Supporting information file:

Francisco Pozo-Martin, James Akazili et al. Cost-effectiveness of a Community-based Hypertension Improvement Project (ComHIP) in Ghana: results from a modelling study

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1. METHODS.

1.1. Cost-effectiveness analysis design

1.1.1. Characterisation of health intervention scenarios.

ComHIP was implemented at the end of 2014 in the Lower Manya Krobo district (from now on, the intervention district), with a population of 89,426 of which 84% live in urban areas. There are two public hospitals and a mission hospital, four public health centres (main contact points and main points of patient referrals), five health centres, seven functional community-based health planning and services (CHPS) compounds, and around 75 LCS in the district. Tables S1 and S2 describe the main CoMHIP programme activities and sub-activities.

Table S1. ComHIP activities/sub-activities, costs and sources of cost data (start-up).

| Activities and sub-activities | Resource data | Sources of resource data | Sources of unit costs/prices |
|------------------------------|---------------|--------------------------|-----------------------------|
| START-UP PERIOD              |               |                          |                             |
| 1. ComHIP app development    | Time of FHI360 staff to develop the ComHIP app | activity logs / staff interviews | FHI360 salary scales |
| 2. Training in the use of the ComHIP app and hypertension management | For 2.1-2.7: 1. Time of FHI360 staff, time of MoH staff, time of patient, time of other agents 2. Per Diems 3. Fuel 4. Accommodation 5. Venue rental | FHI360 activity logs/staff interviews/financial records | 1. FHI360/MoH/consultant salary scales, minimum legal salary in Ghana 2-5. FHI360 financial records |
| 3. Management                | For 3.1.-3.2: Same as Training costs above | For 3.1.-3.2: Same as Training costs above | For 3.1.-3.2: Same as Training costs above |
| 3.1. Coordination meetings to launch ComHIP | For 3.3: 1. Time of FHI360/technical staff time net of training and coordination activities 2. Vehicle depreciation and maintenance allocated to ComHIP 3. Office equipment depreciation allocated to ComHIP 4. Office rental and overheads allocated to ComHIP | For 3.3: 1. Activity logs/staff interviews | For 3.4: FHI360 financial records |
| 3.2. Field activities to launch ComHIP |  | For 3.4: FHI360 financial records | |
| 3.3. Technical staff support |  | For 3.4: FHI360 financial records | |
| 3.4. General administration |  | For 3.4: FHI360 financial records | |
| 3.4.1. Administration staff support |  | For 3.4: FHI360 financial records | |
| 3.4.2. Office equipment and supplies |  | For 3.4: FHI360 financial records | |
| 3.4.3. Vehicles (including maintenance) |  | For 3.4: FHI360 financial records | |
| 3.4.4. Office space and overheads |  | For 3.4: FHI360 financial records | |
Table S2. ComHIP activities/sub-activities, costs and sources of cost data (post-implementation).

| Activities and sub-activities | Resource data | Sources of resource data | Sources of unit costs/prices |
|------------------------------|---------------|--------------------------|----------------------------|
| **POST-IMPLEMENTATION PERIOD** |               |                          |                            |
| 1. ComHIP app support        |               | activity logs / staff interviews | FHI360 salary scales        |
| 1.1. Time of FHI360 staff to develop the ComHIP app |               |                          | FHI360 financial records    |
| 1.2. Internet connectivity   |               |                          |                            |
| 2. Acquisition of clinical and ICT equipment |               |                          | FHI360 financial records    |
| 2.1. Mobile devices and implements |               | Clinical and ICT equipment depreciation | FHI360 financial records |
| 2.2. Blood pressure machines |               |                          |                            |
| 2.3. Weighting scales and stadiometers |               |                          |                            |
| 2.4. Glucometers             |               |                          |                            |
| 2.5. Lancets and strips      |               |                          |                            |
| 2.6. Rechargeable batteries  |               |                          |                            |
| 3. Health service provision  |               |                          |                            |
| 3.1. Clinical staff time costs/ patient non-health care costs |               |                          |                            |
| 3.2. Diagnostic tests        |               |                          |                            |
| 3.3. Medications             |               |                          |                            |
| 3.1. Time of clinical staff/ patient time (at diagnosis and over 12 months), patient OOP expenditures, time lost to work by patients over 12 months on programme |               |                          | 3.1. Minimum legal salary for Ghana and MoH staff salaries/ ComHIP patient monthly income from survey |
| 3.2. Type and number of diagnostic tests per patient by hypertension grade at diagnosis and over 12 months |               |                          | 3.2. NHIS diagnostic tests price list |
| 3.3. Type and number of medications consumed during 12 months on programme |               |                          | 3.3. NHIS medication price list |
| 4. Management                | Same as point 3 on previous page | Same as point 3 on previous page | Same as point 3 on previous page |
| 4.1. Coordination meetings   |               |                          |                            |
| 4.2. Field activities        |               |                          |                            |
| 4.3. Technical staff support |               |                          |                            |
| 4.4. General administration  |               |                          |                            |
| 4.4.1. Administration staff support |               |                          |                            |
| 4.4.2. Office equipment and supplies |               |                          |                            |
| 4.4.3. Vehicles (including maintenance) |               |                          |                            |
| 4.4.4. Office space and overheads |               |                          |                            |
Table S3 describes the main resource consumption characterising the programme costs of the current ComHIP implementation (as is), for the two modelled ComHIP scenarios and for standard hypertension care.

**Table S3. Resource consumption, current and by scale-up scenario.**

| ComHIP implementation as is | Current ComHIP scale-up scenario | GHS-LCS ComHIP scale-up scenario | Standard hypertension care |
|----------------------------|----------------------------------|----------------------------------|---------------------------|
| Patients on treatment* = 965 | Patients on treatment* = 3,368  | Patients on treatment* = 3,368  | Patients on treatment* = 3,368  |
| General population covered** = 2,865 | General population Covered** = 10,000 | General population Covered** = 10,000 | General population Covered** = 10,000 |
| Health care staff trained: 9 clinicians | Health care staff trained: 23 clinicians | Health care staff trained: 23 clinicians | N/A |
| 31 CVD nurses | 54 CVD nurses | 54 CVD nurses | 54 CVD nurses |
| 45 community health officers (CHOs) | 65 community health officers (CHOs) | 65 community health officers (CHOs) | 65 community health officers (CHOs) |
| 7 hospital pharmacists | 13 hospital pharmacists | 13 hospital pharmacists | 13 hospital pharmacists |
| 4 community pharmacists | 8 community pharmacists | 8 community pharmacists | 8 community pharmacists |
| 46 licensed chemical sellers (LCS) | 75 licensed chemical sellers (LCS) | 75 licensed chemical sellers (LCS) | 75 licensed chemical sellers (LCS) |
| 61 community volunteers | 31 community volunteers | 31 community volunteers | 31 community volunteers |
| ICT and medical equipment and supplies: 78 Tablets | ICT and medical equipment and supplies: 170 Tablets | ICT and medical equipment and supplies: 170 Tablets | Medical equipment and supplies: 157 blood pressure gauges |
| 70 blood pressure gauges | 157 blood pressure gauges | 157 blood pressure gauges | 157 blood pressure gauges |
| 70 rechargeable batteries | 157 rechargeable batteries | 157 rechargeable batteries | 157 rechargeable batteries |
| 29 weighing scales/stadiometers | 45 weighing scales/stadiometers | 45 weighing scales/stadiometers | 45 weighing scales/stadiometers |
| 20 glucometers | 22 glucometers | 22 glucometers | 22 glucometers |
| 2300 lancets and strips | 6900 lancets and strips | 6900 lancets and strips | 6900 lancets and strips |
| Staff: 3 full-time equivalents (FTE) technical support staff | Staff: 4 FTE technical support staff | Staff: 4 FTE technical support staff | Staff: 4 FTE technical support staff |
| 0.83 FTE administrative staff | 0.83 FTE administrative staff | 0.83 FTE administrative staff | 0.83 FTE administrative staff |
| Office equipment/furniture for technical support staff: 4 laptops | Office equipment/furniture for technical support staff: 5 laptops | Office equipment/furniture for technical support staff: 5 laptops | Office equipment/furniture for technical support staff: 5 laptops |
| 1 digital camera | 1 digital camera | 1 digital camera | 1 digital camera |
| 9 office chairs | 10 office chairs | 10 office chairs | 10 office chairs |
| 3 desks | 4 desks | 4 desks | 4 desks |
| 3 cabinets | 3 cabinets | 3 cabinets | 3 cabinets |
| 3 phones | 4 phones | 4 phones | 4 phones |
| ComHIP app: 485 hours app development | ComHIP app: 485 hours app development | ComHIP app: 485 hours app development | N/A |
| 116 hours of app deployment support | 232 hours of app deployment support | 232 hours of app deployment support | 232 hours of app deployment support |
| Average of 2700 GhC/month in connectivity fees | Average of 2700 GhC/month in connectivity fees | Average of 2700 GhC/month in connectivity fees | Average of 2700 GhC/month in connectivity fees |
| Vehicles: 3 cars | Vehicles: 3 X 1.15 cars (+increase in 15% in car use) | Vehicles: 3 X 1.15 cars | Vehicles: 3 X 1.15 cars |

*Patients on hypertension treatment are patients who received a prescription at any time while on the programme.

