MINISTRY OF HEALTH
REPUBLIC OF GHANA

An Economic Evaluation Considering the Benefits Package of The National Health Insurance Scheme in Ghana

Heleen Vellekoop
Dr. Emmanuel Odame

EXECUTIVE SUMMARY

The objective of this research study was to help inform ongoing discussions regarding the review of the benefits package of the National Health Insurance Scheme (NHIS). In the study, 70 healthcare interventions were costed, using local data from various sources. The costing exercise showed the need to reduce the current NHIS benefits package to ensure financial sustainability of the NHIS. Data on the health benefit of each intervention was also gathered.

The costs and health benefit of each intervention, in combination with an estimate of the national cost-effectiveness threshold, were used to calculate the intervention's net health benefit. Ranking the interventions according to their net health benefit showed that many beneficial interventions are in the areas of *malaria*, *maternal and neonatal care* and *sexual and reproductive health*. A number of *child health* interventions also have high net health benefit, as well as antivenom for snakebites and surgical interventions inguinal hernia repair and cataract surgery. Less beneficial interventions were mostly in the areas of *NCDs* and *neurological and psychological disorders*. Preventive interventions in the area of *NCDs* were more cost-effective than curative NCD interventions.

A scenario analysis was conducted, in which six benefits packages were compiled, based on four different policy aims. The packages were kept within a budget that was drawn from 2017 NHIA expenditure on claims. 5 outcome indicators were reported on: number of interventions included; number of cases treated; total net health benefit (measured in DALYs averted); expected total cost; and budget impact by disease area. In Packages 1A and 1B, it was found that focusing on maximising total health benefit brings good results in all three areas. It was also found that budget impact is important to consider and may sometimes prevent interventions from being included in the benefits package.

Focusing on including a high number of interventions (Package 2), as opposed to covering a larger proportion of the population, was shown to lead to relatively low figures for total health benefit and number of cases treated. Focusing on primary care (Package 3) resulted in a package similar to the package that maximises total health benefit. However, DALYs averted with the primary care package were lower, largely because of the absence of emergency obstetric and emergency neonatal care in the package. It was found that not all available primary care interventions can be included in the primary care package, due to financial constraints. This shows that additional funding would be needed in order to achieve universal health coverage of primary care.

Packages 4A and 4B were split into two parts: (a) a basic package provided for free (at the point of delivery) and (b) an additional package with a capped 50% co-insurance rate. Charging co-payments on interventions with high budget impact allowed for a high number of interventions included in the package and a high number of cases treated (Package 4A). Charging co-payments on interventions with low health benefit led to a high number of DALYs averted (Package 4B). Concerns regarding financial protection might be addressed by making the co-payments income and/or wealth-based, though this would require strengthened data collection on these variables.

Improved data collection on epidemiology and price levels for medicines and consumables would be useful. Follow-up research considering additional important variables like social and cultural factors, equity, practical feasibility and fiscal space in a systematic manner would be valuable.

It would also be valuable to establish an independent body responsible for assessing health technologies, though initially it could be a unit within the Ministry of Health. Ideally staff would have a range of backgrounds, including health economics, mathematical modelling, statistics, epidemiology, public health, pharmacy and clinical care. The HTA body should have extensive stakeholder engagement to ensure that the generated evidence is relevant to the local context.

Policy Recommendations

(1) **Focus on enrolling a high proportion of the population into the NHIS** rather than covering many different interventions in the NHIS benefits package. Focusing on covering a high proportion of the population is more cost-effective, i.e. the same amount of government spending renders higher population health.

(2) Given the current budget available for NHIS claims reimbursement, **it is unlikely that all primary care interventions can be covered**. In order to achieve universal health coverage at the primary care level, additional NHIS funding would be needed.

(3) Consider ways of **increasing financial resources** available to the **NHIS**.

(4) When assembling a primary care package, it is recommended that **emergency obstetric care and emergency neonatal care** are **included**, despite being higher-level care, as these are very cost-effective interventions.

(5) Introducing **co-insurance** (for a subset of interventions) appears a **promising avenue** for achieving high population health as well as including many interventions in the benefits package and treating a high number of cases annually. However, **further research is needed** to investigate this option, especially because there may be concerns regarding financial protection. **Income/wealth-based co-payments** could be **considered**.

(6) In the area of non-communicable diseases, preventive interventions tend to be more cost-effective than curative interventions. An **increased policy focus on preventing NCDs** is recommended.

(7) **Strengthen** systems for **data collection**, especially regarding the prevalence and incidence of diseases/conditions occurring in Ghana, prices of medicines and consumables, and income/wealth levels of informal sector workers.

(8) **Cost interventions(/policies)** under consideration in order to enable **assessment of the budget impact.**

(9) It is **recommended that HTA becomes institutionalised** in the health sector. Ideally, HTA tasks would be undertaken by a dedicated body, with technical people from a range of backgrounds. Initially, HTA research could be conducted by a unit within the Ministry of Health. In the future, an Agency (under the Ministry) or an altogether independent institute should be established. Extensive stakeholder engagement is desirable to ensure the generated evidence is relevant to the decision-makers and in line with society's vision. Nonetheless, the research should be conducted in an autonomous manner.

(10) In order to achieve institutionalised HTA, it is recommended that a number of interested and talented officers working in the health sector receive **opportunities for HTA education and training**. Furthermore, seasoned **HTA experts** should continue to be **engaged**.

CONTENTS

ACKNOWLEDGEMENTS

We are grateful for the valuable comments on earlier versions of this report by Dr Martin Ayanore (University of Health and Allied Sciences), Dr Kalipso Chalkidou (iDSI), Dr Mohamed Gad (iDSI), Jessica Ochalek (CHE, University of York) and Dr Lauren Wallace (School of Public Health, University of Ghana). We would also like to thank participants of the October 2018 Health Sector Working Group for useful comments and questions after a presentation of the research. Participants included: Honourable Minister Kwaku Agyeman-Manu and Deputy Minister Kingsley Aboagye Gyedu; senior management from the Ministry of Health and the Ghana Health Service; and representatives from DFID, JICA, Unicef and USAID. Participants in a research seminar at the Health Economics Research Centre (University of Oxford) in November 2017 helped shape the direction of the research with their valuable comments and questions, which we are grateful for. We thank Peter Akorsu (Comboni Hospital, Sogakope), George Arthur (Accra Psychiatric Hospital), Justina Darko (Ministry of Health) and Bryan Sampram (Ministry of Health) for their research support. We also thank Cam Bowie for sharing the data from his earlier work on using HTA to assist priority-setting in the Ghanaian health sector. Special thanks to Samuel Okike, who worked on the design of this report.

LIST OF ABBREVIATIONS

ART	Antiretroviral Therapy
CEA	Cost-Effectiveness Analysis
CER	Cost-Effectiveness Ratio
CHPS	Community-based Health Planning and Services
CVD	Cardiovascular Disease
DALY	Disability-Adjusted Life Year
DOTS	Directly Observed Treatment Short-course
DRG	Diagnosis-Related Group
GBD	Global Burden of Disease
GSS	Ghana Statistical Service
HITAP	Health Intervention Technology Assessment Programme
HPV	Human Papillomavirus
HR	Human Resources
HTA	Health Technology Assessment
iDSI	International Decision Support Initiative
IGF	Internally Generated Funds
IHD	Ischaemic Heart Disease
MoH	Ministry of Health
NCD	Non-Communicable Disease
NHIA	National Health Insurance Authority
NHIF	National Health Insurance Fund
NHIS	National Health Insurance Scheme
OHT	OneHealth Tool
ORS	Oral Rehydration Solution
pPROM	Preterm Premature Rupture of the Membranes
STI	Sexually Transmitted Infection
TB	Tuberculosis
UHC	Universal Health Coverage
VIA	Visual Inspection with acetic Acid
VCT	Voluntary Counselling and Testing
WHO	World Health Organisation
YLD	Years Lived with Disability
YLL	Years of Life Lost

LIST OF FIGURES AND TABLES

1.

INTRODUCTION

The vision of the Ministry of Health is to have a healthy population for national development[1], which poses a challenging task. Funding coming into the health sector is limited (Witter, Ruddle, Murray-Zmijewski, & Somji, 2017)[2], which may be exacerbated by the expected decrease in donor funding over the next years (Murray-Zmijewski & Witter, 2018)[3]. This means that not all population health demands and needs can be met. There is therefore the need for priority-setting, which is a process that aims to select among different options for addressing health needs (Terwindt, Rajan, & Soucat, 2017). Priority-setting can occur at any level, including national, district, sub-district and within programmes (Kapiri & Martin, 2007). Priority-setting is inherently political and its outcomes should reflect society's values and vision for the health system. Nonetheless, relevant evidence is needed to assess which of the available options are most likely to help achieve desired outcomes.

HTA

The field that concerns itself with generating evidence to enable informed priority-setting in health is called health technology assessment (HTA). The definition of HTA by the World Health Organisation (2014) follows below.

> *"Health technology assessment is the systematic evaluation of properties, effects and/or impacts of health technologies and interventions. It covers both the direct, intended consequences of technologies and interventions and their indirect, unintended consequences. […] It may be applied to interventions, such as including a new medicine into a reimbursement scheme, rolling-out broad public health programmes (such as immunisation or screening for cancer), priority setting in health care, identifying health interventions that produce the greatest health gain and offer value for money, setting prices for medicines and other technologies based on their cost–effectiveness, and formulating clinical guidelines."*

Although an HTA study can consider many outcomes of interest (e.g. social and organisational effects), it should always include an economic evaluation in which costs and health effects are considered.

HTA in Ghana

In Ghana, the use of HTA has been limited. In a systematic review of economic evaluations of pharmaceuticals and medical devices in Ghana published between 1997 and 2012, Odame (2013) finds only three studies, out of which two studies have

[1] http://www.moh.gov.gh/vision/

[2] Even though Ghana is a signatory of the Abuja declaration and has therewith committed to allocating 15% of the national budget to health, only 2.8% of general government expenditure was allocated to health over the 2012-2017 period. When including NHIF and IGF the total allocation comes to 9.3%.

[3] External finance is projected to decrease by US$104 million over the 2018-2025 period, decreasing from US$229 million in 2018 to US$125 million in 2025.

non-Ghanaian principal authors. Nonetheless, interest in HTA has increased in recent years. Various stakeholders in the health sector are collaborating with iDSI (international Decision Support Initiative) to increase HTA activity in Ghana[4]. As part of this collaboration, a report on the cost-effective management of hypertension in Ghana was published (Chalkidou, Lord, & Gad, 2017). In the National Medicines Policy, launched in 2018, a plan is outlined for establishing a National Medicines Pricing Committee that will assess various pharmaceuticals using findings from HTA studies. The 2018 Aide Memoire, which captures the commitments from all health sector signatories for the ensuing year, states that the Ministry of Health 'should institutionalise health technology assessment to provide technical advice to the [National Pricing Committee]'.

Educational activities have also taken place, including a conference on the use of health technology assessment in Sub-Saharan Africa that was hosted in Accra in September 2018[5]. In May 2018 a delegation with representatives from the Ghana health sector went on a study trip to Thailand to learn about using HTA as an aid to achieve universal health coverage. The Thai HITAP (Health Intervention and Technology Assessment Programme) is a pioneer in this area, especially among low- and middle-income countries.

UHC

Ghana signed the World Health Assembly resolution 64.9 in 2011, thereby committing to striving towards universal health coverage (UHC). Ghana is also a signatory of the UHC 2030 Compact. Indeed, Ghana started implementing the National Health Insurance Scheme (NHIS), with the aim of achieving UHC, as early as 2004. UHC has not yet been achieved, however, with NHIS coverage at 35% in 2017, after having dropped from 40% in 2015.

The National Health Insurance Authority (NHIA) has experienced consistent financial deficits since 2009. Concerns about the sustainability of the NHIS have been raised and several issues potentially jeopardising NHIS sustainability have been identified (Alhassan, Nketiah-Amponsah, & Arhinful, 2016; Wang, Otoo, & Dsane-Selby, 2017). An often-quoted issue is the NHIS benefits package, which has been argued to be too large for it to be financially sustainable.

Potential reforms of the NHIS are under discussion, including a review of the benefits package. To provide inputs into these deliberations, we undertook an economic evaluation of the benefits package of the National Health Insurance Scheme (NHIS). In our analysis, the contents of the benefits package are aligned with the resources

[4] http://www.idsihealth.org/our-impact/ghana/
[5] See http://www.idsihealth.org/setting-priorities-fairly-sustainable-policies-for-effective-resource-allocation-in-africa/ for more information and the slides for all the presentations delivered.

annually available for claims payments to ensure financial sustainability, while the cost-effectiveness of interventions is also considered. We investigate a number of different scenarios regarding the benefits package, focusing on a different policy aim each time. The choice of the policy aims was based on available scientific evidence and current policy discourse.

1.1 OBJECTIVE

This project aims to generate evidence that can be used in the ongoing discussions regarding the review of the NHIS benefits package, as well as provide an educational resource on some of the concepts and methods used in HTA.

2.

METHODS

The research methods were inspired by research in which an essential health package was developed for Malawi (Ochalek, Claxton, Revill, Sculpher, & Rollinger, 2016).

Interventions

A health intervention is defined by the WHO as an *"act performed for, with or on behalf of a person or population whose purpose is to assess, improve, maintain, promote or modify health, functioning or health conditions"*. The definition is broad and includes preventive and curative treatments, public health policies and changes in the organisational structure of the health sector, among others. Interventions for which inclusion in the NHIS benefits package was not deemed feasible were not considered for this research[6].

A list of healthcare interventions for consideration was compiled based on data from the Ghana College of Physicians and Surgeons, as well as information from the OneHealth Tool. The OneHealth Tool is a piece of software (overseen by the World Health Organisation) that is used for health system modelling. The NHIS Tariff Operational Manual, which outlines the reimbursement tariffs for healthcare covered under the scheme, could not be used to inform the compilation of the interventions list because the NHIA reimburses based on diagnosis-related groups (DRGs) rather than on the specific treatment given.

Costs

Each intervention was costed, using 2017 cost figures that were obtained through various local sources. Cost items included were: HR (i.e. the wages of the health workers providing care), medicines, consumables, and the lodging costs for in-patient days. The average costs per case treated were calculated and then multiplied by the estimated population in need of the intervention each year.

Population in need

Various data sources were used to calculate the population in need for each intervention. Data items used for calculating the population in need were; the size of the target group (for preventive interventions), the prevalence of the addressed condition (for curative treatments of chronic conditions) or the incidence of the addressed condition (for curative treatments of non-chronic conditions)[7].

