhuiyan http://orcid.org/0000-0001-6962-7264
Deliana Kostova http://orcid.org/0000-0003-2414-0166

Contributors MJH and MSH conceptualised the study, led the formal analysis, implemented the methodology and the excel-based costing tool, and wrote the draft manuscript. DK, SRC, MRB and AEM contributed to the study concept, analytical aspects, manuscript write-up and critical review. RT and SJ contributed to data collection and critical review of the manuscript. MJH, MSH, SRC, RT, SJ and MRB contributed to data collection. MJH and MSH are responsible for the overall content as guarantor. All authors provided critical feedback and helped shape the research, analysis and manuscript.

Funding This analysis was conducted on behalf of Resolve to Save Lives, an initiative of Vital Strategies. Resolve to Save Lives is funded by grants from Bloomberg Philanthropies; the Bill & Melinda Gates Foundation; and Gates Philanthropy Partners, which is funded with support from the Chan Zuckerberg Foundation.

Disclaimer The findings and conclusions of this report are those of authors only and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Competing interests None declared.

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

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

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ORCID iDs
Muhammad Jami Husain http://orcid.org/0000-0001-6049-0505
Mohammad Sabbir Haider http://orcid.org/0000-0003-0013-0051
Shamim Jubayer http://orcid.org/0000-0002-8595-1993
Mahfuzur Rahman Bhuiyan http://orcid.org/0000-0001-6962-7264
Deliana Kostova http://orcid.org/0000-0003-2414-0166

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