**General population reached is calculated considering that the prevalence of hypertension in the intervention district is estimated to be 33.7% from a recently conducted survey.
1.1.2. The Markov model.

Figure S1 presents an outline of the Markov model, where we have included details of the health states and of the transitions between the states only for the ComHIP branch. Costs and health outcomes (DALYs) were modelled over a period of 10 years.

Figure S1. Outline of the Markov model.

In our model, individuals with hypertension experience each year a risk of stroke, a risk of coronary heart disease (CHD), or a risk of death from causes other than CVD. Individuals who suffer a stroke or a CHD can be treated or not treated. They can then survive or die (we made the simplifying assumption that death from CHD or stroke occurred immediately after the event). Those who survive experience in the following year a risk of repeat stroke or repeat CHD. Individuals without hypertension experience each year a risk of death from any cause. They can survive or die. Those who survive continue in the no hypertension state in the following year. For simplicity, we assume individuals in the “no hypertension” state do not develop hypertension.

1.1.3. Estimation of societal costs

Health care provider costs -Current ComHIP scenario and GHS-LCS ComHIP scenario

We estimated annual costs as follows:

For the individuals in the population not diagnosed with hypertension (66.32%, see section 1.2.1 below), we estimated the annual costs of screening per individual in the ComHIP database (= 6.46 US$).

For the patients identified with hypertension:
First, we selected all patients who had been on treatment for at least 12 months. Patient selection was based on those individuals having started treatment who had received hypertension medication prescriptions at least 12 months after joining the study. For each patient on treatment for at least 12 months (n=219), we extracted from the ComHIP app database the number of health care visits by type (screening visit, hypertension confirmation visit, follow-up visit). Using time sheets in a sample of LCS and GHS health care visits (43 LCS screening visits, 5 CVD nurse hypertension confirmation visits, 58 CVD nurse follow-up visits, 10 clinician follow-up visits) we estimated the average time of staff per type of visit and valued it at the corresponding staff salary. Multiplying cost per visit by the number of annual visits per type per patient, we estimated the annual staff time cost for each individual patient;

Second, for each patient we extracted from the ComHIP app database the type, dosage and duration of all medication prescriptions and valued this medication consumption at National Health Insurance Service (NHIS) reimbursement cost. From this we calculated the annual medication cost per patient;

Third, diagnostic tests consumption per patient was estimated for different levels of hypertension severity using an expert opinion exercise with three clinicians who were asked about the type and number of tests done over 12 months for a typical patient with mild/moderate/severe hypertension as defined in the ComHIP clinical protocol. These were then valued at NHIS reimbursement costs and allocated to each individual patient according to his/her level of hypertension severity.

We separated annual costs per patient into year one (including screening and hypertension confirmation visits with related diagnostic tests) and year two-and-following (excluding these visits). Once we estimated the annual costs of health care provision per patient, we estimated the annual overhead costs per patient. For this task we undertook a ingredients-based costing exercise of the ComHIP intervention supplemented with an expert opinion elicitation exercise with clinicians. We defined ComHIP in terms of activities and sub-activities.

Following standard programme costing methodology (1), activities were separated into a start-up period (i.e. before the implementation of patient-related activities) and a post-implementation period. Broadly, start-up period activities included 1) ComHIP app development, 2) training of health care and other staff in the use of the ComHIP app and in the clinical protocol for treating patients, 3) Management of the ComHIP project during start-up (including coordination meetings to launch ComHIP, field activities, time of technical FHI360 staff, and general administration). Post-implementation activities net of direct health care provision included 1) ComHIP app support, 2) Acquisition of clinical and IT equipment (i.e. tablets for the health care workers), and 4) Management of the ComHIP programme during post-implementation.

For each activity, wherever possible we estimated economic costs, i.e. actual resource use. Time of staff was obtained from activity logs supplemented with staff interviews and valued using individual staff salaries. Office equipment and furniture use was based on an inventory and valued at market prices. The costs of vehicle utilisation and maintenance, rentals and utilities were drawn from administrative records. ComHIP Medical and IT equipment quantities used were obtained from
administrative records and valued at their purchase prices adjusted by inflation where necessary. Start-up costs were considered capital costs and annualised and discounted over a period of the estimated lifetime of the project (10 years). We adjusted all quantities by the changes in programme activities assumed for the scale-up of the project to serve a general population of 10,000 individuals. Annual programme costs per patient were estimated by dividing total annual programme costs by the number of patients within this general population who would be treated considering the current prevalence of hypertension in the intervention district (n=3368).

The annual health care provider costs for the GHS-LCS ComHIP scale-up scenario were based on the same scale-up assumptions as for the current ComHIP scale-up scenario but assuming that all services currently provided by FHI360 would be provided by the GHS — and hence valued at local salaries.

**Health care provider costs - standard care**

For the estimation of direct health care costs, we undertook an expert elicitation exercise with three clinicians from the control district with ample experience in the management of hypertension patients using the standard of care. Each of the three clinicians was asked to estimate the average resource consumption in terms of time of staff, diagnostic tests, and medication in 1) the diagnosis and 2) 12-month treatment of patients with different levels of hypertension severity (mild/moderate/high) as per standard clinical guidelines. Time of resource consumption was valued at GHS salary levels, diagnostic test and medication use were valued at NHIS reimbursement costs. We averaged results across the three clinicians to obtain a total annual cost per patient for year one on treatment (including diagnosis) and for subsequent years on treatment (i.e. excluding diagnosis) by level of hypertension severity and assigned these costs to each individual reporting being on standard of care at start of the study who were retained at 12 month endline. The annual overhead costs per patient were estimated based on the overhead costs that were calculated for the GHS-LCS ComHIP scale-up scenario but excluding all ComHIP-related programme activities.

**Costs of CVD events**

Estimation of the costs of CVD events were based on an expert opinion exercise with two experienced clinical experts. The two experts met together and did a joint consensual assessment of the direct health care provision costs. They were asked to estimate the average resource consumption (time of clinical staff, diagnostic tests, medication, in-hospital stays) of CHD (angina/myocardial infarction) and stroke patients over 12 months, including diagnosis and follow-up. Resources were valued in the same way as with the expert opinion exercises to determine the costs of hypertension treatment in standard hypertension care. Based on this exercise, we estimated the annual health care provider cost per patient for year one on treatment (including diagnosis) and for subsequent years on treatment (excluding diagnosis), to which we added the hypertension medication costs in each scenario. Overhead costs were drawn from the literature (2).

**Patient-related costs**

In order to estimate annual patient-related costs of hypertension for the ComHIP scenario we did a survey of hypertension treatment costs in a group of ComHIP patients (n = 257). Similarly, in order to
estimate annual patient-related costs of hypertension for the standard care scenario we did a survey of patients on standard care (n=130). Annual patient-related costs of CVD-related events were estimated from those patients on the standard of care who reported having suffered a CVD event (n=7) and complemented with clinicians’ expert opinion. In order to calculate the patient-level costs of CVD events, we added an estimate of annual informal care costs. This estimate was based on a Thai study which analysed the time costs of informal care in disabled stroke patients (3). We assumed informal care was required throughout the year for all patients with severe and moderate stroke - estimated in a survey in Ghana (4) respectively as 12% and 35% and during the period unable to work for patients with CHD and angina.

In order to estimate the annual societal costs of the hypertension health state per patient for both ComHIP scenarios and standard care, we summed the annual health care provider costs of hypertension management estimated for each patient in each scenario to the average annual patient-related cost (excluding patient expenditures in medical costs to avoid double counting) in the same scenario. The same approach was taken to estimate the annual societal costs per patient of the CVD-related health states (treated first CHD event, treated repeat CHD event, treated first stroke event, treated repeat stroke event), to which we added the medication costs of hypertension treatment.

1.2. Data inputs for cost-effectiveness analysis

In this section we present in detail all the data inputs for the Markov model, i.e. probabilities, costs and disability weights.