[6] This includes vaccinations for childhood diseases. Only 35% of the population was an active NHIS member in 2017, which is too low to achieve herd immunity.

[7] The incidence of a disease indicates the new number of cases in a given period (usually annually), whereas the prevalence indicates the total number of cases at any given point in time. Prevalence was used in cases of chronic conditions as not only the new cases need treatment.

Health benefit

A literature search was undertaken to identify studies reporting on the health benefit of the interventions under consideration[8]. Only studies using the 'Disability-Adjusted Life Years (DALYs) averted' metric were included. Appropriate data was found for 70 interventions. Study findings were adapted to the Ghanaian context where needed. Interventions for which insufficient data was available were excluded from the analysis.

Net health benefit

The cost and health benefit for each intervention, in combination with an estimate of Ghana's 'cost-effectiveness threshold' (also referred to as 'productivity of the health system' or 'opportunity cost of healthcare spending'), were used to calculate the **net** health benefit of each intervention. 'Net health benefit' reflects the cost-effectiveness of an intervention and is expressed in terms of DALYs averted. An explanation of DALYs and net health benefit follows in sections 2.2 and 2.3, respectively.

Scenario analysis

A scenario analysis was then conducted. Different options for the review of the benefits package were assessed. As cost-effectiveness is an important variable in economic evaluations and indeed a useful one when allocating limited resources, a package focusing solely on net health benefit (measured in DALYs averted) was compiled first. Additional packages were compiled, focusing on a different policy aim each time but taking net health benefit into account as well. The primary policy aims for the packages were:

(1) Maximise DALYs averted
(2) Include a high number of interventions
(3) Include only primary care interventions
(4) Include a co-insurance component for part of the interventions

For each package, five parameters were reported on:

(i) Number of interventions included
(ii) Number of cases treated
(iii) Number of DALYs averted
(iv) Expected total cost
(v) Budget impact by disease area

In each scenario, total expected annual cost for each package was kept within a budget that was based on the 2017 annual expenditure on claims by the NHIA.

More detail on the methods can be found in Appendix A.1-3.

[8] Note that the health benefit of an intervention depends on a range of factors, including: the prevalence of the disease that the intervention is addressing; the efficacy of the intervention; adherence to the intervention by patients. Therefore, calculating the health benefit of interventions generally requires a combination of clinical research and mathematical modelling.

2.1 Rationale policy focuses

The following section details the rationale for picking the four policy focuses mentioned above.

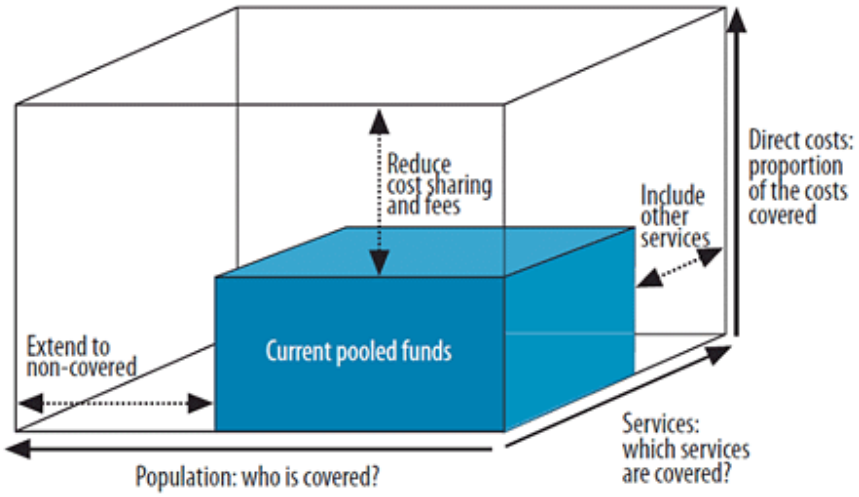
(1) Maximise DALYs averted

Net health benefit, expressed in DALYs averted, is a measure of cost-effectiveness. In contrast to the 'cost-effectiveness ratio', which is another often-used measure of cost-effectiveness, the net health benefit measure automatically takes burden of disease into account. That is, the net health benefit measure does not only consider whether an intervention offers 'value for money', it also shows by how much total population health will increase or decrease as a result of the intervention. The cost-effectiveness ratio solely establishes 'value for money', without looking at the change in disease burden at population level.

Cost-effectiveness is important to consider as resources are limited. Spending resources in a way that maximises population health is an important objective and is therefore the first policy focus to be considered. It may not be the only aim though; hence why other policy focuses were also discussed. Nonetheless, maximising DALYs averted was included as a secondary goal in the remaining packages.

Figure 1 shows the three dimensions to consider when moving toward universal health coverage, which have to be traded off against each other by decision-makers (because of limited resources). The packages under policy focus 1 assumed 100% coverage and no cost-sharing, while restricting service coverage.

Figure 1 – Dimensions to consider when moving toward universal health coverage



Source: World Health Organisation

(2) Include a high number of interventions

Historically, the NHIS benefits package has had an emphasis on covering the dimensions of: services (over 95% of disease conditions occurring in Ghana are covered[9]); and cost (membership fees are low and there are no user charges). Population coverage is lagging behind in comparison and was 35% in 2017. The package under policy focus 2 mimicked this by focusing on service and cost coverage. Population coverage was reduced.

(3) Include only primary care interventions

Strengthening primary care has been identified as a key activity in achieving universal health coverage and the Sustainable Development Goals more generally (Pettigrew et al., 2015; Bhutta, 2017). The Alma-Ata Declaration[10], which emphasises the importance of primary healthcare in achieving 'Health For All', was adopted by WHO member states as early as 1978. The 2018 Astana Declaration called for a renewed focus on primary healthcare. Ghana's efforts in the area of primary healthcare include the decentralisation of primary healthcare coordination (with District Health Management Teams now playing a key role) and the implementation of the Community-based Health Planning and Services (CHPS).

A prominent idea in discussions regarding the reform of the NHIS benefits package has been to reduce the package to a 'primary care only' package. This option was therefore included in the scenario analysis.

(5) Include a co-insurance component for part of the interventions

In policy focus 4, cost coverage was reduced, based on the idea of a 'tiered package' that has been coined in policy circles. While a basic package of services was assumed to be free (at the point of delivery), an additional package came with co-payment requirements. Co-payments can be used to prevent frivolous or unnecessary healthcare demand. Experimental research in the United States, for example, found that patients on an insurance plan without cost-sharing consumed significantly more healthcare than those in cost-sharing plans. However, their health outcomes were not significantly better (Manning, Newhouse, Duan, Keeler, & Leibowitz, 1987). When co-payments are made income- and/or wealth-based, they may be used to promote vertical equity, which is the notion that those with low income/wealth should pay relatively less for their healthcare than those with high income/wealth.

[9] http://www.nhis.gov.gh/benefits.aspx
[10] http://www.who.int/publications/almaata_declaration_en.pdf?ua=1

2.2 Disability-Adjusted Life Years

Disability-Adjusted Life Years (DALYs) is a common measure for the burden that a disease or condition causes. The DALY measure takes into account the reduced life time (in relation to life expectancy) as well as the worsened state in which life is lived. It is constructed as follows:

$$DALY = YLL + YLD$$

where DALY = Disability-Adjusted Life Years, YLL = Years of Life Lost, YLD = Years Lived with Disability.

The health benefit of an intervention can be expressed in terms of the disease burden that is alleviated by the intervention, i.e. the DALYs that are averted.

2.3 Net health benefit

When assessing an intervention, the aim is essentially to find out if the health benefit it renders is worth the cost. However, health benefit, measured in DALYs averted, and cost, measured in Ghana cedis, are not directly comparable. We can compare the two by expressing the cost in terms of DALYs. To be able to do so, we need to know the so-called 'opportunity cost' of healthcare spending. Opportunity cost can be illustrated with the following example:

> *Example 1: Imagine we have a total amount of GH₵3,000 to spend. We have the choice between two interventions that both cost GH₵3,000. Intervention A averts 1 DALY. Intervention B, on the other hand, averts 2 DALYs. If we choose to spend our money on Intervention A, we might be tempted to say that we have averted 1 DALY. However, we also have to consider that we could have spent the money on Intervention B instead. If we had spent the money on Intervention B, we would have averted 2 DALYs. By spending our money on Intervention A instead of Intervention B, we have missed out on the 2 DALYs that we could have gained with Intervention B.*
>
> *That is, the opportunity cost of Intervention A is 2 DALYs. Although the health benefit of Intervention A is 1 DALY averted, the **net** health benefit of Intervention A is not 1 DALY averted but rather (1 – 2 =) –1 DALY averted. Similarly, while the health benefit of Intervention B is 2 DALYs averted, the opportunity cost of not spending the money on Intervention A is 1 DALY and so the **net** health benefit is (2 – 1 =) 1 DALY averted.*

Table 1.1 – Net health benefit calculations Example 1 (comparing Intervention A to Intervention B)

Intervention	A	B
Health benefit (DALYs averted)	1	2
Opportunity cost = Health benefit of the other intervention (DALYs averted)	2	1
Net health benefit = Health benefit – Opportunity cost (DALYs averted)	-1	1

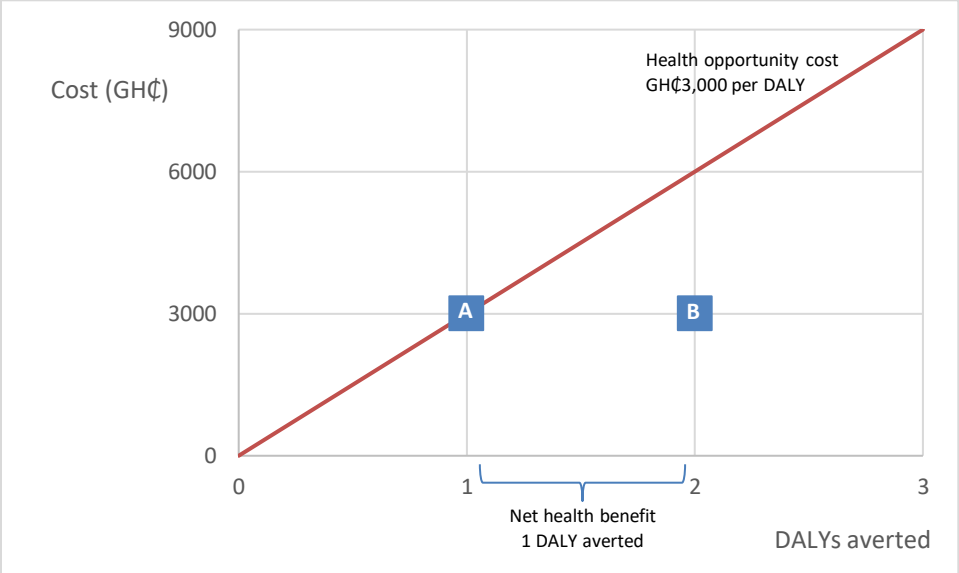
In the example above, we compared only two interventions. At the national level, we want to be able to compare each intervention to all the other possible interventions in the health sector. However, directly comparing each intervention to every single other intervention would be very difficult and time-consuming. Instead, we can use the so-called 'productivity of the healthcare system'. The productivity of a country's healthcare system can be interpreted as the amount of money that needs to be spent in the health system to avert 1 extra DALY. For example, at a productivity of k = GH₵3,000/DALY averted, an extra GH₵3,000 spent in the health system will avert 1 DALY among the Ghanaian population. Similarly, if the health budget is cut by GH₵3,000 the population will suffer 1 additional DALY. The productivity measure k is sometimes also referred to as the 'cost-effectiveness threshold'.

> *Example 2: Like in Example 1, we have GH₵3,000 available for spending. Again, we can spend it on Intervention A or Intervention B. We can also spend it on activities already ongoing in the healthcare system.*
>
> *Intervention A averts 1 DALY for GH₵3,000. Intervention B averts 2 DALYs for GH₵3,000. The healthcare system, with its current activities, averts 1 DALY for GH₵3,000.*
>
> *The net health benefit of implementing Intervention A instead of spending the money on activities already ongoing in the healthcare system is (1 – 1 =) 0. That is, in terms of health benefit to the population, it does not matter whether the money is spent on Intervention A or on activities already ongoing within the system.*
>
> *The net health benefit of implementing Intervention B instead of spending the money on activities already ongoing in the health sector is (2 – 1 =) 1 DALY averted. That is, total population health would be higher if the money was spent on Intervention B instead of on activities already ongoing in the health system.*

Table 1.2 – Net health benefit calculations Example 2 (comparing Intervention A and B to the current healthcare system)

Intervention	A	B
Health benefit (DALYs averted)	1	2
Opportunity cost = Health benefit of activities already ongoing in health sector (DALYs averted)	1	1
Net health benefit = Health benefit – Opportunity cost (DALYs averted)	0	1

Figure 2 – Graphical representation of net health benefit calculation Example 2*



** Note that the red line represents the opportunity cost of healthcare spending, which is the health benefit rendered by activities currently ongoing in the system. As mentioned above, the opportunity cost of spending GH₵3,000 is 1 DALY, which implies it is 2 DALYs when GH₵6,000 is spent, 3 DALYs when GH₵9,000 is spent, etc.*

The blue squares indicate the cost and health benefit of Intervention A and B respectively. The horizontal distance between each square and the red line reflects the net health benefit of the intervention. Like Table 1.2, Figure 2 shows that the net health benefit of Intervention A is 0 DALYs averted and the net health benefit of Intervention B is 1 DALY averted.

The following formula is used to convert the cost of an intervention, expressed in monetary terms, into opportunity cost, expressed in DALYs averted.

$$c_h = {}^{c_\$}/_{k}$$

where c_h = opportunity cost in terms of DALYs, $c_\$$ = cost in monetary terms, k = cost-effectiveness threshold = productivity of the healthcare system (expressed in GH₵/DALY averted).

The net health benefit of an intervention can subsequently be calculated by subtracting the opportunity cost in terms of DALYs from the gross health benefit.

$$\Delta h = h - c_h$$

where Δh = net health benefit, h = gross health benefit.

When the net health benefit of an intervention is negative, resource allocation to this intervention instead of resource allocation to activities already ongoing in the system will lead to lower total health benefit.