1.2.1. Probabilities

The probability of hypertension in ComHIP and standard hypertension care was 0.3368, i.e. 33.68% of the population had hypertension. This value was based on the overall proportion of individuals with hypertension in the endline surveys undertaken in the intervention and control districts as part of the ComHIP evaluation. The probability of no hypertension was the complementary probability, i.e 0.6632 or 66.32%. Results from the endline surveys are unpublished, but details of the survey design and content can be found in Lamptey et al (5).

Table S4 presents a description of the blood pressure and demographic characteristics of the individuals from which the probabilities of CVD events were estimated and the results of the statistical comparison (using a two-tailed t-test assuming unequal variances for continuous variables and a two-tailed z-test for the comparison of proportions).

Table S4 shows the values of the variables that drive the 10-year CVD risks in the ComHIP and standard care scenarios. In Table S4, the “mean systolic blood pressure (latest measurement)” and the “mean diastolic blood pressure (latest measurement)” for the ComHIP group (respectively, 132.7 mm Hg and 81.4 mm HG) were used to estimate the 10-year CVD risks in the ComHIP scenario. The “mean systolic blood pressure (measurement before starting treatment in ComHIP)” and the “mean diastolic blood pressure (measurement before starting treatment in ComHIP)” for the standard care group (respectively, 147.65 mm Hg and 90.14 mm HG) drive the 10-year CVD risks in the standard care scenario.
Table S4. Blood pressure and demographic characteristics of individuals on ComHIP/standard care.

| Characteristic                                      | COMHIP\(^1\) (n=219) | Standard care\(^2\) (n=142) | p-value for assessing difference between the two groups |
|-----------------------------------------------------|------------------------|------------------------------|--------------------------------------------------------|
| Mean age                                            | 56.5                   | 56.8                         | p = 0.78                                               |
| Proportion of women                                 | 65.7%                  | 62.7%                        | P = 0.60                                               |
| Proportion of individuals who smoke (self-reported) | 0.4%                   | 0%                           | p = 0.69                                               |
| Proportion of individuals with diabetes (self-reported) | 4.1%                   | 4.9%                         | p = 0.71                                               |
| Mean systolic blood pressure (measurement before starting on treatment in ComHIP) | 147.13                 | 147.65                       | p = 0.78                                               |
| Mean systolic blood pressure (latest measurement)   | 132.27                 | 132.37                       | p = 0.96                                               |
| Mean diastolic blood pressure (measurement before starting on treatment in ComHIP) | 90.36                  | 90.14                        | p = 0.88                                               |
| Mean diastolic blood pressure (latest measurement)  | 81.04                  | 80.50                        | p = 0.65                                               |

\(^1\)All individuals aged 18-79 on treatment in ComHIP for more than 12 months

\(^2\)All individuals aged 18-79 on treatment in ComHIP for more than 12 months reporting being on hypertension treatment at the time of joining the ComHIP patient cohort

Tables S5 and S6 present, respectively the one-year probabilities of CHD and stroke for ComHIP and standard hypertension care. Table S7 presents the probabilities of treatment/no treatment and of death after treatment/no treatment with their ranges.
Table S5. Mean (SD) one-year probabilities of CHD for Beta distributions

| Year | COMHIP | Standard hypertension care |
|------|--------|-----------------------------|
|      |        |                             |
| 1    | 0.0039 (0.0050) | 0.0059 (0.0064) |
| 2    | 0.0053 (0.0055) | 0.0076 (0.0069) |
| 3    | 0.0060 (0.0057) | 0.0085 (0.0072) |
| 4    | 0.0066 (0.0059) | 0.0091 (0.0073) |
| 5    | 0.0070 (0.0060) | 0.0096 (0.0074) |
| 6    | 0.0074 (0.0061) | 0.0100 (0.0075) |
| 7    | 0.0077 (0.0062) | 0.0104 (0.0076) |
| 8    | 0.0081 (0.0062) | 0.0107 (0.0076) |
| 9    | 0.0084 (0.0063) | 0.0110 (0.0076) |
| 10   | 0.0086 (0.0063) | 0.0113 (0.0076) |

Table S6. Mean (SD) one-year probabilities of stroke for Beta distributions

| Year | COMHIP | Standard hypertension care |
|------|--------|-----------------------------|
|      |        |                             |
| 1    | 0.0026 (0.0024) | 0.0033 (0.0030) |
| 2    | 0.0045 (0.0035) | 0.0055 (0.0039) |
| 3    | 0.0046 (0.0036) | 0.0056 (0.0041) |
| 4    | 0.0056 (0.0045) | 0.0069 (0.0053) |
| 5    | 0.0060 (0.0049) | 0.0074 (0.0059) |
| 6    | 0.0066 (0.0051) | 0.0080 (0.0079) |
| 7    | 0.0080 (0.0065) | 0.0099 (0.0092) |
| 8    | 0.0084 (0.0075) | 0.0106 (0.0078) |
| 9    | 0.0070 (0.0063) | 0.0089 (0.0072) |
| 10   | 0.0082 (0.0062) | 0.0099 (0.0072) |

Table S7. Mode (ranges) one-year probabilities of treatment/no treatment and of death after treatment/no treatment for Triangular distributions.

|                      | Treatment after first time CHD | Treatment after repeat CHD | Death with treatment after first time CHD | Death with treatment after repeat CHD | Death without treatment after first time CHD | Death without treatment after repeat CHD |
|----------------------|--------------------------------|-----------------------------|-----------------------------------------|----------------------------------------|-------------------------------------------|------------------------------------------|
| Treatment after first time stroke | 0.908 (0.817-1.000) | 0.808 (0.696-0.908) | 0.368 (0.288-0.450) | 0.588 (0.492-0.663) | 0.608 (0.450-0.767) | 0.754 (0.658-0.871) |
| Treatment after repeat stroke | 0.933 (0.867-1.000) | 0.900 (0.800-1.000) | 0.356 (0.278-0.450) | 0.407 (0.308-0.510) | 0.550 (0.433-0.667) | 0.533 (0.433-0.633) |

With respect to the mortality due to overall causes, which was estimated for two age groups (56-60 and 61-65) as the mean age of the population in the model was 55.5, it was, respectively, 0.01564 at ages 56-60 and 0.02906 at ages 61-65. The mortality due to non-CVD causes, again estimated for the two same age groups, this time subtracting CVD mortality from overall mortality, was, respectively, 0.01022 at ages 56-60 and 0.02036 at ages 61-65.
1.2.2. Costs.

1.2.2.1. Hypertension treatment costs.

Patient-level costs

Table S8 presents the estimations of patient-level costs of hypertension treatment based on the patient surveys.

Table S8. Average patient-level costs for hypertension treatment: ComHIP and standard care (2017 US$)

|                        | Screening visit | First confirmation consultation | Second confirmation consultation | Hypertension review consultations | Blood pressure management visits | Pharmacy visits | All visits |
|------------------------|-----------------|-------------------------------|---------------------------------|----------------------------------|---------------------------------|-----------------|-----------|
| **COMHIP**             |                 |                               |                                 |                                  |                                 |                 |           |
| Number of patients answering | 198             | 178                           | 182                             | 166                              | 169                             | 177             |           |
| Direct medical costs   | 0               | 0                             | 0                               | 5.27                             | 0                               | NA*             | 5.27      |
| Direct non-medical costs | 0.53            | 0.80                          | 1.13                            | 15.27                            | 8.83                            | 16.45           | 43.01     |
| Cost of time seeking treatment | 0.81            | 1.14                          | 1.05                            | 18.62                            | 16.23                           | 19.28           | 57.12     |
| SUBTOTAL               | 1.34            | 1.94                          | 2.18                            | 39.16                            | 25.06                           | 42.41           | 105.4     |
| Cost of time lost to work |                |                               |                                 |                                  |                                 |                 | 9.22      |
| **TOTAL**              |                 |                               |                                 |                                  |                                 |                 | 114.62    |

| **STANDARD CARE**      |                 |                               |                                 |                                  |                                 |                 |           |
| Number of patients answering | N/A             | N/A                           | N/A                             | 123                              | N/A                             | 123             |           |
| Direct medical costs   |                 |                               |                                 | 13.99                            |                                 | NA*             | 13.99     |
| Direct non-medical costs |                 |                               |                                 | 14.09                            | 6.79                            |                 | 20.87     |
| Cost of time seeking treatment | 15.30            |                               |                                 | 4.29                             | 19.59                           |                 |           |
| SUBTOTAL               | 43.38           |                               |                                 | 22.15                            | 54.45                           |                 |           |
| Cost of time lost to work |                 |                               |                                 |                                  |                                 |                 | 7.68      |
| **TOTAL**              |                 |                               |                                 |                                  |                                 |                 | 62.13     |

*Not applicable, as medical costs of treatment were included in the health care provider cost
From Table S8, the total estimated annual patient-level costs per patient are 114.6 US$ in ComHIP, about 80% higher than the annual patient-level costs per patient in standard care. The main cost-drivers for this difference are, first, the additional costs in time spent seeking health care by patients in ComHIP (nearly threefold those of standard care patients) and the direct non-medical costs (including payments for transport and payments for non-medical items such as childcare).