> *Example 3: A new intervention comes onto the market: Intervention C. Intervention C averts 2 DALYs and costs GH₵9,000. If we want to implement Intervention C, we have to reallocate GH₵9,000 of the current budget[11]. The GH₵9,000 will be taken away from activities that are already ongoing, which will result in a health loss.*
>
> *The ongoing activities can avert 1 DALY with GH₵3,000, as described in Example 2. Reducing the funding of ongoing activities by GH₵9,000 therefore causes a loss of 3 DALYs. That is, the opportunity cost of Intervention C is 3 DALYs averted. In formula:*
>
> $$c_h = {}^{c_\$}/_{k} = {}^{GH\text{₵}9{,}000}/_{GH\text{₵}3{,}000\ per\ DALY\ averted} = 3\ DALYs\ averted$$
>
> *Given that Intervention C averts only 2 DALYs, the net health benefit of Intervention C is -1 DALY averted. Because the net health benefit of Intervention C is negative, implementing Intervention C would decrease total population health.*
>
> $$\Delta h = h - c_h = 2 - 3 = -1\ DALYs\ averted$$

Appendix A.4 explains why net health benefit was used as the measure of cost-effectiveness in this research, rather than the cost-effectiveness ratio.

[11] Assuming a constant budget.

3.

FINDINGS

3.1 Rankings

Firstly, all interventions were ranked according to their net health benefit. See Table 2.1. Drug treatment of uncomplicated malaria (<5) renders the highest net health benefit by far. Other high-ranking interventions are in the areas of *tuberculosis*, *maternal and neonatal care*, *sexual and reproductive health* and *malaria*. A number of *child health* interventions also have high net health benefit, as well as antivenom for snakebites and surgical interventions inguinal hernia repair and cataract surgery.

Some interventions have negative net health benefit. These interventions are in the areas of breast cancer, cervical cancer, asthma, bipolar disorder and unipolar depression. The drug treatment of post-acute ischaemic heart disease and stroke and the glycaemic control of diabetes also have negative net health benefit.

Among the *maternal and neonatal* interventions, emergency obstetric care and skilled maternal and immediate new-born care bring high net health benefit to the population, as well as community-based support for low birthweight babies and emergency neonatal care (see Table 2.2). In the area of *non-communicable diseases (NCDs)*, preventive interventions generally bring more net health benefit than curative interventions.

Table 2.1 – Ranking of all interventions under consideration, according to net health benefit*

Rank	Intervention	Disease area	Remarks	Net health benefit (DALYs averted)
1	Drug treatment uncomplicated malaria (<5)	Malaria		12,820,037
2	Full combination DOTS	TB	'DOTS' stands for Directly Observed Treatment, Short-course. Full combination DOTS is Full DOTS + treatment of multidrug resistant cases.	2,754,068
3	Full DOTS	TB	Minimal DOTS + smear-negative and extra-pulmonary cases.	2,699,506
4	Minimal DOTS plus resistant cases	TB	Minimal DOTS + treatment of multidrug resistant cases.	2,613,290
5	Minimal DOTS	TB	Treatment for new smear-positive cases only.	2,551,994

6	Emergency obstetric care	Maternal and neonatal	Management of obstructed labour, (pre-)eclampsia and maternal sepsis are included.	928,757
7	Skilled maternal and immediate new-born care	Maternal and neonatal	Skilled attendant at birth undertaking: labour surveillance, assistance to birth. If necessary, early detection, management and referral of complications, as well as resuscitation of new-born.	682,072
8	Use of insecticide treated bed nets	Malaria		584,307
9	Inguinal hernia repair	Surgical		563,234
10	Community-based support for low birthweight babies	Maternal and neonatal	Support for breastfeeding, warmth, hygienic cord care and early detection of infections.	448,793
11	Drug treatment sexually transmitted infections (STIs)	SRH		356,121
12	Malaria vaccination	Malaria		341,687
13	Voluntary Counselling and Testing (VCT)	SRH		283,701
14	Antivenom for snakebites	NTDs		255,308
15	Emergency neonatal care (ENC)	Maternal and neonatal	Asphyxia aftercare, management of serious infections, management of very low birthweight infants.	235,431
16	Oral rehydration solution (ORS) for diarrhoea in <5s	Child health		228,165
17	Cataract surgery	Surgical		176,112
18	Tetanus toxoid vaccination (as part of antenatal care)	Maternal and neonatal		172,138
19	Drug treatment childhood pneumonia	Child health		159,043
20	Iron supplementation for pregnant women	Maternal and neonatal		152,278
21	Syphilis detection and treatment (as part of antenatal care)	Maternal and neonatal		144,485
22	Corticosteroids for preterm labour	Maternal and neonatal		141,609

23	Anti-retroviral therapy (ART, first- and second-line treatment, intensive monitoring)	SRH		141,227
24	Anti-retroviral therapy (ART, first- and second-line treatment, no intensive monitoring)	SRH		140,365
25	Pre-referral rectal drug treatment malaria for <5s	Malaria		135,167
26	Anti-retroviral therapy (ART, first-line treatment, intensive monitoring)	SRH		129,405
27	Anti-retroviral therapy (ART, first-line treatment, no intensive monitoring)	SRH		127,993
28	Drug treatment neonatal pneumonia	Maternal and neonatal		122,035
29	Male circumcision	SRH		104,203
30	Antibiotics in case of preterm premature rupture of membranes (pPROM)	Maternal and neonatal		96,461
31	Drug treatment epilepsy	Psychological and neurological		80,733
32	Screening hearing loss	ENT	Screening of all individuals who present themselves at health facilities with relevant symptoms. It is assumed hearing aids are purchased when needed.	66,645
33	Intermittent preventive treatment malaria during pregnancy	Malaria		51,165
34	Advice in case of heavy alcohol use	Psychological and neurological		44,865
35	Pre-referral rectal drug treatment malaria for >5s	Malaria		41,620
36	Retinopathy screening and photocoagulation for diabetes	NCDs		39,281
37	Screening children 5-15 for uncorrected refraction error	Child health	Annual screening of all children 5-15. It is assumed spectacles are purchased when needed.	37,318

38	Iron supplementation for infants	Child health		31,314
39	HPV (16,18) vaccination	NCDs	HPV stands for human papilloma virus. The vaccination is used to prevent cervical cancer.	20,496
40	Integrated mass drug administration for schistosomiasis and soil-transmitted helminthiasis (children 5-14)	NTDs	Annual concurrent administration of praziquantel and albendazole to children aged 5-14.	15,849
41	Distribution misoprostol for the prevention of post-partum haemorrhage	Maternal and neonatal		13,812
42	Integrated mass drug administration strategies for schistosomiasis and soil-transmitted helminthiasis (community-wide)	NTDs	Annual concurrent administration of praziquantel and albendazole to the entire population.	13,186
43	Pap smear (at age 40) + cervical cancer treatment if necessary	NCDs		12,660
44	VIA (at age 40) + cervical cancer treatment if necessary	NCDs	VIA stands for visual inspection with acetic acid.	11,701
45	Drug treatment otitis media	ENT		11,439
46	Asymptotic bacteriuria detection and treatment (as part of antenatal care)	Maternal and neonatal		10,898
47	Preventive drug treatment for patients at risk of a cardiovascular disease (CVD) event	NCDs	For patients with >20% absolute risk of CVD event.	8,178
48	VIA (at age 35,40,45) + cervical cancer treatment if necessary	NCDs	VIA stands for visual inspection with acetic acid.	7,752
49	First Hepatitis B vaccination within 24 hours of birth	Maternal and neonatal	Vaccination schedule of vaccinations at 0 – 10 – 14 weeks, instead of standard schedule (6 – 10 – 14 weeks).	3,990
50	Isoniazid preventive therapy all HIV-infected pregnant women	Maternal and neonatal		3,383

51	Pap smear (at age 40) + removal of lesions	NCDs		2,071
52	Breast cancer, treatment stage I	NCDs		1,389
53	Drug + psychosocial treatment schizophrenia	Psychological and neurological		1,317
54	VIA (at age 40) + removal of lesions	NCDs	VIA stands for visual inspection with acetic acid.	1,043
55	Isoniazid preventive therapy HIV-infected pregnant women with CD4 < 200	Maternal and neonatal		616
56	Breast cancer, treatment stage II	NCDs		176
57	VIA (at age 35,40,45) + removal of lesions	NCDs	VIA stands for visual inspection with acetic acid.	-826
58	Cervical cancer treatment	NCDs		-1,988
59	Breast cancer, treatment stage IV	NCDs		-3,166
60	Pap smear (every 5 years at ages 20-65) + removal of lesions	NCDs		-3,465
61	Breast cancer, treatment stage III	NCDs		-7,604
62	Breast cancer, treatment all stages	NCDs		-8,420
63	Pap smear (every 5 years at ages 20-65) + cervical cancer treatment if necessary	NCDs		-11,209
64	Drug treatment of post-acute ischaemic heart disease (IHD) and stroke	NCDs		-22,018
65	Drug treatment asthma	NCDs		-26,704
66	Drug treatment bipolar disorder	Psychological and neurological		-26,887
67	Drug + psychosocial treatment bipolar disorder	Psychological and neurological		-33,935
68	Episodic drug + psychosocial treatment unipolar depression	Psychological and neurological		-84,231

69	Maintained drug + psychosocial treatment unipolar depression	Psychological and neurological		-113,295
70	Standard glycaemic control diabetes	NCDs		-1,339,134

** ENT = ear, nose and throat. NCDs = non-communicable diseases. NTDs = neglected tropical diseases. SRH = sexual and reproductive health. TB = tuberculosis.*

Table 2.2 – Ranking of interventions according to net health benefit, by disease area

Rank	Intervention	Net health benefit (DALYs averted)
CHILD HEALTH		
16	Oral rehydration solution (ORS) for diarrhoea in <5s	228,165
19	Drug treatment childhood pneumonia	159,043
37	Screening school children for uncorrected refraction error	37,318
38	Iron supplementation for infants	31,314
EAR, NOSE AND THROAT		
32	Screening hearing loss	66,645
45	Drug treatment otitis media	11,439
MALARIA		
1	Drug treatment uncomplicated malaria (<5)	12,820,037
8	Use of insecticide treated bed nets	584,307
12	Malaria vaccination	341,687
25	Pre-referral rectal drug treatment malaria for <5s	135,167
33	Intermittent preventive treatment malaria during pregnancy	51,165
35	Pre-referral rectal drug treatment malaria for >5s	41,620
MATERNAL AND NEONATAL		
6	Emergency obstetric care	928,757
7	Skilled maternal and immediate new-born care	682,072
10	Community-based support for low birthweight babies	448,793
15	Emergency neonatal care (ENC)	235,431
18	Tetanus toxoid vaccination (as part of antenatal care)	172,138
20	Iron supplementation for pregnant women	152,278
21	Syphilis detection and treatment (as part of antenatal care)	144,485
22	Corticosteroids for preterm labour	141,609
28	Drug treatment neonatal pneumonia	122,035
30	Antibiotics in case of preterm premature rupture of membranes (pPROM)	96,461
41	Distribution misoprostol for the prevention of post-partum haemorrhage	13,812

46	Asymptotic bacteriuria detection and treatment (as part of antenatal care)	10,898
49	First Hepatitis B vaccination within 24 hours of birth	3,990
50	Isoniazid preventive therapy all HIV-infected pregnant women	3,383
55	Isoniazid preventive therapy HIV-infected pregnant women with CD4 < 200	616
NEGLECTED TROPICAL DISEASES		
14	Antivenom for snakebites	255,308
40	Integrated mass drug administration for schistosomiasis and soil-transmitted helminthiasis (children 5-14)	15,849
42	Integrated mass drug administration strategies for schistosomiasis and soil-transmitted helminthiasis (community-wide)	13,186
NON-COMMUNICABLE DISEASES		
36	Retinopathy screening and photocoagulation for diabetes	39,281
39	HPV (16,18) vaccination	20,496
43	Pap smear (at age 40) + cervical cancer treatment if necessary	12,660
44	VIA (at age 40) + cervical cancer treatment if necessary	11,701
47	Preventive drug treatment for patients at risk of a cardiovascular disease (CVD) event	8,178
48	VIA (at age 35,40,45) + cervical cancer treatment if necessary	7,752
51	Pap smear (at age 40) + removal of lesions	2,071
52	Breast cancer, treatment stage I	1,389
54	VIA (at age 40) + removal of lesions	1,043
56	Breast cancer, treatment stage II	176
57	VIA (at age 35,40,45) + removal of lesions	-826
58	Cervical cancer treatment	-1,988
59	Breast cancer, treatment stage IV	-3,166
60	Pap smear (every 5 years at ages 20-65) + removal of lesions	-3,465
61	Breast cancer, treatment stage III	-7,604
62	Breast cancer, treatment all stages	-8,420
63	Pap smear (every 5 years at ages 20-65) + cervical cancer treatment if necessary	-11,209
64	Drug treatment of post-acute ischaemic heart disease (IHD) and stroke	-22,018
65	Drug treatment asthma	-26,704
70	Standard glycaemic control diabetes	-1,339,134

PSYCHOLOGICAL AND NEUROLOGICAL		
31	Drug treatment epilepsy	80,733
34	Advice in case of heavy alcohol use	44,865
53	Drug + psychosocial treatment schizophrenia	1,317
66	Drug treatment bipolar disorder	-26,887
67	Drug + psychosocial treatment bipolar disorder	-33,935
68	Episodic drug + psychosocial treatment unipolar depression	-84,231
69	Maintained drug + psychosocial treatment unipolar depression	-113,295
SEXUAL AND REPRODUCTIVE HEALTH		
11	Drug treatment sexually transmitted infections (STIs)	356,121
13	Voluntary Counselling and Testing (VCT)	283,701
23	Anti-retroviral therapy (ART, first- and second-line treatment, intensive monitoring)	141,227
24	Anti-retroviral therapy (ART, first- and second-line treatment, no intensive monitoring)	140,365
26	Anti-retroviral therapy (ART, first-line treatment, intensive monitoring)	129,405
27	Anti-retroviral therapy (ART, first-line treatment, no intensive monitoring)	127,993
29	Male circumcision	104,203
SURGERY		
9	Inguinal hernia repair	563,234
17	Cataract surgery	176,112
TUBERCULOSIS		
2	Full combination DOTS	2,754,068
3	Full DOTS	2,699,506
4	Minimal DOTS plus resistant cases	2,613,290
5	Minimal DOTS	2,551,994

3.2 Total cost

When we: assume 100% coverage (i.e. the entire population in need receives the intervention); exclude interventions that currently fall under the TB and HIV/AIDS Control Programmes[12]; and delete the least beneficial one(s) in cases of mutually exclusive interventions[13], the total cost of delivering the interventions under consideration is GH₵4,396 million. See Table 3 for a breakdown of the delivery cost by cost category (HR, medicines, consumables, in-patient days). When assuming 35% coverage (which is current coverage), the total cost of delivering the interventions under consideration would be GH₵1,539 million. Given that many interventions were excluded from consideration for lack of data availability, this cost estimate is likely to be an underestimation of the actual cost of delivering a benefits package with a wide range of interventions included. The total available budget is assumed to be GH₵1,020 million, which is based on the 2017 NHIA expenditure on claims (see Appendix A.1). This suggests the need to slim down the current NHIA package, which includes over 95% of diseases occurring in Ghana. Alternatively, resource allocation to the health sector should be greatly increased.