**Societal costs**

In current ComHIP scale-up, the resulting mean annual undiscounted societal costs per patient were 264.2 US$ (SD= 36.45) for year 1 on treatment and 244.56 US$ (SD= 33.75) for years 2 and following years on treatment. In GHS-LCS ComHIP scale-up, the resulting mean annual undiscounted societal costs per patient were 219.05 US$ (SD= 36.45) for year 1 on treatment and 199.44 US$ (SD= 33.75) for years 2 and following years on treatment.

For standard hypertension care, Tables S9-S11 present the annual societal costs of hypertension treatment by hypertension grade.
Table S9. Annual costs of hypertension treatment for standard hypertension care (2017 US$): Grade 1 hypertension

| Resources                              | Costs                      | Mean   |
|----------------------------------------|----------------------------|--------|
|                                        | Expert 1 | Expert 2 | Expert 3 | Expert 1 | Expert 2 | Expert 3 |        |
| SOCIETAL COST YR 1                     |          |          |          |          | 150.41   |         |         |
| PATIENT-LEVEL COST                     |          |          |          |          | 62.13    |         |         |
| TOTAL HEALTH CARE PROVISION COSTS YR 1|          |          |          | 86.07    | 86.07    | 98.47   | 88.28   |
| OVERHEAD COSTS                         |          |          |          | 18.06    | 18.06    | 18.06   | 18.06   |
| TOTAL HEALTH CARE PROVISION COST       |          |          |          | 61.65    | 61.65    | 87.55   | 70.28   |
| DIAGNOSIS + 12 MONTH FOLLOW-UP*        |          |          |          | 11.7     | 11.3     | 25.2    | 16.2    |
| Consultations                          |          |          |          | 0.4      | 0.2      | 0.4     | 0.3     |
| Diagnostic tests:                      |          |          |          | 11.3     | 11.3     | 24.7    | 15.7    |
| Chest x-ray                            |          |          |          | 3.5      | 3.5      | 3.5     |         |
| Full blood count                       |          |          |          | 2.1      | 2.1      |         |         |
| Liver function                         |          |          |          | 1        |          | 10.8    |         |
| Kidney function                        |          |          |          | 1        |          | 4.7     |         |
| SOCIETAL COST YR 2 AND FOLLOWING       |          |          |          |          | 134.27   |         |         |
| PATIENT-LEVEL COST                     |          |          |          |          | 62.13    |         |         |
| TOTAL HEALTH CARE PROVISION COST YR 2 |          |          |          | 68.01    | 68.01    | 80.41   | 72.14   |
| AND FOLLOWING                          |          |          |          | 18.06    | 18.06    | 18.06   | 18.06   |
| *TOTAL HEALTH CARE PROVISION COST      |          |          |          | 49.95    | 49.95    | 62.35   | 54.1    |
| 12 MONTH FOLLOW-UP                    |          |          |          |          |          |         |         |
| Consultations                          |          |          |          | 1.1      | 1.3      | 1.1     | 1.2     |
| Diagnostic tests:                      |          |          |          | 11.3     | 11.3     | 23.9    | 15.5    |
| Bue and creatinine                     |          |          |          | 1        |          | 2.7     |         |
| Lipid profile                          |          |          |          | 5.6      | 5.6      |         |         |
| Chest x-ray                            |          |          |          | 3.5      | 3.5      | 3.5     |         |
| Full blood count                       |          |          |          | 2.1      | 2.1      | 2.1     |         |
| Liver function                         |          |          |          | 1        |          | 10.8    |         |
| Kidney function                        |          |          |          | 1        |          | 4.7     |         |
| Medication with non-compliance and     |          |          |          | 37.35    | 37.35    | 37.35   | 37.35   |
| dropouts (=50%):                       |          |          |          |          |          |         |         |
| Medication:                            |          |          |          | 74.7     | 74.7     | 74.7    | 74.7    |
| Aspirin 75 mg daily                    | 365      | 365      | 365      | 5.0      | 5.0      | 5.0     |         |
| Nifedipine 20 mg twice daily           |          |          |          |          | 365x2    | 365x2   | 365x2   |
| Losartan 50 mg daily                   | 365      | 365      | 365      | 41.5     | 41.5     | 41.5    |         |
Table S10. Annual costs of hypertension treatment for standard hypertension care (2017 US$):
Grade 2 hypertension

| Resources                                      | Expert 1 | Expert 2 | Expert 3 | Expert 1 | Expert 2 | Expert 3 | Mean |
|------------------------------------------------|----------|----------|----------|----------|----------|----------|-------|
| **SOCIETAL COST YR 1**                        |          |          |          |          |          |          | 152.84|
| PATIENT-LEVEL COST                             |          |          |          |          |          |          | 62.13 |
| TOTAL HEALTH CARE PROVISION COSTS YR 1        |          |          |          |          |          |          | 90.71 |
| OVERHEAD COSTS                                 |          |          |          |          |          |          | 18.06 |
| TOTAL HEALTH CARE PROVISION COST DIAGNOSIS + 12 MONTH FOLLOW-UP* | 63.6     | 63.6     | 90.75    |          |          |          | 72.65 |
| COST DIAGNOSIS                                 | 11.65    | 11.65    | 25.6     |          |          |          | 16.3  |
| Consultations                                  | 2x10 min | 2x10 min | 2x10 min | 0.4      | 0.4      | 0.9      | 0.4   |
| Diagnostic tests:                              | 11.25    | 11.25    | 24.7     |          |          |          | 15.75 |
| Lipid profile                                  | 1        | 1        | 1        | 5.6      | 5.6      | 5.6      | 5.6   |
| Chest x-ray                                    | 1        | 1        | 1        | 3.5      | 3.5      | 3.5      | 3.5   |
| Full blood count                               | 1        | 1        |          | 2.1      | 2.1      |          | 2.1   |
| Liver function                                 | 1        |          |          | 10.8     |          |          | 10.8  |
| Kidney function                                | 1        |          |          | 4.7      |          |          | 4.7   |
| **SOCIETAL COST YR 2 AND FOLLOWING**           |          |          |          |          |          |          | 136.54|
| PATIENT-LEVEL COST                             |          |          |          |          |          |          | 62.13 |
| TOTAL HEALTH CARE PROVISION COSTS YR 2+        | 70.01    | 70.01    | 83.21    |          |          |          | 74.41 |
| OVERHEAD COSTS                                 | 18.06    | 18.06    | 18.06    |          |          |          | 18.06 |
| *TOTAL HEALTH CARE PROVISION COST 12 MONTH FOLLOW-UP* | 51.95    | 51.95    | 65.15    |          |          |          | 56.35 |
| Consultations:                                  | 9x10 min | 9x10 min | 7x15 min | 3.3      | 3.3      | 3.9      | 3.5   |
| Diagnostic tests:                              | 11.3     | 11.3     | 23.9     |          |          |          | 15.5  |
| Bue and creatinine                             | 1        |          |          | 2.7      |          |          | 2.7   |
| Lipid profile                                  | 1        | 1        |          | 5.6      | 5.6      |          | 5.6   |
| Chest x-ray                                    | 1        | 1        | 1        | 3.5      | 3.5      | 3.5      | 3.5   |
| Full blood count                               | 1        | 1        | 1        | 2.1      | 2.1      | 2.1      | 2.1   |
| Liver function                                 | 1        |          |          | 10.8     |          |          | 10.8  |
| Kidney function                                | 1        |          |          | 4.7      |          |          | 4.7   |
| Medication with non-compliance and dropouts (=50%): | 37.35    | 37.35    | 37.35    |          |          |          | 37.35 |
| Medication:                                    | 74.7     | 74.7     | 74.7     |          |          |          | 74.7  |
| Aspirin 75 mg daily                            | 365      | 365      | 365      | 5.0      | 5.0      | 5.0      | 5.0   |
| Nifedipine 20 mg twice daily                   | 365x2    | 365x2    | 365x2    | 28.2     | 28.2     | 28.2     | 28.2  |
| Losartan 50 mg daily                           | 365      | 365      | 365      | 41.5     | 41.5     | 41.5     | 41.5  |
Table S11. Annual costs of hypertension treatment for standard hypertension care (2017 US$):
Grade 3 hypertension