Table 3 – Cost of including all interventions under consideration in the benefits package, by cost category

Category	HR	Medicines	Consumables	In-patient days
Total cost	387,845,976	2,798,194,660	1,022,931,936	187,127,692
% of total	9%	64%	23%	4%

3.3 Scenario analysis – packages

Six different benefits package options are presented.

- Packages 1A and 1B focus on maximising total net health benefit.
    - In Package 1A all interventions are considered, while Package 1B excludes from consideration interventions with a budget impact > GH₵250 million.
- Package 2 includes a high number of interventions and assumes only 50% population coverage.
- Package 3 assumes that only primary care is covered through the NHIS.

[12] The prevention and treatment of HIV/AIDS and TB is currently largely funded by the Global Fund, which is projected to remain the case at least until 2025 (Murray-Zmijewski & Witter, 2018).

[13] With one exception. Although offering breast cancer treatment for all stages of cancer is the least beneficial option out of the mutually exclusive options for breast cancer treatment, the alternative options (treating only breast cancer cases in stage I, II, III or IV, respectively) were deleted for ethical reasons.

- Packages 4A and 4B assume that certain interventions require a 50% co-payment by the patient.
    - In Package 4A a co-payment is charged for interventions with high budget impact (> GH₵50 million), while in Package 4B a co-payment is charged for interventions with low net health benefit (< 40,000 DALYs averted)

See Table 4 for an overview. Additional details can be found in Appendix A.3. Maximising net health benefit is included as a secondary goal in Packages 2-4B as it is a measure of cost-effectiveness. The presented packages serve as examples; many more options are possible.

Table 4 – Goals and assumptions used for assembling the different packages (scenario analysis)

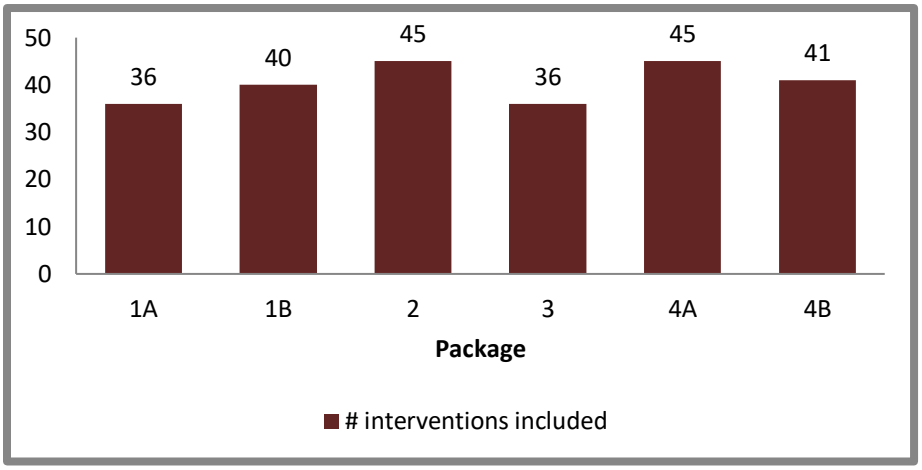
Package	Primary goal	Secondary goal(s)	Additional assumptions
1A	Maximise net health benefit	- No co-payments - 100% coverage	Consider all interventions
1B	Maximise net health benefit	- No co-payments - 100% coverage	Do not consider interventions with budget impact > GH₵250 million
2	Include high number of interventions	- Maximise net health benefit - No co-payments	- 50% coverage
3	Include only primary care interventions	- Maximise net health benefit - No co-payments - 100% coverage	
4A	Add co-insurance	- Maximise net health benefit - 50% co-insurance rate with a cap at GH₵1,000 for a subset of interventions	- 85% coverage for co-insurance interventions - Co-insurance for interventions with budget impact > GH₵50 million
4B	Add co-insurance	- Maximise net health benefit - 50% co-insurance rate with a cap at GH₵1,000 for a subset of interventions	- 85% coverage for co-insurance interventions - Co-insurance for interventions with net health benefit < 40,000 DALYs averted

The packages were compiled by first ranking the interventions and then including all the interventions that fitted within the budget. It was assumed that the last intervention to be included had to be provided at the same level of coverage as the other interventions in the package (i.e. it could not be provided to only a subset of the population in need), implying that the budget of GH₵1,020 million was never fully exhausted. The costs for packages 1A-4B range between GH₵847 and 1,000 million.

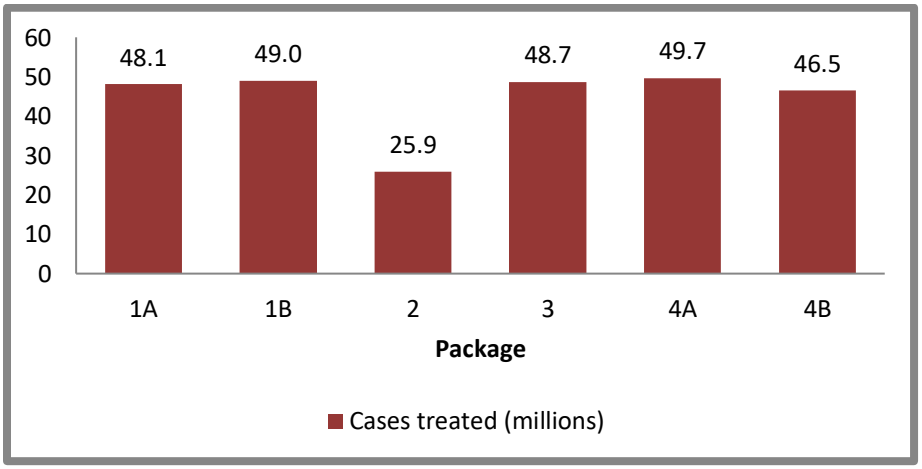
The number of interventions included ranges between 36 and 45. The cases treated range between 25.9 million and 49.7 million and the DALYs averted between 9.6 million and 19.5 million (see Figure 3). The budget impacts by disease area vary across the packages and are shown in Figures 4.1-6. Appendix A.5 shows the full lists of interventions for each package.

Figure 3 – Comparison of indicator performance of the benefits packages

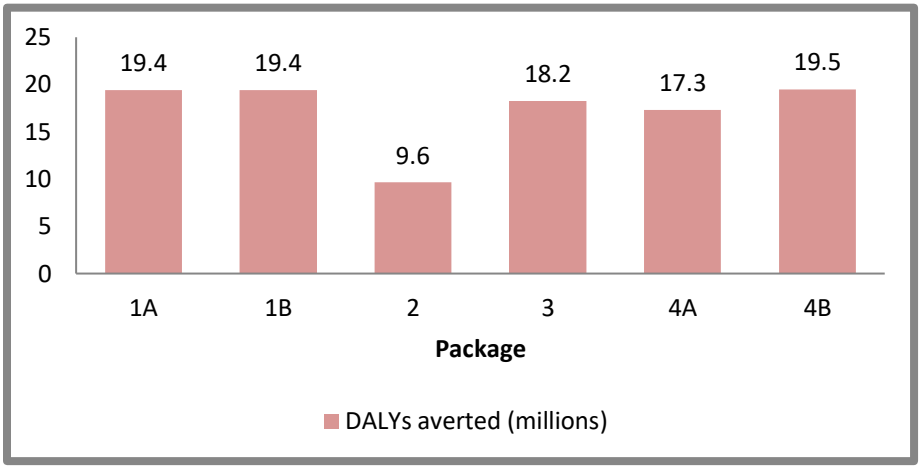
(i) Number of interventions included



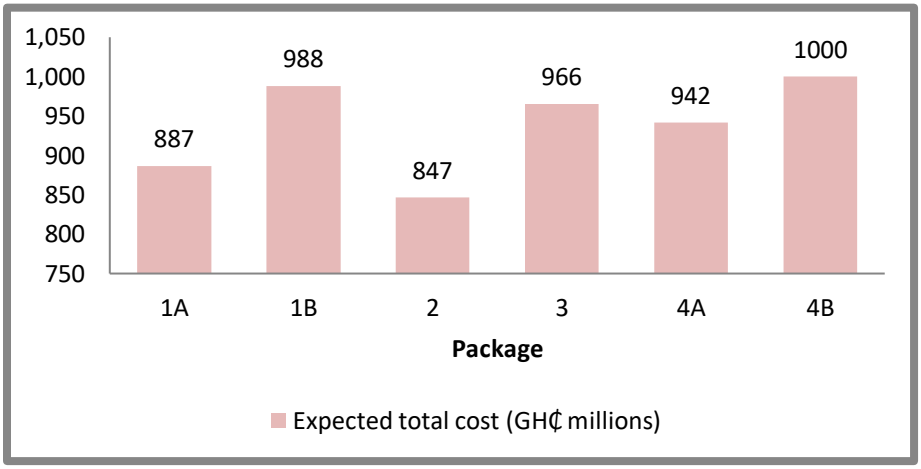
(ii) Cases treated



(iii) DALYs averted



(iv) Expected total cost



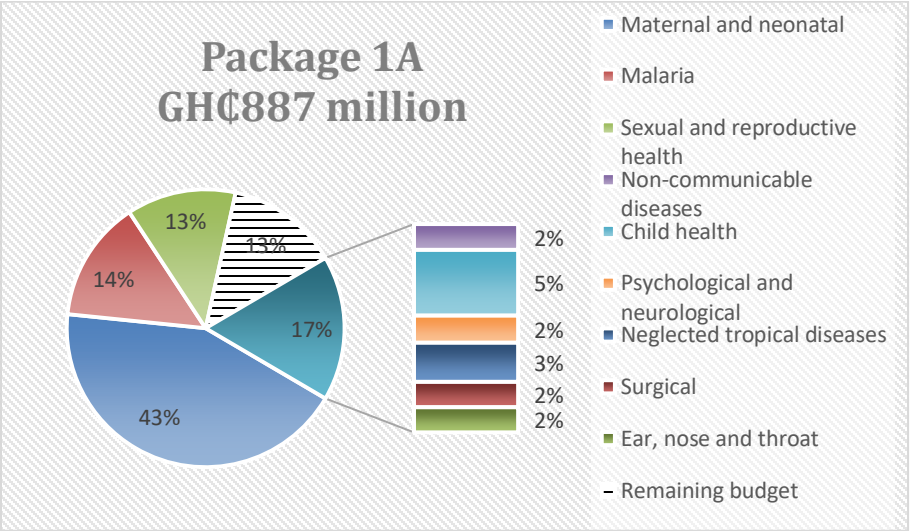
3.3.1 Package 1 – Maximise total health benefit

For Packages 1A and 1B, interventions were added in order of decreasing net health benefit until the budget ran out. While Package 1A considers all interventions, interventions with a budget impact > GH₵250 million were excluded in Package 1B.

Package 1A

36 interventions were included in Package 1A. The total annual cost was estimated to be GH₵887 million and total annual DALYs averted 19.4 million. 48.1 million cases are treated annually. The areas *maternal and neonatal*, *malaria* and *sexual and reproductive health* make up 70% of the budget. *Child health* takes up 5%, while the other disease areas each take 2-3% of the budget. 13% of the budget is remaining.

Figure 4.1 – Budget impact by disease area (Package 1A)



Package 1B

However, once interventions with very high budget impact (> GH₵250 million) were excluded from consideration, Package 1B could be assembled, which contains 4 additional interventions[14]. The additional interventions were in the areas of *NCDs*, *psychological and neurological disorders* and *maternal and neonatal care*. The total cost was estimated to be GH₵988 million and total DALYs averted 19.4 million. 49 million cases are treated annually. The three largest disease areas take 72% of the budget. The shares for *NCDs* and *psychological and neurological* are larger than in Package 1A (13% combined in Package 1B vs. 4% combined in Package 1A), while a smaller percentage of the total budget remains (3% in Package 1B vs. 13% in Package 1A).

[14] The 37th intervention to be included in Package 1A (based on its net health benefit) was preventive drug treatment for people at risk of a CVD event. However, this intervention would take up 27% of the total budget, while only 13% of the budget was left for Package 1A. Excluding the CVD prevention treatment from consideration meant that other interventions that were less beneficial but had a smaller budget impact could be included.

Figure 4.2.1 – Budget impact by disease area (Package 1B)

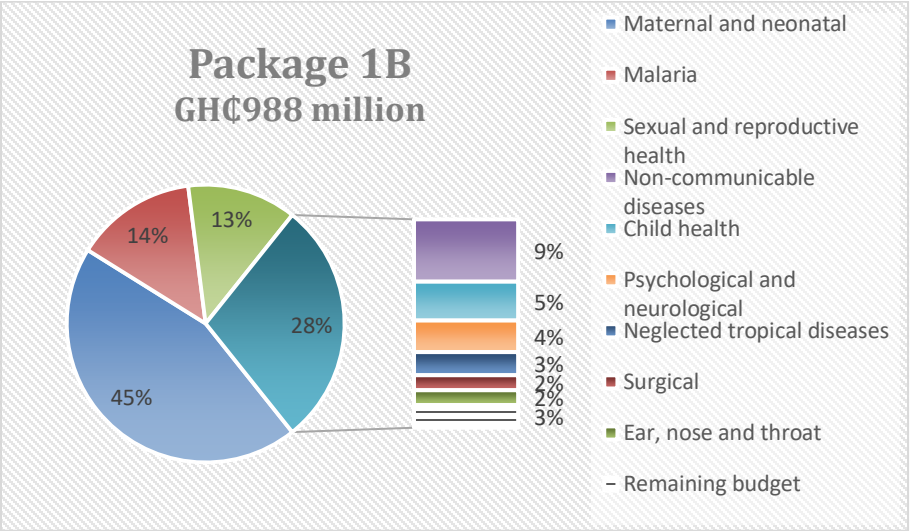


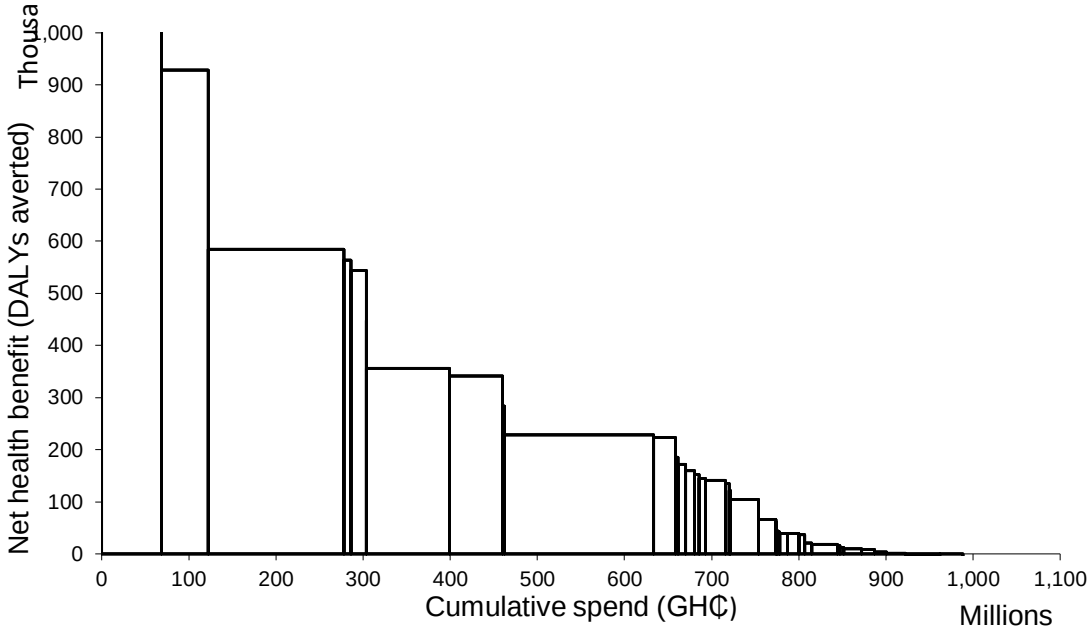
Table 5 shows that the only two interventions with a budget impact > GH₵250 million are both in the area of NCDs. Previous research has shown that inducing lifestyle changes in order to reduce the occurrence of NCDs has the potential for large cost-savings and increased health outcomes (Barton, Andronis, Briggs, McPherson, & Capewell, 2011; Shroufi et al., 2013). The topic of inducing lifestyle changes is beyond the scope of this research study, as it may involve public health programmes and collaboration with stakeholders outside the realm of standard service delivery (e.g. Ministry of Education, Ministry of Youth and Sports) but it warrants further attention (as will be discussed in section 4.2).

Table 5 – Interventions with budget impact > GH₵250 million

Intervention	Annual cost per case treated (GH₵)	Population in need	Total annual cost (GH₵)
Preventive drug treatment for patients at risk of a cardiovascular disease (CVD) event	470	587,544	**275,950,783**
Standard glycaemic control diabetes	3,610	748,660	**2,702,563,936**

Figure 4.2.2 illustrates the method for compiling Package 1B. The net health benefit of each intervention is indicated along the y-axis, while the cost of delivering the intervention is indicated along the x-axis. The decreasing height of the bars demonstrates that the interventions were added to the package in order of decreasing net health benefit. Figure 4.2.2 shows that some of the most beneficial interventions have high budget impact.

Figure 4.2.2 – Graphic representation of process for compiling Package 1B

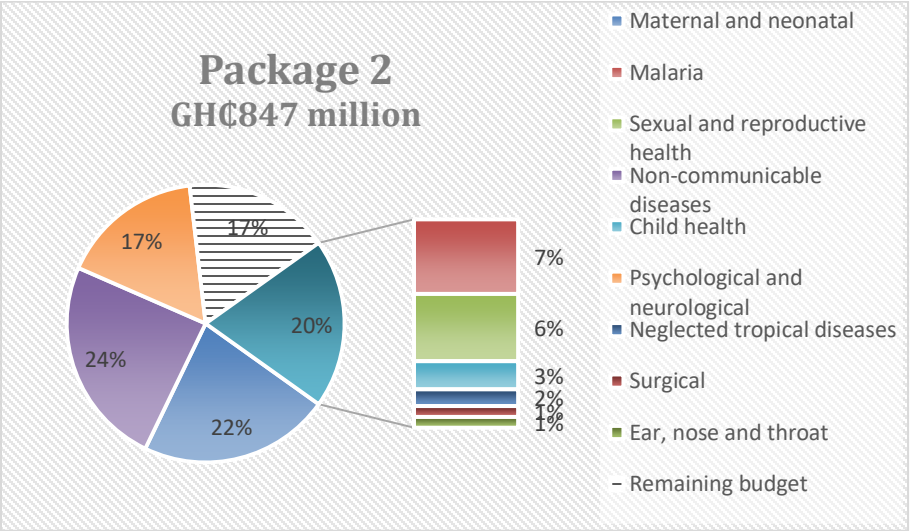


3.3.2 Package 2 – Many interventions covered

For benefits package 2, again, interventions with high net health benefit were added first. To enable a high number of interventions to be included in the package, it was assumed that only 50% of the total annual 'population in need' received treatment. 45 interventions were included in Package 2. The total cost was estimated to be GH₵847 million and total DALYs averted 9.6 million. 25.9 million cases are estimated to be treated.

The budget allocation for *NCDs* and *psychological and neurological* is much larger than in Package 1B (41% combined in Package 2 vs. 13% combined in Package 1B), while the shares for *maternal and neonatal*, *malaria* and *sexual and reproductive health* are smaller (35% combined in Package 2 vs. 72% combined in Package 1B).

Figure 4.3 – Budget impact by disease area (Package 2)

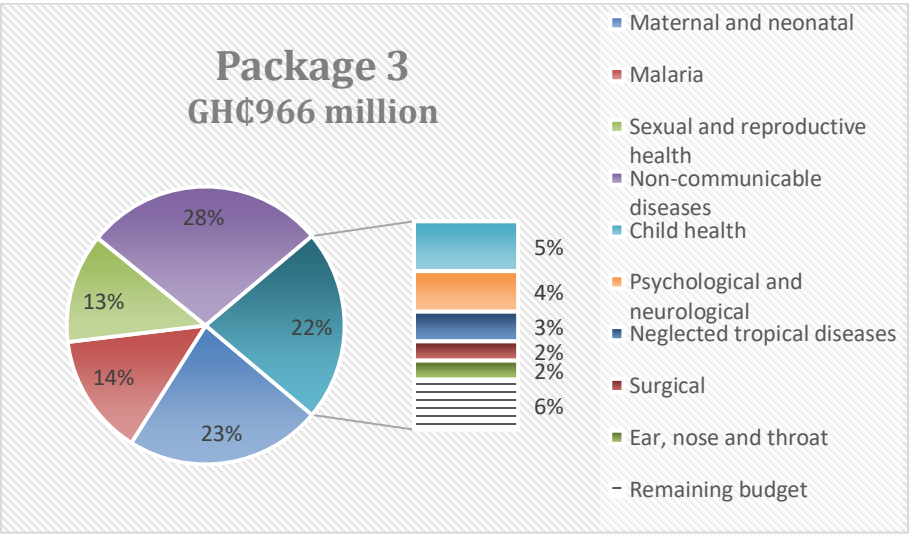


3.3.3 Package 3 – Only primary care

Only primary care interventions were included in benefits package 3.
A benefits package covering all primary care interventions under consideration costs GH₵4,097 million (see Appendix A.5.3), which is above budget. Therefore, interventions with lower net health benefit were excluded from Package 3. The cost of the obtained package was estimated to be GH₵966 million, with 18.2 million DALYs averted and 48.7 million total cases treated.

In terms of budget allocation, Package 3 looks similar to Package 1B. However, the share for *maternal and neonatal* is smaller (23% in Package 3 vs. 45% in Package 1B). The share for *NCDs* is larger (28% in Package 3 vs. 9% in Package 1B).

Figure 4.4 – Budget impact by disease area (Package 3)



3.3.4 Benefits package 4 – Co-insurance

Packages 4A and 4B were both split up in two parts: **(a)** a basic package provided for free at the point of delivery and **(b)** an additional package which has a 50% co-insurance rate, with a maximum co-payment of GH₵1,000. The presence of co-insurance is likely to discourage some people from seeking treatment. It was assumed that a co-insurance rate of 50% will lead to a 15% drop in coverage[15]. See Tables 6.1 and 6.2 for an overview of the co-payment levels for the interventions included in part **(b)** of Packages 4A and 4B.

Package 4A

45 interventions were included in Package 4A. 34 interventions were included in part (a) of Package 4A. 11 interventions (those with a budget impact of more than GH₵50 million) were included in part (b). The total cost was estimated to be GH₵942 million and total DALYs averted 17.3 million. 49.7 cases are estimated to be treated annually.

The budget allocations by disease area are similar to those for Package 2 (which focused on including many interventions), though there is a larger budget share for the areas of *child health*, *neglected tropical diseases*, *surgical* and *ENT* and a smaller budget share remaining (8% remaining budget in Package 4A vs. 17% remaining budget in Package 2). The basic package takes up 41% of the estimated total cost, while the additional package receives 59%.

Co-payments range between GH₵8 and GH₵805. A number of drug treatments for chronic disorders require a co-payment, as well as the drug treatment of bipolar disorder and unipolar depression. Some (emergency) maternal and neonatal interventions also require a co-payment. The median co-payment is GH₵125.

[15] This is based on experimental research by Manning et al. (1987), which finds that the likelihood of any healthcare use drops by 16% for children and 13% for adults when comparing a 50% co-insurance plan to an insurance plan without co-insurance.

Figure 4.5.1 – Budget impact by disease area (Package 4A)

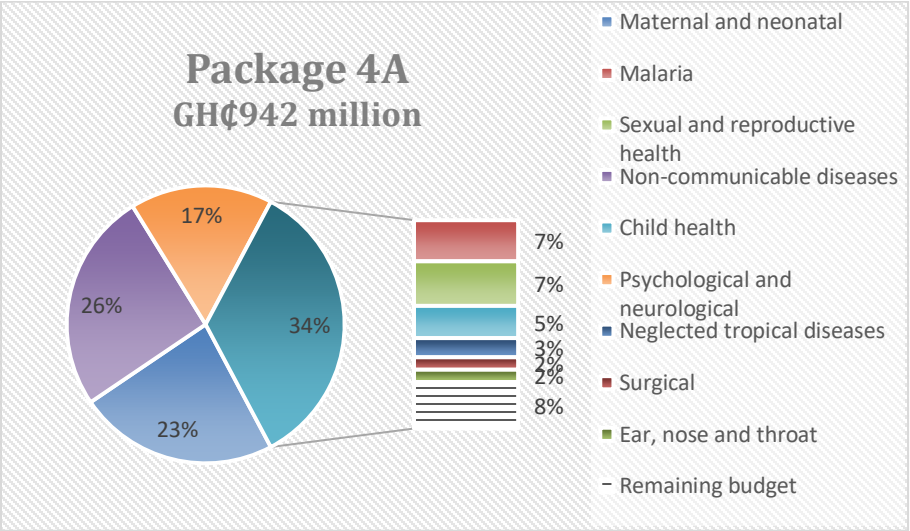
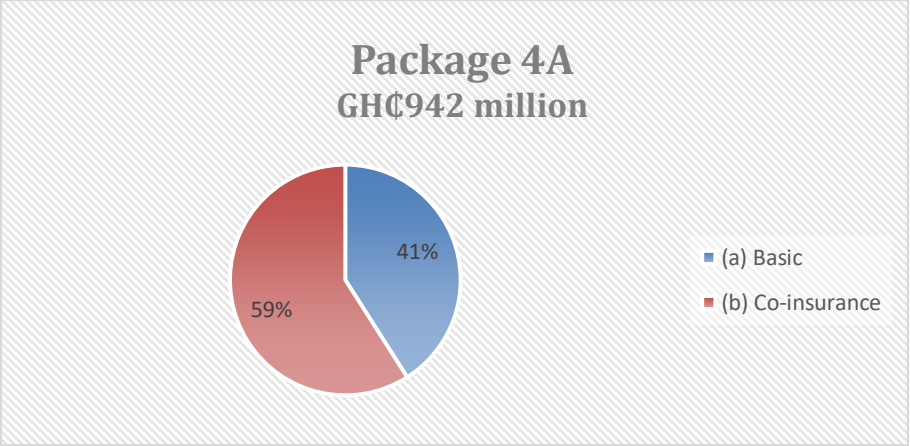


Figure 4.5.2 – Budget allocation for part (a) and part (b) (Package 4A)



Package 4B

Package 4B contains 41 interventions. 27 interventions were included in part (a) of the package, while part (b) consists of 14 interventions. Interventions were included in part (b) if they had a net health benefit of less than 40,000 DALYs averted. Total cost was estimated to be GH₵1,000 million. DALYs averted were estimated to be 19.5 million and cases treated 46.5 million.

The budget impact by disease area is similar to that for Package 1B (which aimed to maximise net health benefit), although the budget share for *NCDs* is larger (17% in Package 4B vs. 9% in Package 1B). Part (a) of the package takes up 78% of the estimated cost and part (b) 22%.

Co-payments range between GH₵1 and GH₵1000. The treatment of cervical cancer and breast cancer require the highest co-payment of GH₵1000. Other co-payments are relatively low and the median co-payment is GH₵8. The interventions requiring co-payments are mostly preventive interventions.