| Resources | Costs |
|-----------|-------|
|           | Expert 1 | Expert 2 | Expert 3 | Expert 1 | Expert 2 | Expert 3 | Mean |
| SOCIETAL COST YR 1 | 213.89 |
| PATIENT-LEVEL COST | 62.13 |
| TOTAL HEALTH CARE PROVISION COSTS YR 1 | 82.36 | 81.66 | 185.76 | 151.76 |
| OVERHEAD COSTS | 18.06 | 18.06 | 18.06 | 18.06 |
| TOTAL HEALTH CARE PROVISION COST DIAGNOSIS + 12 MONTH FOLLOW-UP* | 64.5 | 63.8 | 271.7 | 133.7 |
| COST DIAGNOSIS | 11.5 | 11.5 | 25.3 | 16.1 |
| Consultations | 1x10 min | 1x10 min | 2x10 min | 0.2 | 0.2 | 0.4 |
| Diagnostic tests: | | | | 11.3 | 11.3 | 24.9 |
| Lipid profile | 1 | 1 | 1 | 5.6 | 5.6 | 5.6 |
| Chest x-ray | 1 | 1 | 1 | 3.5 | 3.5 | 3.5 |
| Full blood count | 1 | 1 | | 2.1 | 2.1 | |
| Liver function | 1 | | | | | |
| Kidney function | 1 | | | | | 4.7 |
| SOCIETAL COST YR 2 AND FOLLOWING | 197.6 |
| PATIENT-LEVEL COST | 62.13 |
| TOTAL HEALTH CARE PROVISION COSTS YR 2+ | 71.06 | 70.9 | 264.46 | 135.47 |
| OVERHEAD COSTS | 18.06 | 18.06 | 18.06 | 18.06 |
| *TOTAL HEALTH CARE PROVISION COST 12 MONTH FOLLOW-UP | 53.0 | 52.3 | 246.4 | 117.24 |
| Consultations | 12x10 min | 10x10 min | 10x15 min | 4.4 | 3.7 | 6.6 | 4.91 |
| Diagnostic tests: | | | | 11.3 | 11.3 | 48.6 | 23.7 |
| Bue and creatinine | 1 | | | | | 2.7 |
| Lipid profile | 1 | 1 | 2 | 5.6 | 5.6 | 11.2 |
| Chest x-ray | 1 | 1 | 1 | 3.5 | 3.5 | 3.5 |
| Full blood count | 1 | 1 | 1 | 2.1 | 2.1 | 2.1 |
| Liver function | 2 | | | | | 21.7 |
| Kidney function | 2 | | | | | 9.4 |
| Medication with non-compliance and dropouts (=50%): | | | | 37.35 | 37.35 | 191.2 | 88.63 |
| Medication: | | | | 74.7 | 74.7 | 382.4 | 177.23 |
| Aspirin 75 mg daily | 365 | 365 | 365 | 5.0 | 5.0 | 5.0 |
| Nitroprin 20 mg twice daily | 365x2 | 365x2 | 365x2 | 28.2 | 28.2 | 28.2 |
| Losartan 50 mg daily | 365 | 365 | 365 | 41.5 | 41.5 | 41.5 |
| IV labetolol 20 mg once | 1 | | | | | |
| IV hydralazine 5 mg once | 1 | | | | | |
| Labetalol 100 mg 2 daily | 365x2 | | | | | 16.0 |
| Atenolol 50 mg 2 daily | 365x2 | | | | | 172.6 |
| Carvedilol 6.25 mg daily | 365 | | | | | 83.0 |
| Methyldopa 250 mg 2 daily | 365x2 | | | | | 33.2 |

In order to estimate the mean hypertension treatment cost for standard hypertension care, the societal costs calculated in tables S9-S11 were assigned to each patient in the ComHIP cohort who reported being on treatment at enrolment by hypertension grade. This resulted in a total mean
societal cost of 157.05 (SD=18.93) US$ for yr 1 treatment and a total mean societal cost of 141.12 (SD=18.94) US$ for yr2 and following years treatment.

1.2.2.2. CVD treatment costs.

Tables S12 and S13 present the aggregate annual health service provision costs of treating angina, myocardial infarction, and stroke for, respectively, the acute phase and the 12-month follow-up.

Table S12. Annual health service provision costs of treating angina, myocardial infarction (MI) and stroke (US$): acute phase

| Resources               | Costs | Resources               | Costs | Resources               | Costs |
|-------------------------|-------|-------------------------|-------|-------------------------|-------|
| TOTAL ACUTE PHASE       | 101.5 | TOTAL ACUTE PHASE       | 137   | TOTAL ACUTE PHASE       | 548.01|
| In-hospital stay (4 days)| 42.98 | In-hospital stay (7 days)| 75.22 | In-hospital stay (14 days)| 150.44|
| Time of clinical staff: | 38.39 | Time of clinical staff: | 38.39 | Time of clinical staff: | 65.22 |
| Clinician (60 min)      | 5.68  | Clinician (60 min)      | 5.68  | Clinician (140 min)     | 13.25 |
| Nurse (1440 min)        | 27.03 | Nurse (1440 min)        | 27.03 | Nurse (1120 min)        | 21.02 |
| Anaesthelist (60 min)   | 5.68  | Anaesthelist (60 min)   | 5.68  | Physiotherapist (840 min)| 30.94 |
| Diagnostic tests:       | 10.32 | Diagnostic tests:       | 10.32 | Diagnostic tests:       |       |
| Cholesterol level (1)   | 5.62  | Cholesterol level (1)   | 5.62  | Chest x-ray (1)         | 3.55  |
| Kidney function (1)     | 4.70  | Kidney function (1)     | 4.70  | Lipid profile (1)       | 5.62  |
| Medication:             | 9.76  | Medication:             | 9.76  | Blood culture (1)       | 1.86  |
| Isosorbide dinitrate    | 3.41  | Isosorbide dinitrate    | 3.41  | Urine culture (1)       | 1.67  |
| 10 mg 2.5 times a day   |       | 10 mg 2.5 times a day   |       |                         |       |
| Pethidine 100 mg        | 4.82  | Pethidine 100 mg        | 4.82  | Hemoglobin levels (1),  |       |
|                         |       |                         |       | incl:                   |       |
| Tramadol 50 mg 3 daily  | 0.47  | Tramadol 50mg 3 daily   | 0.47  | HB estimation           | 1.00  |
| Soluble aspirin 200 mg  | 0.12  | Soluble aspirin 200 mg  | 0.12  | WBC + differentials     | 1.41  |
| daily                   |       | daily                   |       |                         |       |
| Anti-lipids 15 mg daily | 0.54  | Anti-lipids 15 mg daily | 0.54  | Kidney function (1)     | 4.70  |
| Clopidrogel 75 mg daily | 0.37  | Clopidrogel 75 mg daily | 0.37  | liver function (1)      | 10.84 |
|                         |       |                         |       | Medication:             | 325.23|
| Nifedipine 20 mg 2 per day|       |                        |       |                        | 3.18  |
| Losartan 50mg once daily|       |                        |       |                        | 1.59  |
| Mythaldopa 250 mg 2 daily|       |                        |       |                        | 3.18  |
| Cefnaxone 2g daily      |       |                        |       |                        | 21.48 |
| Augmentine 625mg 2 per day|       |                        |       |                        | 8.40  |
| Fragmin 5000iu daily    |       |                        |       |                        | 112.1 |
| Clexane 40mg daily      |       |                        |       |                        | 137.2 |
| Atorvastatin 15 mg daily|       |                        |       |                        | 1.88  |
| Piracetam 800mg 2 daily |       |                        |       |                        | 12.73 |
Table S13. Annual health service provision costs of treating angina, myocardial infarction (MI) and stroke (US$): 12-month follow-up