Figure 4.6.1 – Budget impact by disease area (Package 4B)

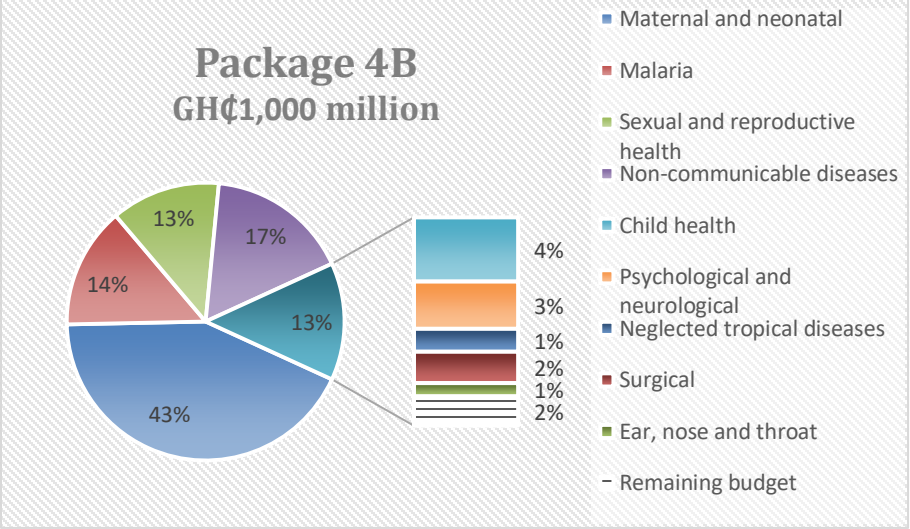


Figure 4.6.2 – Budget allocation for part (a) and part (b) (Package 4B)

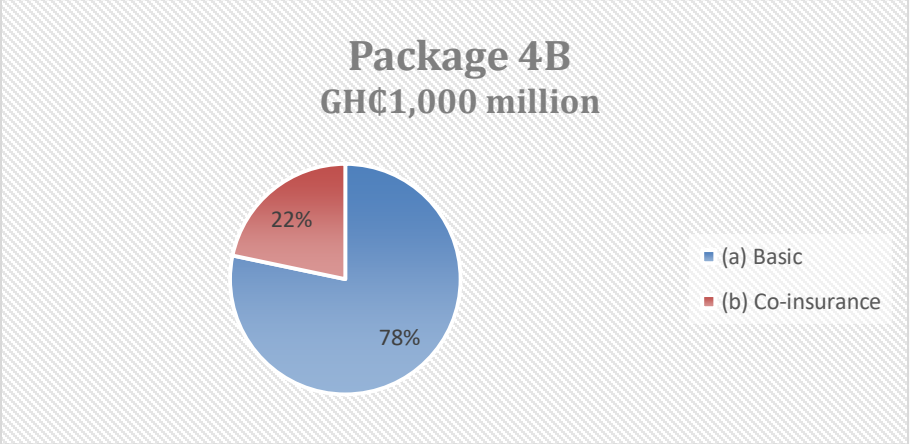


Table 6.1 – Co-payments for interventions in Package 4A**

#	Intervention	Disease area	Co-payment (GH₵)
1	Drug treatment uncomplicated malaria (<5)	Malaria	10
2	Emergency obstetric care	Maternal and neonatal	753

3	Skilled maternal and immediate new-born care	Maternal and neonatal	89
4	Drug treatment sexually transmitted infections (STIs)	SRH	8
5	Malaria vaccination	Malaria	36
6	Emergency neonatal care (ENC)	Maternal and neonatal	805
7	Preventive drug treatment for patients at risk of a cardiovascular disease (CVD) event	NCDs	235
8	Drug treatment of post-acute ischaemic heart disease (IHD) and stroke	NCDs	413
9	Drug treatment asthma	NCDs	26
10	Drug treatment bipolar disorder	Psychological and neurological	295
11	Episodic drug + psychosocial treatment unipolar depression	Psychological and neurological	125
AVERAGE CO-PAYMENT			**254**
MEDIAN CO-PAYMENT			**125**

Table 6.2 – Co-payments for interventions in Package 4B**

#	Intervention	Disease area	Co-payment (GH₵)
1	Retinopathy screening and photocoagulation for diabetes	NCDs	5
2	Screening children 5-15 for uncorrected refraction error	Child health	1
3	Iron supplementation for infants	Child health	3
4	HPV (16,18) vaccination	NCDs	13
5	Integrated mass drug administration for schistosomiasis and soil-transmitted helminthiasis (children 5-14)	NTDs	2
6	Distribution misoprostol for the prevention of post-partum haemorrhage	Maternal and neonatal	3
7	Pap smear (at age 40) + cervical cancer treatment if necessary	NCDs	15
8	Drug treatment otitis media	ENT	5
9	Asymptotic bacteriuria detection and treatment (as part of antenatal care)	Maternal and neonatal	8
10	Preventive drug treatment for patients at risk of a cardiovascular disease (CVD) event	NCDs	235
11	First Hepatitis B vaccination within 24 hours of birth	Maternal and neonatal	8
12	Drug + psychosocial treatment schizophrenia	Psychological and neurological	251
13	Cervical cancer treatment	NCDs	1000
14	Breast cancer, treatment all stages	NCDs	1000
AVERAGE CO-PAYMENT			**182**
MEDIAN CO-PAYMENT			**8**

*** ENT = ear, nose and throat. NCDs = non-communicable diseases. NTDs = neglected tropical diseases. SRH = sexual and reproductive health.*

4.

DISCUSSION

4.1 Comparison of packages

Tables 7.1 and 7.2 show the outcomes of the six benefits packages in terms of three indicators:

(i) Number of interventions included in the package

(ii) Number of cases treated with the package

(iii) DALYs averted with the package

For each indicator, the package with the highest outcome is marked green in Table 7.1. Table 7.2 shows, by indicator, the percentage difference between each outcome and the highest outcome. Values ≤ |5%| are marked green, values ≥ |25%| are marked red. Values in between |5%| and |25%| are marked amber. Tables 7.1 and 7.2 show that there may be trade-offs between different policy goals.

Table 7.1 – Comparison of outcomes (absolute)

Package	1A	1B	2	3	4A	4B
(i) # interventions included	36	40	45	36	45	41
(ii) Cases treated (millions)	48.1	49.0	25.9	48.7	49.7	46.5
(iii) DALYs averted (millions)	19.4	19.4	9.6	18.2	17.3	19.5

Table 7.2 – Comparison of outcomes (relative)

Package	1A	1B	2	3	4A	4B
(i) # interventions included	-20%	-11%	0%	-20%	0%	-9%
(ii) Cases treated (millions)	-3%	-1%	-48%	-2%	0%	-6%
(iii) DALYs averted (millions)	0%	0%	-51%	-6%	-11%	0%

Package 1A: Maximises total net health benefit

Package 1B: Maximises total health benefit, excludes interventions with budget impact > GH₵250 million

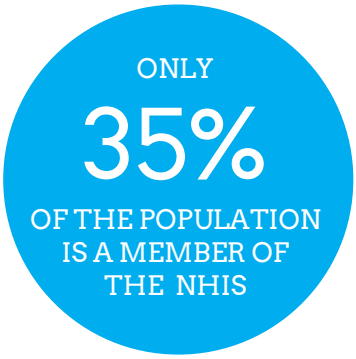
Package 2: Focuses on including many interventions, reduces population coverage

Package 3: Includes only primary care interventions

Package 4A: Requires a 50% co-payment for interventions with budget impact > GH₵50 million

Package 4B: Requires a 50% co-payment for interventions with net health benefit < 40,000 DALYs averted

Package 1A focuses solely on maximising net health benefit and considers all interventions. The outcomes for the package are good, though the number of interventions included is the (shared) lowest. Package 1B, which excluded from consideration interventions with very high budget impact (> GH₵250 million), has better outcomes. This implies that budget impact is important to consider and that it may sometimes be favourable to prioritise for inclusion interventions that are less beneficial but have a smaller budget impact. An alternative option could be to provide high-budget impact interventions only to specific sub-groups (e.g. indigents, elderly, pregnant women) rather than the entire 'population in need'.



Package 2, which has the (shared) highest number of interventions but a relatively low level of population coverage, achieves poor outcomes in terms of DALYs averted and number of cases treated. Currently, the NHIS benefits package includes interventions for over 95% of Ghana's diseases/ conditions yet only 35% of the population is a member of the NHIS. The findings for Package 2 suggest that cutting the number of interventions covered and focusing on enrolling more people in the NHIS is likely to achieve better outcomes in terms of total population health.

Package 3 includes only primary care services. The package achieves a high number of cases treated, though it has the (shared) lowest number of interventions included. Package 3 averts 6% less DALYs that Package 1B, despite the contents of the two packages being fairly similar. An important reason for this is that some highly cost-effective interventions that cannot be provided at the primary care level (most notably emergency obstetric care and emergency neonatal care) are no longer covered.

Package 4A, which assumes co-insurance for interventions with a budget impact > GH₵50 million, achieves the (shared) highest number of interventions included and the highest number of cases treated. Charging co-insurance payments on interventions with high budget impact is an effective way of expanding the budget available to the NHIS, which can indeed be used to include more interventions in the package and treat more cases. However, the outcome for DALYs averted is second-lowest. The reason for this is that Package 4A charges co-payments on some highly beneficial interventions. Given that the introduction of co-insurance was assumed to reduce the cases treated (i.e. the healthcare demanded), introducing co-payments on highly beneficial interventions causes a high loss of DALYs averted.

Package 4B, which charges co-insurance payments for interventions with net health benefit < 40,000 DALYs averted, has the second highest number of interventions included and is a mid-range performer in terms of cases treated. It achieves the highest number of DALYs averted, though the difference with Packages 1A and 1B is small. The reason that Package 4B achieves a higher total net health benefit than Packages 1A-B,

despite the primary goal of Packages 1A and 1B to maximise net health benefit, is that changes to the cost of an intervention change its net health benefit. By introducing co-insurance, the cost *to the NHIS* per case treated reduces while the (gross) health benefit stays the same. The net health benefit therefore increases.

Equity concerns may be raised, as part of the population in need foregoes the treatments that require co-payments. Package 4A in particular could also be criticised for requiring co-payments for emergency treatments (emergency obstetric care, emergency neonatal care) and for treatments in potentially vulnerable populations such as psychiatric patients. However, equity effects of co-insurance are not clear-cut (O'Donnell et al., 2008; Fleurbaey & Schokkaert, 2012). A number of interventions are included in Packages 4A-B that were not included in Packages 1A-B and 3. The inclusion of these interventions in the package might enable vulnerable populations to receive treatments they would have otherwise foregone. For example, interventions that are included in Package 4A but not in Package 3 are drug treatment bipolar disorder and drug + psychosocial treatment schizophrenia. Furthermore, as a result of limited resources, the *absence* of co-payments might contribute to longer waiting times or reduced quality of (some of the) care. Individuals of higher socioeconomic status are more likely to be able to exploit the system to their advantage, which increases inequity (Schokkaert & van de Voorde, 2011). Introducing co-insurance could therefore be argued to promote equity in some ways, especially if the level of co-payment is based on patients' income and/or wealth levels. Ideally the total annual co-payment, rather than the individual co-payment per treatment, would be based on income/wealth, as low socioeconomic status has been linked to worse health and more healthcare consumed (van Doorslaer, Masseria, & Koolman, 2006; Cutler, Lleras-Muney, & Vogl, 2011; van Doorslaer & Van Ourti, 2011). This could be in a gradual manner (i.e. the higher the income/wealth, the higher the co-payment level) or in a binary way (i.e. individuals below a certain cut-off point are exempted from payments). Both options would require a high degree of administrative sophistication, which might not be feasible in Ghana in the short term. More research suited to the Ghana context is needed.

4.2 Study limitations

Data availability was limited. Limited research has been done on the (cost-) effectiveness of interventions in Ghana. International data was used and adapted where appropriate but various interventions had to be excluded from consideration due to insufficient data. It was particularly hard to find sufficient data regarding the (cost-)effectiveness of interventions in the area of *injuries*, as Ghana does not keep a national Trauma Registry. This led to the exclusion of most injury interventions.

Data inputs came from many different, not always directly comparable sources. For example, most of the studies reporting on the effectiveness of interventions reported only the total amount of DALYs averted for a number of Sub-Saharan African countries lumped together. The relevant Ghana-only figures often had to be derived using additional demographic and epidemiological data. As the effectiveness studies generally did not report the number of people 'in need' of each intervention, the interventions' population in need had to be calculated separately. The myriad of data sources used increases the uncertainty around our research findings. The extent to which the research findings may be affected by this uncertainty could be investigated using sensitivity analysis. Such an exercise was deemed beyond the scope of this research project but we encourage follow-up research in which sensitivity analysis is performed. Sensitivity analysis regarding cost inputs is particularly encouraged as price changes in medicines and consumables are common and can significantly influence interventions' net health benefit. Sensitivity analysis regarding the effect of different co-insurance policies on healthcare demand is also encouraged. The assumption used (50% co-insurance rate resulting in a 15% reduction in demand) was based on empirical research in the US, which may not be sufficiently appropriate for the Ghanaian context.

Additional suggestions for follow-up research are as follows. Firstly, additional outcome indicators may be looked at. In this research, the packages were assessed in terms of five indicators[16]. Yet many other parameters may be deemed relevant and could be included in future research, such as practical feasibility, fiscal space, cultural and social factors, and equity concerns. Equity is a complex topic, as it is multifaceted and depends on ethical judgements about what is 'fair' or 'right'[17]. Equity considerations have historically received less attention in health technology assessments than cost-effectiveness but they are increasingly incorporated, often using Multi-Criteria Decision Analysis (MCDA). See Thokola et al. (2016) and Marsh et al. (2017) for reports on good practices in conducting MCDA. See Culyer & Bombard (2012) and Asaria, Griffin & Cookson (2015) for more information on incorporating equity in HTAs.

Secondly, additional research could be undertaken regarding the benefit of an increased focus on preventive interventions in the area of NCDs – which would be in line with the High-level Meeting on NCDs as part of the 2018 United Nations General Assembly, which called for an increased focus on preventive measures for NCD control. The cost savings of investing in preventive interventions (rather than relying mostly on curative interventions) could be calculated. A health technology assessment aiming to

[16] (i) Number of interventions included in the package, (ii) Number of cases treated with the package, (iii) DALYs averted with the package, (iv) Expected total cost, (v) Budget impact by disease area

[17] Common notions of equity are financial protection (i.e. no one incurs catastrophic spending or impoverishment as a result of receiving care), vertical equity in healthcare financing (i.e. those who have a higher ability-to-pay pay relatively more for care) and horizontal equity in care use (i.e. people of equal need receive equal care). However, many other equity discussions may be had, e.g. 'Should we prioritise people who have very severe diseases over those with mild diseases?', 'Should we prioritise people with a healthy lifestyle over those with an unhealthy lifestyle?', etc.

give recommendations on the best interventions and care pathways for preventing NCDs in Ghana could be conducted. Such studies would help in priority-setting and resource allocation in the increasingly prominent area of NCDs.

Thirdly, the assumption that 100% of the population in need receives treatment (for Packages 1A-B and 3) is not representative of the current situation in Ghana and is not likely to be practically feasible in the short term. It was used to show the maximum attainable benefit for each intervention (under current circumstances). A follow-up study could be done using more realistic coverage figures. See for example Ochalek et al. (2016), an HTA study in which the health benefit of moving from current coverage to 100% coverage was calculated for each intervention under consideration for the Malawian Essential Health Package.

4.3 Way forward

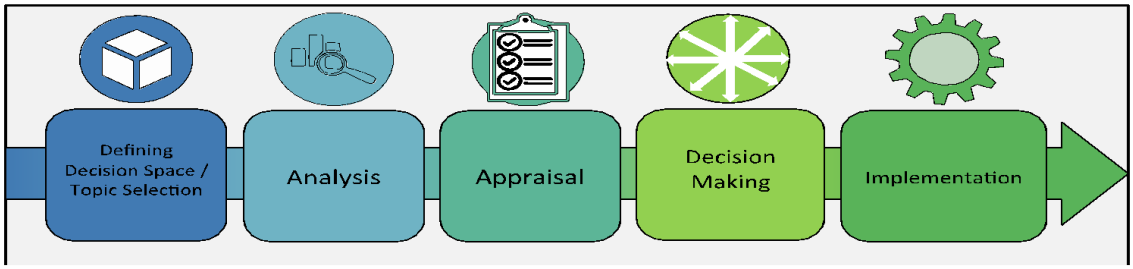
The establishment of an independent body with the technical capacity to follow up on this study as well as pursue other HTA research would be highly valuable. Implementing the findings from relevant and rigorous HTA research has the potential to reduce costs and increase population health (Teerawattanon, Tritasavit, Suchonwanich, & Kingkaew, 2014; Guthrie, Hafner, Bienkowska-Gibbs, & Wooding, 2016). A recent report making recommendations regarding the institutionalisation of HTA in Ghana's health sector suggests that HTA research could initially be done by a small team within the Ministry of Health, aided by external resources from academia (PATH, unpublished). Subsequently, the HTA team can gradually develop into a larger body. The HTA body could become an Agency under the Ministry of Health or an altogether independent institute. In either case, safeguards should be put in place to ensure the research can be conducted in an autonomous manner. As HTA is a broad field, there ought to be staff with a variety of backgrounds, including clinical, pharmaceutical and public health. Health economists and other professionals with modelling/quantitative skills would be essential to include.

Experience in other countries teaches us the paramount importance of extensive stakeholder involvement to ensure the relevance of the conducted HTA research to the local context. See Figure 5 for a broad overview of the typical steps in the priority-setting process (Siegfried, Wilkinson, & Hofman, 2017). HTA research takes place in step 2: *Analysis*. Before that, however, the topics to be researched are selected, typically by a group of stakeholders from different backgrounds (including beneficiaries and civil society organisations). After the HTA research has been conducted, an appraisal committee considers the evidence in a structured manner and distils recommendations (step 3: *Appraisal*). The *Appraisal* step should be undertaken by an independent expert committee, though with technical and secretarial support from the HTA team within MoH (PATH, unpublished). After steps 1-3, the evidence is submitted to relevant

decision-makers. Finally, decisions taken should be fully implemented in order to reap the projected benefits.

See the iDSI Health Technology Assessment Toolkit[18] for more information on how HTA processes can be built.

Figure 5 – Diagrammatic overview priority-setting process



Source: Siegfried et al. (2017)

[18] http://www.idsihealth.org/HTATOOLKIT/

5.

CONCLUSION

In this research study, an economic evaluation of the NHIS benefits package was undertaken. 70 healthcare interventions were costed, using local data from various sources. The costing exercise showed the need to reduce the current NHIS benefits package to ensure financial sustainability of the NHIS. Alternatively, resource allocation to the health sector should be steeply increased.

The interventions were compared according to their net health benefit. This showed that many beneficial interventions are in the areas of *malaria*, *maternal and neonatal care* and *sexual and reproductive health*. A number of *child health* interventions also have high net health benefit, as well as antivenom for snakebites and surgical interventions inguinal hernia repair and cataract surgery. Less beneficial interventions were mostly in the areas of *NCDs* and *neurological and psychological disorders*. Preventive interventions in the area of *NCDs* were generally more cost-effective than curative NCD interventions.

A scenario analysis was conducted in which six different benefits packages were compiled, based on four different policy focuses. It was found that budget impact is important to consider and may prevent interventions from being included in the benefits package. It was shown that aiming to maximise DALYs averted also achieves good results in other areas of interest.

It appeared that focusing on including a high number of interventions, as opposed to covering a larger proportion of the population, leads to low numbers of cases treated and DALYs averted. It is therefore recommended that the NHIS focuses on increasing membership coverage, while cutting the number of interventions included in the benefits package.

It was found that including all available primary care interventions in the benefits package is unlikely to be possible with the current NHIS budget. Additional funding would be needed in order to achieve universal health coverage of primary care. It is recommended that emergency obstetric care and emergency neonatal care are included in any primary care package, despite being higher-level care, as these interventions are highly cost-effective.

Introducing co-insurance appears a promising avenue to achieve good outcomes, though it has the potential to threaten financial protection of the population. To ensure financial protection, the levels of co-payment could be made dependent on the income and/or wealth of the patient. However, this would require the strengthening of data collection on income and wealth, especially among informal sector workers.

Improved data collection on the prevalence and incidence of diseases/conditions in Ghana would also be highly useful. The initiation of a national Trauma Registry is especially encouraged. Monitoring of the prices of medicines and consumables in Ghana would be valuable as well and may be used both to improve the accuracy of follow-up research and to provide inputs into price negotiations between suppliers

and procurement departments. In this vein the planned set-up of the National Medicines Pricing Committee is lauded.

Additional parameters like social and cultural factors, equity, practical feasibility and fiscal space would be useful to consider in a systematic way in follow-up research. Findings from this research project could be elaborated to show the benefits of allocating additional resources to the health sector. They could be used for priority-setting for donor support. They could also be used to make a case for investing in interventions preventing NCDs. Note that preventive interventions in the area of NCDs are likely to require collaborations beyond the normal care pathways, including for example the education, recreation/sports and food production sectors.

6.

POLICY RECOMMENDATIONS

(1) **Focus on enrolling a high proportion of the population into the NHIS** rather than covering many different interventions in the NHIS benefits package. Focusing on covering a high proportion of the population is more cost-effective, i.e. the same amount of government spending renders higher population health.

(2) Given the current budget available for NHIS claims reimbursement, **it is unlikely that all primary care interventions can be covered**. In order to achieve universal health coverage at the primary care level, additional NHIS funding would be needed.

(3) Consider ways of **increasing financial resources** available to the **NHIS**.

(4) When assembling a primary care package, it is recommended that **emergency obstetric care and emergency neonatal care** are **included**, despite being higher-level care, as these are very cost-effective interventions.

(5) Introducing **co-insurance** (for a subset of interventions) appears a **promising avenue** for achieving high population health as well as including many interventions in the benefits package and treating a high number of cases annually. However, **further research is needed** to investigate this option, especially because there may be concerns regarding financial protection. **Income/wealth-based co-payments** could be **considered**.

(6) In the area of non-communicable diseases, preventive interventions tend to be more cost-effective than curative interventions. An **increased policy focus on preventing NCDs** is recommended.

(7) **Strengthen** systems for **data collection**, especially regarding the prevalence and incidence of diseases/conditions occurring in Ghana, prices of medicines and consumables, and income/wealth levels of informal sector workers.

(8) **Cost interventions(/policies)** under consideration in order to enable **assessment of the budget impact.**

(9) It is **recommended that HTA becomes institutionalised** in the health sector. Ideally, HTA tasks would be undertaken by a dedicated body, with technical people from a range of backgrounds. Initially, HTA research could be conducted by a unit within the Ministry of Health. In the future, an Agency (under the Ministry) or an altogether independent institute should be established. Extensive stakeholder engagement is desirable to ensure the generated evidence is relevant to the decision-makers and in line with society's vision. Nonetheless, the research should be conducted in an autonomous manner.

(10) In order to achieve institutionalised HTA, it is recommended that a number of interested and talented officers working in the health sector receive **opportunities for HTA education and training**. Furthermore, seasoned **HTA experts** should continue to be **engaged**.

REFERENCES

Aboagye, A. Q. Q., Degboe, A. N. K., & Obuobi, A. A. D. (2010). Estimating the cost of healthcare delivery in three hospitals in southern Ghana. *Ghana Medical Journal*, *44*(3).

Adam, T., Lim, S. S., Mehta, S., Bhutta, Z. A., Fogstad, H., Mathai, M., ... & Darmstadt, G. L. (2005). Cost effectiveness analysis of strategies for maternal and neonatal health in developing countries. *BMJ*, *331*(7525), 1107.

Alhassan, R. K., Nketiah-Amponsah, E., & Arhinful, D. K. (2016). A Review of the National Health Insurance Scheme in Ghana: What Are the Sustainability Threats and Prospects?. *PLOS One*, *11*(11), e0165151.

Asaria, M., Griffin, S., & Cookson, R. (2016). Distributional Cost-Effectiveness Analysis: A Tutorial. *Medical Decision Making*, *36*(1), 8-19.

Baltussen, R., & Smith, A. (2012). Cost effectiveness of strategies to combat vision and hearing loss in sub-Saharan Africa and South East Asia: mathematical modelling study. *BMJ*, *344*, e615.

Baltussen, R., Floyd, K., & Dye, C. (2005). Cost effectiveness analysis of strategies for tuberculosis control in developing countries. *BMJ*, *331*(7529), 1364.

Baltussen, R., Knai, C., & Sharan, M. (2004). Iron Fortification and Iron Supplementation are Cost-Effective Interventions to Reduce Iron Deficiency in Four Subregions of the World. *The Journal of Nutrition*, *134*(10), 2678-2684.

Barton, P., Andronis, L., Briggs, A., McPherson, K., & Capewell, S. (2011). Effectiveness and cost effectiveness of cardiovascular disease prevention in whole populations: modelling study. *BMJ*, *343*, d4044.

Beard, J. H., Oresanya, L. B., Ohene-Yeboah, M., Dicker, R. A., & Harris, H. W. (2013). Characterizing the Global Burden of Surgical Disease: A Method to Estimate Inguinal Hernia Epidemiology in Ghana. *World Journal of Surgery*, *37*(3), 498-503.

Bhutta, Z. A. (2017). Community–based primary health care: a core strategy for achieving sustainable development goals for health. *Journal of Global Health*, *7*(1).

Buchanan, J., Mihaylova, B., Gray, A., & White, N. (2010). Cost-Effectiveness of Pre-Referral Antimalarial, Antibacterial, and Combined Rectal Formulations for Severe Febrile Illness. *PLOS One*, *5*(12), e14446.

Chalkidou, K., Lord, J., & Gad, M. (2017). Improving the quality and efficiency of healthcare services in Ghana through HTA. *F1000Research*, *6*.

Chisholm, D., & Saxena, S. (2012). Cost effectiveness of strategies to combat neuropsychiatric conditions in sub-Saharan Africa and South East Asia: mathematical modelling study. *BMJ*, *344*, e609.

Culyer, A. J. (2016). Cost-effectiveness thresholds in health care: a bookshelf guide to their meaning and use. *Health Economics, Policy and Law*, *11*(4), 415-432.

Culyer, A. J., & Bombard, Y. (2012). An Equity Framework for Health Technology Assessments. *Medical Decision Making*, *32*(3), 428-441.

Cutler, D., Lleras-Muney, A., & Vogl, T. (2011). Socioeconomic Status and Health: Dimensions and Mechanisms. In P.C. Smith & S. Glied (Eds.), *The Oxford Handbook of Health Economics*. Oxford, U.K.: Oxford University Press.

Darmstadt, G. L., Bhutta, Z. A., Cousens, S., Adam, T., Walker, N., De Bernis, L., & Lancet Neonatal Survival Steering Team. (2005). Evidence-based, cost-effective interventions: how many newborn babies can we save?. *The Lancet*, *365*(9463), 977-988.

van Doorslaer, E., Masseria, C., & Koolman, X. (2006). Inequalities in access to medical care by income in developed countries. *Canadian Medical Association Journal*, *174*(2), 177-183.

van Doorslaer, E., & Van Ourti, T. (2011). Measuring Inequality and Inequity in Health and Health Care. In P.C. Smith & S. Glied (Eds.), *The Oxford Handbook of Health Economics*. Oxford, U.K.: Oxford University Press.

Drummond, M. F., Sculpher, M. J., Claxton, K., Stoddart, G. L., & Torrance, G. W. (2015). *Methods For The Economic Evaluation Of Health Care Programmes*. Oxford, U.K.: Oxford University Press.

Edejer, T. T. T., Aikins, M., Black, R., Wolfson, L., Hutubessy, R., & Evans, D. B. (2005). Cost effectiveness analysis of strategies for child health in developing countries. *BMJ*, *331*(7526), 1177.

Fleurbaey M., & Schokkaert E. (2011). Equity in Health and Health Care. In Pauly M, McGuire T, Barros P (Eds.), *Handbook of Health Economics, Volume* 2. Amsterdam, Netherlands: Elsevier.

GBDx (2016). GBD Results Tool. Available at: http://ghdx.healthdata.org/gbd-results-tool. [Accessed January 8, 2018].

Ghana Statistical Service (2018). Population projections 2010-2020. Unpublished manuscript.

Ginsberg, G. M., Lauer, J. A., Zelle, S., Baeten, S., & Baltussen, R. (2012). Cost effectiveness of strategies to combat breast, cervical, and colorectal cancer in sub-Saharan Africa and South East Asia: mathematical modelling study. *BMJ*, *344*, e614.

González, M. A., Menendez, C., Font, F., Kahigwa, E., Kimario, J., Mshinda, H., ... & Alonso, P. L. (2000). Cost-effectiveness of iron supplementation and malaria chemoprophylaxis in the prevention of anaemia and malaria among Tanzanian infants. *Bulletin of the World Health Organization*, *78*(1), 97-107.

Guthrie, S., Hafner, M., Bienkowska-Gibbs, T., & Wooding, S. (2016). Returns on Research Funded Under the NIHR Health Technology Assessment (HTA) Programme: Economic Analysis and Case Studies. *Rand Health Quarterly*, 5(4), 5.

Habib, A. G., Lamorde, M., Dalhat, M. M., Habib, Z. G., & Kuznik, A. (2015). Cost-Effectiveness of Antivenoms for Snakebite Envenoming in Nigeria. *PLOS Neglected Tropical Diseases*, *9*(1), e3381.

Hogan, D. R., Baltussen, R., Hayashi, C., Lauer, J. A., & Salomon, J. A. (2005). Cost effectiveness analysis of strategies to combat HIV/AIDS in developing countries. *BMJ*, *331*(7530), 1431-1437.

the International Decision Support Initiative (2018). HTA Toolkit v1. www.idsihealth.org/HTATOOLKIT

Kapiriri, L., & Martin, D. K. (2007). A strategy to improve priority setting in developing countries. *Health Care Analysis*, *15*(3), 159-167.

Kapoor, S., Gupta, A., & Shah, M. (2016). Cost-effectiveness of isoniazid preventive therapy for HIV-infected pregnant women in India. *The International Journal of Tuberculosis and Lung Disease*, *20*(1), 85-92.