| Resources                      | Angina      | Costs   | Myocardial infarction | Costs   | Stroke     | Costs   |
|--------------------------------|-------------|---------|-----------------------|---------|------------|---------|
| TOTAL FOLLOW-UP                | 186.29      |         | TOTAL FOLLOW-UP       | 161.40  | TOTAL FOLLOW-UP | 278.30  |
| Time of professionals:         | 36.24       |         | Time of professionals: | 45.55   | In-hospital stay (10 days): | 107.46  |
| Clinician (240 minutes)        | 22.72       |         | Clinician (240 minutes)   | 22.87   | Time of professionals: | 45.44  |
| Nurse (80 minutes)             | 1.50        |         | Nurse (80 minutes)      | 1.51    | Clinician (480 min)      | 45.44  |
| Pharmacist (160 minutes)       | 5.89        |         | Pharmacist (160 minutes) | 15.24  | -           |         |
| Nutritionist (160 minutes)     | 5.89        |         | Nutritionist (160 minutes) | 5.93  | -           |         |
| Tests over 12 months:          | 46.16       |         | Tests over 12 months:   | 46.16   | Tests over 12 months:   | 41.07  |
| chest x-ray (1)                | 3.55        |         | chest x-ray (1)         | 3.57    | Tests over 12 months:   | 41.07  |
| Kidney function (2)            | 9.40        |         | Kidney function (2)     | 9.46    | Tests over 12 months:   | 41.07  |
| Liver function (2)             | 21.68       |         | Liver function (2)      | 21.82   | Tests over 12 months:   | 41.07  |
| Lipid profile (2)              | 11.24       |         | Lipid profile (2)       | 11.31   | Tests over 12 months:   | 41.07  |
| Treatment over 12 months:      | 104.41      |         | Treatment over 12 months: | 79.52  | Tests over 12 months:   | 41.07  |
| Isosorbide dinitrate 10 mg 2.5 times a day for a month | 25.58 |         | Isosorbide dinitrate 10 mg 2.5 times a day for a month | 25.58 | Tests over 12 months: | 41.07 |
| Soluble aspirin 75 mg daily    | 4.98        |         | Soluble aspirin 75 mg daily | 4.98 | Tests over 12 months: | 41.07 |
| Atorvastatin 20 mg daily       | 73.86       |         | Anti-lipids 15 mg daily  | 48.96   | Tests over 12 months:   | 41.07 |
|                                 |             |         |                       |         | Tests over 12 months:   | 41.07 |
| Liver function (1)             | 10.84       |         |                       |         | Liver function (1)      | 10.84 |
| Treatment over 12 months:      | 107.05      |         |                       |         | Treatment over 12 months: | 107.05 |
| Mylaldopa 250 mg 2 daily       | 58.09       |         |                       |         | Mylaldopa 250 mg 2 daily | 58.09 |
| Atorvastatin 15 mg daily       | 48.96       |         |                       |         | Atorvastatin 15 mg daily | 48.96 |

In order to estimate the costs of CHD/treated for year 1 and year 2 and following we estimated the annual societal costs (including the health service provision costs above, overhead costs at 76% of the direct costs and the average annual patient costs – these last ones presented in Table S14). We then calculated the weighted average of the year 1 and year 2 and following societal costs taking into account the relative frequency of angina and myocardial infarction (6). Finally, for all cost estimates we used a wide (30%) uncertainty range and a triangular distribution for sensitivity analysis.

Table S14 below shows the average patient-level costs of CVD events for the acute care and 12-month follow-up phases as estimated from the patient survey (n=7) and expert clinical opinion.
Table S14. Average patient-level costs for CVD events (2017 US$)

|                      | Angina  | Myocardial Infarction | Stroke  |
|----------------------|---------|------------------------|---------|
| **ACUTE CARE COST**  | 44.79   | 59.12                  | 92.51   |
| Medical costs        | NA*     |                        |         |
| Non-medical costs    | 20.69   |                        |         |
| Cost of time seeking |         |                        |         |
| health care          | 5.01    |                        |         |
| Cost of time lost to | 19.09   | 33.42                  | 66.81   |
| work                 |         |                        |         |
| Cost of informal care| 0       | 0                      | 0       |
| 12 MONTH FOLLOW-UP  | 361.31  | 560.23                 | 1152    |
| COST                  |         |                        |         |
| Medical costs        | NA*     |                        |         |
| Non-medical costs    | 70.94   |                        |         |
| Cost of time seeking |         |                        |         |
| health care          | 11.90   |                        |         |
| Cost of time lost to | 200.52  | 343.75                 | 906.68  |
| work                 |         |                        |         |
| Cost of informal care| 77.95   | 133.64                 | 162.37  |

*Not applicable, as medical costs of treatment were included in health care provider costs

Table S15 presents the societal costs of CVD treatment for year 1 and years 2 and following for, respectively, ComHIP (both scenarios) and standard care.

Table S15. Societal costs of CVD treatment for year 1 and years 2 and following (US$): ComHIP and standard care

|                          | Total annual societal cost ComHIP | Total annual societal cost standard care |
|--------------------------|----------------------------------|-----------------------------------------|
| **YR 1 CHD**             | 904                              | 931                                     |
| **YR 2 AND FOLLOWING CHD**| 654                              | 681                                     |
| **YR 1 STROKE**          | 2550                             | 2578                                    |
| **YR 2 AND FOLLOWING STROKE** | 1548                            | 1575                                    |
1.2.3. Disability weights.

Disability weights for the different health states included in the Markov model were estimated based on the Global Burden of Disease 2016 study and on the peer-reviewed literature. Table S16 displays the modes and their ranges of these disability weights.

Table S16. Disability weights for each health state with ranges for Triangular distributions.

| Health state         | Disability weights mode and ranges | GBD health state                                                                 |
|----------------------|-----------------------------------|----------------------------------------------------------------------------------|
| Hypertension         | Mode: 0.031                        | Based on GBD as reported by Rosendaal et al                                     |
|                      | Min: 0.017                         |                                                                                  |
|                      | Max: 0.05                          |                                                                                  |
| No hypertension      | 0                                 | Full health                                                                      |
| CVD/treated          | Mode: 0.08                         | Moderate angina due to IHD and respective bounds                                  |
|                      | Min: 0.033                         |                                                                                  |
|                      | Max: 0.167                         |                                                                                  |
| CVD/untreated        | Mode: 0.167                        | Severe angina due to IHD and respective bounds                                   |
|                      | Min: 0.11                          |                                                                                  |
|                      | Max: 0.24                          |                                                                                  |
| Stroke/treated       | Mode: 0.372                        | Weighted average of acute and chronic haemorrhagic and ischemic stroke health states (mild/ moderate/ high moderate/ severe/ very severe consequences) – weights are based on stroke severity distribution as reported in Feigin et al |
|                      | Min: 0.253                         |                                                                                  |
|                      | Max: 0.478                         |                                                                                  |
| Stroke/untreated     | Mode: 0.415                        | Weighted average of acute and chronic haemorrhagic and ischemic stroke health states (mild/ moderate/ high moderate/ severe/ very severe consequences) – weights are based on adapting the stroke severity distribution in Feigin et al assuming there are no mild strokes |
|                      | Min: 0.283                         |                                                                                  |
|                      | Max: 0.531                         |                                                                                  |
| Death                | 1                                 | Death                                                                            |
2. RESULTS.

2.1. Cost-effectiveness

2.1.1. Incremental cost-effectiveness scatterplots (base case)

Figure S2 shows the incremental cost-effectiveness scatterplot (ICES) of current ComHIP scale-up versus standard care compared to the two willingness-to-pay ratios used in the paper. Figure S3 shows the incremental cost-effectiveness scatterplot of GHS-LCS ComHIP scale-up versus standard care compared to two willingness-to-pay ratios used in the paper. The ICES show how uncertainty affects the cost-effectiveness over 10,000 probabilistic sensitivity analysis simulations. In any simulation where the results of the analysis were actually cost-effective, the green dots show under the diagonal willingness-to-pay dashed line.

Figure S2. Incremental cost-effectiveness scatterplot, current ComHIP scale-up versus standard care
2.1.2. Sensitivity analysis on CVD probabilities (WHO CVD Risk Chart Working Group)

It was not possible from the cardiovascular disease risk charts developed by the WHO CVD Risk Chart Working Group (7) to re-estimate the annual probabilities of a CHD or a stroke event in the ComHIP and Standard care scenarios as had been done using the Framingham 10-year risk equations (8, 9). However, it was possible to estimate the average 10-year risk of a CVD event for the two scenarios. For this task, we applied the Western Sub-Saharan Africa cardiovascular disease charts to the blood pressure, gender and age data from, respectively, the sample of 216 individuals on hypertension treatment for at least 12 months (ComHIP scenario) and the sub-sample of these individuals who had reported being on standard hypertension treatment at enrolment into ComHIP (Standard care scenario). Table S17 shows how the 10-year risk differed when estimated using the two approaches.
Table S17. Average 10-year CVD risks for patients in the ComHIP and standard care scenarios: Framingham equations versus WHO-ISH risk charts

|                  | Framingham risk equations | WHO cardiovascular disease risk charts |
|------------------|---------------------------|---------------------------------------|
|                  | 10-year risk of CHD       | 10-year risk of stroke                | 10-year risk of CVD                  | 10-year risk of CVD |
| ComHIP           | 0.066                     | 0.06                                  | 0.126                                | 0.06               |
| Standard care    | 0.089                     | 0.072                                 | 0.161                                | 0.08               |

From Table S17, the risk of CVD in the ComHIP and Standard care scenarios was approximately 50% when estimated using the WHO cardiovascular disease risk charts compared to the Framingham risk equations. The base case cost-effectiveness analysis was then repeated adjusting downwards the annual probabilities of CHD and stroke by 50% for both the ComHIP and the Standard care scenario. Table S18 presents the results from this sensitivity analysis.

Table S18. Cost-effectiveness analysis (sensitivity analysis on the base case: annual probabilities of CHD and stroke events reduced by 50%)

| Intervention                  | Cost (US$) | Incremental Cost (US$) | DALYs | DALYs averted | ICER        |
|-------------------------------|------------|------------------------|-------|--------------|-------------|
| Standard care                 | 4,419,957  |                        | 7,440 |              |             |
| Current ComHIP scale-up       | 7,131,690  | 2,711,733              | 7,334 | 106          | 25,582      |
| Standard care                 | 4,419,957  |                        | 7,440 |              |             |
| GHS-LCS ComHIP scale-up       | 5,923,610  | 1,503,653              | 7,334 | 106          | 14,185      |

From Table S18, reducing the annual probabilities of CHD and stroke events by 50% leads to a decrease in the number of DALYs averted by ComHIP compared to Standard care from 208 in the base case to 106 (a drop of 49%). For the current ComHIP scale-up vs standard care comparison, incremental costs increase by 176,493 US$, leading to a mode than-doubling of the incremental cost-effectiveness ratio (ICER) from 12,189 US$ per DALY averted in the base case to 25,582 US$ per DALY averted in the sensitivity analysis. For the GHS-LCS ComHIP scale-up versus standard care comparison, incremental costs increase by 145,365 US$: in consequence, the ICER in the sensitivity analysis increases to 14,185 US$ per DALY averted, more than double of the original 6,530 US$ per DALY averted.
2.1.3. Threshold analysis on key parameters

Table S19 below shows the results of the threshold analysis estimating the percentage change required in key model parameters for the current ComHIP scale-up and the GHS-LCS ComHIP scale-up scenarios to be cost-effective at a willingness-to-pay threshold of 2025 US$ (Ghana’s GDP per capita). The key model parameters used in the threshold analysis were: the societal cost of hypertension treatment, the annual probabilities of CVD events (including both CHD and stroke events), and the societal cost of all CVD events.

Table S19. Threshold analysis for key parameters.

| Parameter changed in threshold analysis | % change for cost-effectiveness at WTP = 2025 |
|----------------------------------------|---------------------------------------------|
| **Current ComHIP scale-up vs Standard care:** |                                           |
| 1. Cost of hypertension treatment in ComHIP scale-up | -34%                                       |
| 2. Cost of hypertension treatment in Standard care | +60%                                      |
| 3. Cost of CVD events in ComHIP scale-up | No change in cost-effectiveness if costs = 0 |
| 4. Cost of CVD events in Standard care | No change in cost-effectiveness if costs increase by 100% |
| 5. Annual probabilities of CVD in ComHIP scale-up | -99%                                      |
| 6. Annual probabilities of CVD in Standard Care | +80%                                      |
| **GHS-LCS scale-up vs Standard care:** |                                           |
| 1. Cost of hypertension treatment in ComHIP scale-up | -18%                                      |
| 2. Cost of hypertension treatment in Standard care | +29%                                      |
| 3. Cost of CVD events in ComHIP scale-up | -91%                                      |
| 4. Cost of CVD events in Standard care | +65%                                      |
| 5. Annual probabilities of CVD in ComHIP scale-up | -43%                                      |
| 6. Annual probabilities of CVD in Standard Care | +33%                                      |

For the current ComHIP scale-up vs Standard care comparison, results were most sensitive to changes in the societal costs of hypertension treatment in ComHIP – a drop of 34% in these societal costs would make the intervention cost-effective. Results were most insensitive to changes in the societal costs of CVD events (both CHD and stroke events). For the GHS-LCS scale-up vs Standard care comparison, results were most sensitive to changes in the societal cost of hypertension treatment in ComHIP – a drop of 18% in these costs would make the intervention cost-effective. Results were most insensitive to changes in the societal costs of CVD events.
2.2. Total annual costs for ComHIP and standard care scenarios.

Tables S20-S22 present the total annual costs by activity and sub-activity for the two ComHIP scenarios and for the standard care scenario.

Table S20. Total annual costs (2017 US$: Current ComHIP scale-up).

| Agent: | FH1360 | Moh/NHIS | Patient | TOTAL | % |
|--------|--------|----------|---------|-------|---|
| TOTAL COST | 2,079 | 2,409 | 39,544 | 90,285 | 100.0% |
| % | 29.6% | 26.7% | 43.7% | 100.0% | |
| START-UP COSTS | 31,223 | 1,873 | - | 33,097 | 3.7% |
| % | 94.3% | 5.7% | 0.0% | 100.0% | |
| 1. ComHIP app development | 5,229 | - | - | 5,229 | 15.8% |
| 2. Training | 9,917 | 1,421 | - | 11,338 | 34.3% |
| 2.1 Developing of training modules | 1,318 | 29 | - | 1,347 | 11.9% |
| 2.2. Training trainers | 236 | 3 | - | 239 | 2.1% |
| 2.3. Training LCS | 1,288 | 56 | - | 1,344 | 11.9% |
| 2.4. Training CHO's | 1,854 | 242 | - | 2,096 | 18.5% |
| 2.5. Training CVD nurses | 3,301 | 436 | - | 3,737 | 33.0% |
| 2.6. Training Physicians | 564 | 416 | - | 980 | 8.6% |
| 2.7. Training hospital and community pharmacists | 692 | 218 | - | 910 | 8.0% |
| 2.8. Community volunteers training | 665 | 22 | - | 687 | 6.1% |
| 3. Management | 16,077 | 452 | - | 16,529 | 49.9% |
| 3.1. Coordination meetings to launch ComHIP | 1,766 | 247 | - | 2,012 | 12.2% |
| 3.2. Field activities to launch ComHIP | 1,116 | 206 | - | 1,321 | 8.0% |
| 3.3. Technical staff support | 8,179 | - | - | 8,179 | 49.5% |
| 3.4. General administration | 5,017 | - | - | 5,017 | 30.4% |
| 3.4.1. Administration staff support | 744 | - | - | 744 | 14.8% |
| 3.4.2. Office equipment and supplies | 883 | - | - | 883 | 17.6% |
| 3.4.3. Vehicles (including maintenance) | 544 | - | - | 544 | 10.8% |
| 3.4.4. Office space and overheads | 2,847 | - | - | 2,847 | 56.7% |
| ANNUAL POST-IMPLEMENTATION COSTS | 236,569 | 239,075 | 39,544 | 870,188 | 96.3% |
| % | 27.2% | 27.5% | 45.3% | 100.0% | |
| 1. ComHIP app support | 15,672 | - | - | 15,672 | 1.8% |
| 2. Acquisition of clinical and IT equipment | 20,849 | - | - | 20,849 | 2.4% |
| 2.1. Mobile devices and their implements | 10,920 | - | - | 10,920 | 52.4% |
| 2.2. Blood pressure machines | 3,970 | - | - | 3,970 | 19.0% |
| 2.3. Weighing scales and stadiometers | 1,348 | - | - | 1,348 | 6.5% |
| 2.4. Glucometers | 1,818 | - | - | 1,818 | 8.7% |
| 2.5. Lancets and strips | 728 | - | - | 728 | 3.5% |
| 2.6. Rechargeable batteries | 2,065 | - | - | 2,065 | 9.9% |
| 3. Health service provision | - | 222,665 | 39,544 | 617,208 | 70.9% |
| 3.1. Clinical staff time costs/ Patient non-healthcare costs | - | 89,054 | 39,544 | 483,598 | 78.4% |
| 3.2. Diagnostic tests | - | 59,889 | - | 59,889 | 9.7% |
| 3.3. Medications | - | 73,721 | - | 73,721 | 11.9% |
| 4. Management | 200,048 | 16,411 | - | 216,459 | 24.9% |
| 4.1. Coordination meetings | 30,579 | 4,832 | - | 35,411 | 16.4% |
| 4.2. Field activities | 15,110 | 11,578 | - | 26,688 | 12.3% |
| 4.3. Technical staff support | 103,604 | - | - | 103,604 | 47.9% |
| 4.4. General administration | 50,756 | - | - | 50,756 | 23.4% |
| 4.4.1. Administration staff support | 13,525 | - | - | 13,525 | 26.6% |
| 4.4.2. Office equipment and supplies | 6,495 | - | - | 6,495 | 12.8% |
| 4.4.3. Vehicles (including maintenance) | 7,160 | - | - | 7,160 | 14.1% |
| 4.4.4. Office space and overheads | 23,575 | - | - | 23,575 | 46.4% |
### Table S21. Total annual costs (2017 US$): GHS-LCS ComHIP scale-up.

| Agent:                                    | MoH/NHIS | Patient | TOTAL | %    |
|-------------------------------------------|----------|---------|-------|------|
| TOTAL COST                                | 356,779  | 394,544 | 751,323 | 100.0% |
| %                                        | 47.5%    | 52.5%   | 100.0% |
| START-UP COSTS                            | 15,499   | -       | 15,499 | 2.1% |
| %                                        | 100.0%   | 0.0%    | 100.0% |
| 1 ComHIP app development                  | 207      | -       | 207    | 1.3% |
| 2. Training                              | 8,955    | -       | 8,955  | 57.8% |
| 2.1 Developing of training modules        | 314      | -       | 314    | 3.5% |
| 2.2 Training trainers                     | 28       | -       | 28     | 0.3% |
| 2.3 Training LCS                          | 1,881    | -       | 1,881  | 21.0% |
| 2.4 Training CHO's                       | 2,199    | -       | 2,199  | 24.6% |
| 2.5 Training CVD nurses                   | 2,582    | -       | 2,582  | 28.8% |
| 2.6 Training Physicians                   | 753      | -       | 753    | 8.4% |
| 2.7 Training hospital and community pharmacists | 793    | -       | 793    | 8.9% |
| 2.8 Community volunteers training         | 404      | -       | 404    | 4.5% |
| 3. Management                            | 6,338    | -       | 6,338  | 40.9% |
| 3.1 Coordination meetings to launch ComHIP| 983      | -       | 983    | 15.5% |
| 3.2 Field activities to launch ComHIP     | 854      | -       | 854    | 13.5% |
| 3.3 Technical staff support               | 1,507    | -       | 1,507  | 23.8% |
| 3.4 General administration                | 2,994    | -       | 2,994  | 47.2% |
| 3.4.1 Administration staff support        | 189      | -       | 189    | 3.3% |
| 3.4.2 Office equipment and supplies       | 883      | -       | 883    | 29.5% |
| 3.4.3 Vehicles (including maintenance)    | 533      | -       | 533    | 17.8% |
| 3.4.4 Office space and overheads          | 1,389    | -       | 1,389  | 46.4% |
| **ANNUAL POST-IMPLEMENTATION COSTS**      | 341,280  | 394,544 | 735,824 | 97.9% |
| %                                        | 46.4%    | 53.6%   | 100.0% |
| 1 ComHIP app support                      | 7,660    | -       | 7,660  | 1.0% |
| 2. Acquisition of clinical and IT equipment| 20,849   | -       | 20,849 | 2.8% |
| 2.1 Mobile devices and their implements    | 10,920   | -       | 10,920 | 52.4% |
| 2.2 Blood pressure machines               | 3,970    | -       | 3,970  | 19.0% |
| 2.3 Weighing scales and stadiometers      | 1,348    | -       | 1,348  | 6.5% |
| 2.4 Glucometers                           | 1,818    | -       | 1,818  | 8.7% |
| 2.5 Lancets and strips                    | 728      | -       | 728    | 3.5% |
| 2.6 Rechargeable batteries                | 2,065    | -       | 2,065  | 9.9% |
| 3. Health service provision               | 222,665  | 394,544 | 617,208 | 83.9% |
| 3.1 Clinical staff time costs/ Patient non-health care costs | 89,054 | 394,544 | 483,598 | 78.4% |
| 3.2 Diagnostic tests                      | 59,889   | -       | 59,889 | 9.7% |
| 3.3 Medications                           | 73,721   | -       | 73,721 | 11.9% |
| 4. Management                            | 90,106   | -       | 90,106 | 12.2% |
| 4.1 Coordination meetings                 | 20,581   | -       | 20,581 | 22.8% |
| 4.2 Field activities                      | 18,624   | -       | 18,624 | 20.7% |
| 4.3 Technical staff support               | 22,346   | -       | 22,346 | 24.8% |
| 4.4 General administration                | 28,554   | -       | 28,554 | 31.7% |
| 4.4.1 Administration staff support        | 3,397    | -       | 3,397  | 11.9% |
| 4.4.2 Office equipment and supplies       | 6,495    | -       | 6,495  | 22.7% |
| 4.4.3 Vehicles (including maintenance)    | 7,160    | -       | 7,160  | 25.1% |
| 4.4.4 Office space and overheads          | 11,501   | -       | 11,501 | 40.3% |
### Table S22. Total annual costs (2017 US$): Standard care.

| Agent:                        | MoH/NHIS | Patient | TOTAL      | %          |
|-------------------------------|----------|---------|------------|------------|
| TOTAL COST                    | 253,356  | 209,280 | 462,636    | 100.0%     |
| %                             | 54.8%    | 45.2%   | 100.0%     | 0.0%       |
| START-UP COSTS                | -        | -       | -          | 0.0%       |
| %                             | 0.0%     | 0.0%    | 0.0%       | 0.0%       |
| 1 ComHIP app development      | -        | -       | -          | 0.0%       |
| 2. Training                   | -        | -       | -          | 0.0%       |
| 2.1 Developing of training modules | -   | -       | -          | 0.0%       |
| 2.2. Training trainers        | -        | -       | -          | 0.0%       |
| 2.3. Training LCS             | -        | -       | -          | 0.0%       |
| 2.4. Training CHOes           | -        | -       | -          | 0.0%       |
| 2.5. Training CVD nurses      | -        | -       | -          | 0.0%       |
| 2.6. Training Physicians      | -        | -       | -          | 0.0%       |
| 2.7. Training hospital and community pharmacists | - | - | - | 0.0% |
| 2.8 Community volunteers training | - | - | - | 0.0% |
| 3. Management                 | -        | -       | -          | 0.0%       |
| 3.1. Coordination meetings to launch ComHIP | - | - | - | 0.0% |
| 3.2. Field activities to launch ComHIP | - | - | - | 0.0% |
| 3.3. Technical staff support  | -        | -       | -          | 0.0%       |
| 3.4. General administration   | -        | -       | -          | 0.0%       |
| 3.4.1. Administration staff support | - | - | - | 0.0% |
| 3.4.2. Office equipment and supplies | - | - | - | 0.0% |
| 3.4.3. Vehicles (including maintenance) | - | - | - | 0.0% |
| 3.4.4. Office space and overheads | - | - | - | 0.0% |
| ANNUAL IMPLEMENTATION COSTS   | 253,356  | 209,280 | 462,636    | 100.0%     |
| %                             | 54.8%    | 45.2%   | 100.0%     | 0.0%       |
| 1 ComHIP app support          | -        | -       | -          | 0.0%       |
| 2. Acquisition of clinical and IT equipment | 9,929 | 9,929 | 2.1%      |
| 2.1. Mobile devices and their implements | - | - | - | 0.0% |
| 2.2. Blood pressure machines  | 3,970    | -       | 3,970      | 40.0%      |
| 2.3. Weighing scales and stadiometers | 1,348 | - | 1,348 | 13.6% |
| 2.4. Glucometers              | 1,818    | -       | 1,818      | 18.3%      |
| 2.5. Lancets and strips       | 728      | -       | 728        | 7.3%       |
| 2.6. Rechargeable batteries   | 2,065    | -       | 2,065      | 20.8%      |
| 3. Health service provision   | 192,527  | 209,280 | 401,807    | 86.9%      |
| %                             | 54.8%    | 45.2%   | 100.0%     | 0.0%       |
| 3.1. Clinical staff time costs/ Patient non-health care costs | 5,558 | 209,280 | 214,838 | 0.0% |
| 3.2. Diagnostic tests         | 83,450   | -       | 83,450     | 0.0%       |
| 3.3. Medications              | 103,519  | -       | 103,519    | 0.0%       |
| 4. Management                 | 50,900   | -       | 50,900     | 11.0%      |
| 4.1. Coordination meetings    | -        | -       | -          | 0.0%       |
| 4.2. Field activities         | -        | -       | -          | 0.0%       |
| 4.3. Technical staff support  | 22,346   | -       | 22,346     | 43.9%      |
| 4.4. General administration   | 28,554   | -       | 28,554     | 56.1%      |
| 4.4.1. Administration staff support | 3,397 | - | 3,397 | 11.9% |
| 4.4.2. Office equipment and supplies | 6,495 | - | 6,495 | 22.7% |
| 4.4.3. Vehicles (including maintenance) | 7,160 | - | 7,160 | 25.1% |
| 4.4.4. Office space and overheads | 11,501 | - | 11,501 | 40.3% |
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