Kim, J. J., Campos, N. G., O'Shea, M., Diaz, M., & Mutyaba, I. (2013). Model-Based Impact and Cost-Effectiveness of Cervical Cancer Prevention in Sub-Saharan Africa. *Vaccine*, *31*, F60-F72.

Klingler, C., Thoumi, A. I., & Mrithinjayam, V. S. (2012). Cost-effectiveness analysis of an additional birth dose of Hepatitis B vaccine to prevent perinatal transmission in a medical setting in Mozambique. *Vaccine*, *31*(1), 252-259.

Kuznik, A., Lamorde, M., Nyabigambo, A., & Manabe, Y. C. (2013). Antenatal Syphilis Screening Using Point-of-Care Testing in Sub-Saharan African Countries: A Cost-Effectiveness Analysis. *PLOS Medicine*, *10*(11), e1001545.

Lo, N. C., Bogoch, I. I., Blackburn, B. G., Raso, G., N'Goran, E. K., Coulibaly, J. T., ... & Andrews, J. R. (2015). Comparison of community-wide, integrated mass drug administration strategies for schistosomiasis and soil-transmitted helminthiasis: a cost-effectiveness modelling study. *The Lancet Global Health*, *3*(10), e629-e638.

Lubinga, S. J., Atukunda, E. C., Wasswa-Ssalongo, G., & Babigumira, J. B. (2015). Potential Cost-Effectiveness of Prenatal Distribution of Misoprostol for Prevention of Postpartum Hemorrhage In Uganda. *PLOS One*, *10*(11), e0142550.

Manning, W. G., Newhouse, J. P., Duan, N., Keeler, E. B., & Leibowitz, A. (1987). Health Insurance and the Demand for Medical Care: Evidence from a Randomized Experiment. *The American Economic Review*, 251-277.

Marsh, K., IJzerman, M., Thokala, P., Baltussen, R., Boysen, M., Kaló, Z., ... & Devlin, N. (2016). Multiple Criteria Decision Analysis for Health Care Decision Making—Emerging Good Practices: Report 2 of the ISPOR MCDA Emerging Good Practices Task Force. *Value in health*, *19*(2), 125-137.

Ministry of Health Ghana (2017). Ghana Standard Treatment Guidelines Seventh Edition. Accra, Ghana: Ministry of Health.

Ministry of Health Ghana (2017). Holistic Assessment 2017. Accra, Ghana: Ministry of Health.

Morel, C. M., Lauer, J. A., & Evans, D. B. (2005). Cost effectiveness analysis of strategies to combat malaria in developing countries. *BMJ*, *331*(7528), 1299.

Mori, A. T., Ngalesoni, F., Norheim, O. F., & Robberstad, B. (2014). Cost-effectiveness of dihydroartemisinin-piperaquine compared with artemether-lumefantrine for treating uncomplicated malaria in children at a district hospital in Tanzania. *Malaria Journal*, *13*(1), 363.

Murray-Zmijewski, A. & Witter, S. (2018). A Roadmap for Sustainability and Transition from External Finance: Mapping Donor and Domestic Financing for the Health Sector in Ghana and Planning for the Future. Oxford Policy Management for Ministry of Health Ghana.

National Health Insurance Scheme (2016). NHIS Medicines List 2016. Available at: http://www.nhis.gov.gh/medlist.aspx. [Accessed April 3, 2017].

Ochalek, J., Claxton, K., Revill, P., Sculpher, M., & Rollinger, A. (2016). Supporting the Development of an Essential Health Package: Principles and Initial Assessment for Malawi (CHE Research Paper No. 136). York, U.K.: Centre for Health Economics, University of York.

Ochalek, J., Revill, P., Manthalu, G., McGuire, F., Nkhoma, D., Rollinger, A., ... & Claxton, K. (2018). Supporting the development of a health benefits package in Malawi. *BMJ Global Health*, *3*(2), e000607.

Ochalek, J., Lomas, J., & Claxton, K. (2015). *Cost per DALY averted thresholds for low-and middle-income countries: evidence from cross country data* (CHE Research Paper No. 122). York, U.K.: Centre for Health Economics, University of York.

Odame, E. A. (2013). Systematic Review of Economic Evaluation Literature in Ghana: Is Health Technology Assessment the Future?. *Value in Health Regional Issues*, *2*(2), 279-283.

O'Donnell, O., van Doorslaer, E., Rannan-Eliya, R. P., Somanathan, A., Adhikari, S. R., Akkazieva, B., ... & Huq, M. N. (2008). Who pays for health care in Asia?. *Journal of Health Economics*, *27*(2), 460-475.

OneHealth Tool (2016). Intervention Assumptions. Available at: http://avenirhealth.org/Download/Spectrum/Manuals/Treatment%20Assumptions%202016%201%2010.pdf. [Accessed March 21, 2017].

Ortegón, M., Lim, S., Chisholm, D., & Mendis, S. (2012). Cost effectiveness of strategies to combat cardiovascular disease, diabetes, and tobacco use in sub-Saharan Africa and South East Asia: mathematical modelling study. *BMJ*, *344*, e607.

PATH (2017). Institutionalizing Health Technology Assessment in Ghana to Support Access to New Health Technologies: Inception Report. Unpublished manuscript.

Pettigrew, L. M., De Maeseneer, J., Anderson, M. I. P., Essuman, A., Kidd, M. R., & Haines, A. (2015). Primary health care and the Sustainable Development Goals. *The Lancet*, *386*(10009), 2119-2121.

Punguyire, D., Baiden, F., Nyuzaghl, J., Hultgren, A., Berko, Y., Brenner, S., ... & Moresky, R. (2014). Presentation, management, and outcome of snake-bite in two district hospitals in Ghana. *The Pan African Medical Journal*, *19*(219).

Schokkaert, E., & Van de Voorde, C. (2011). User charges. In P.C. Smith & S. Glied (Eds.), *The Oxford Handbook of Health Economics*. Oxford, U.K.: Oxford University Press.

Seo, M. K., Baker, P., & Ngo, K. N. L. (2014). Cost-effectiveness analysis of vaccinating children in Malawi with RTS,S vaccines in comparison with long-lasting insecticide-treated nets. *Malaria Journal*, *13*(1), 66.

Siegfried, N., Wilkinson, T., & Hofman, K. (2017). Where from and where to for health technology assessment in South Africa? A legal and policy landscape analysis. *South African Health Review*, *2017*(1), 42-48.

Shillcutt, S. D., Clarke, M. G., & Kingsnorth, A. N. (2010). Cost-effectiveness ff Groin Hernia Surgery in the Western Region of Ghana. *Archives of Surgery*, *145*(10), 954-961.

Shroufi, A., Chowdhury, R., Anchala, R., Stevens, S., Blanco, P., Han, T., ... & Franco, O. H. (2013). Cost effective interventions for the prevention of cardiovascular disease in low and middle income countries: a systematic review. *BMC Public Health*, *13*(1), 285.

Stanciole, A. E., Ortegón, M., Chisholm, D., & Lauer, J. A. (2012). Cost effectiveness of strategies to combat chronic obstructive pulmonary disease and asthma in sub-Saharan Africa and South East Asia: mathematical modelling study. *BMJ*, *344*, e608.

Teerawattananon, Y., Tritasavit, N., Suchonwanich, N., & Kingkaew, P. (2014). The use of economic evaluation for guiding the pharmaceutical reimbursement list in Thailand. *Zeitschrift für Evidenz, Fortbildung und Qualität im Gesundheitswesen*, *108*(7), 397-404.

Terwindt, F., Rajan, D., & Soucat, A. (2016). Priority-setting for national health policies, strategies and plans. In Schmets, G., Rajan, D., & Kadandale, S (Eds.), *Strategizing national health in the 21st century: a handbook*. Geneva, Switzerland: World Health Organisation.

Thokala, P., Devlin, N., Marsh, K., Baltussen, R., Boysen, M., Kalo, Z., ... & IJzerman, M. (2016). Multiple Criteria Decision Analysis for Health Care Decision Making—An Introduction: Report 1 of the ISPOR MCDA Emerging Good Practices Task Force. *Value in Health*, *19*(1), 1-13.

Uthman, O. A., Popoola, T. A., Yahaya, I., Uthman, M. M., & Aremu, O. (2011). The cost-utility analysis of adult male circumcision for prevention of heterosexual acquisition of HIV in men in sub-Saharan Africa: a probabilistic decision model. *Value in Health*, *14*(1), 70-79.

Wang, H., Otoo, N., & Dsane-Selby, L. (2017). *Ghana National Health Insurance Scheme: improving financial sustainability based on expenditure review*. Washington, D.C.: The World Bank.

Witter, S., Ruddle, N., Murray-Zmijewski, A., & Somji, N. (2017). Promoting inclusive economic growth in Ghana: exploring the potential use of oil and gas revenues to fund the social sectors. OPM for GOGIG.

Woods, B., Revill, P., Sculpher, M., & Claxton, K. (2016). Country-Level Cost-Effectiveness Thresholds: Initial Estimates and the Need for Further Research. *Value in Health*, *19*(8), 929-935.

World Health Organization. (2014). Health intervention and technology assessment in support of universal health coverage. *The Sixty-seventh World Health Assembly*, *24*.

APPENDIX

Appendix A.1 – Detailed methods

DATA COLLECTION

A list of interventions relevant to Ghana was compiled. For each intervention, data was gathered on the DALYs averted and the costs. Data on the 'population in need' was also collected. More details about the data collection process are outlined below.

At various points, the OneHealth Tool (OHT) was used. The OHT is a piece of software with various functionalities that was designed to inform national healthcare planning in low- and middle-income countries. The OHT comes with a 'Ghana file', which contains a number of data items and assumptions that were used for this research project. The actual calculations for the project, however, were done in Microsoft Excel.

Interventions

An initial list of interventions to be included in the analysis was informed by information from the Ghana College of Physicians and Surgeons and the OneHealth Tool. The interventions list was further developed through literature searching.

DALYs averted

Data on DALYs averted was found through a literature search, using the Global Health CEA Registry. This is a comprehensive database of studies that use the 'cost-per-DALY averted' metric to establish the efficacy of health interventions. Initially, all studies focusing on Sub-Saharan countries were considered for inclusion by assessing the abstracts. Subsequently, all studies analysing those interventions that were still without DALY data after the first search, were considered (regardless of the country setting), again by assessing the abstracts.

Inclusion criteria

The inclusion criteria comprised: research quality; applicability to Ghana; and availability of key information. The Global Health CEA Registry provides quality scorings, on a scale from 1(low) to 7(high). Studies with a score below 5 were generally excluded, though some cases were left to the researchers' discretion.

The applicability of each study to the Ghana context was decided based on two main factors: (i) the similarity in disease prevalence between Ghana and the country considered in the study, and (ii) the similarity in the income levels of the two countries. The disease prevalence was obtained using the GBD Results Tool. The income levels served as a proxy of the efficacy of the countries' healthcare systems and were acquired through the World Bank DataBank.

The key information needed was: a description of the population that had been treated; intervention coverage[19]; the comparator[20]; and the total amount of DALYs averted. The information items were abstracted from the studies and used to calculate, for each intervention, the total DALYs averted in Ghana if the intervention were implemented at 100% coverage. Whenever a study assumed less than 100% coverage its findings were extrapolated to 100% using the assumption that there would be a linear increase in the DALYs averted. Demographic and epidemiological data from the Ghana Statistical Service (GSS), Global Burden of Disease (GBD) Project, World Bank DataBank and a number of academic papers were used for adapting the studies' findings to the Ghanaian context.

Costs

The costs of health worker time, medicines, consumables and in-patient days were collected for each intervention. A number of Ghanaian health professionals (including a medical doctor, pharmacist and biomedical scientist) checked whether the assumptions used were relevant for Ghana.

Human resources

The OneHealth Tool contains information about the types of health worker needed for each intervention and the time spent per case treated. We used this information where possible and when necessary collected additional information in papers found through the Global Health CEA Registry and Google Scholar. The gross monthly salaries of all public sector health workers (which reflect the cost of the health workers to the government) were obtained through the central government payroll (Integrated Payroll and Personnel Database). It was assumed that health workers work 8 hours per day, 5 days per week and 4 weeks per month. We calculated the cost per minute for the different types of health workers. We combined this with the information on the health worker type and time per case treated and subsequently computed the HR cost per case treated for each intervention.

Medicines and consumables

The OHT, Global Health CEA Registry and Google Scholar were also used to retrieve information about the types and quantities of medicines and consumables needed for each intervention. The costs of the medicines were largely taken from the NHIS Medicines List 2016, which states the reimbursement tariff for all of the medicines that are currently covered through the NHIS. The costs of medicines that are not covered, as well as the costs of consumables, were obtained through the procurement departments of health facilities and quotes from whole-sellers.

[19] That is, the percentage of the 'total population in need' that received treatment.
[20] 'Comparator' is a term to describe the alternative to the intervention (e.g., current standard practice).

In-patient days

Lodging costs for in-patient days were included in the cost for in-patient interventions. For each in-patient intervention, the number of in-patient days per case treated were gathered through the OHT and Google Scholar. The lodging cost of an in-patient day for the average patient was quoted by the Ridge Hospital.

Population in need

To be able to calculate the annual cost of implementing each intervention at 100% coverage nationwide, the total population in need of the intervention was identified. The population in need for each intervention was based upon the prevalence/ incidence[21] of the condition it addresses or, in cases of preventive interventions, the size of the target group (e.g. annual number of pregnant women). Data on the prevalence of the various conditions and the sizes of the target groups was obtained through the GSS, GBD and various academic papers.

Productivity of the healthcare system

An assessment of the productivity of Ghana's healthcare system (/opportunity cost of healthcare spending/cost-effectiveness threshold) was done by Ochalek, Lomas & Claxton (2015). They estimated that in Ghana's current healthcare system it takes US$432 to avert 1 DALY, which translates into GH₵1,962, assuming an exchange rate of 4.5 GH₵/US$. That is, the productivity, or 'k', is GH₵1,962.

They estimated that in Ghana's current healthcare system it takes US$432 to avert 1 DALY, which translates into GH₵1,962, assuming an exchange rate of 4.5 GH₵/US$.

Budget

The NHIA expenditure on claims reimbursement was GH₵1,396 million in 2017.

When the NHIA calculated their reimbursement tariffs, overhead costs were included. In the costing exercise for this research project, however, overhead costs were left out of consideration. We assumed overhead costs to be 27% of the total cost of delivering healthcare[22]. We therefore reduced the amount the NHIS spent on claims in 2017 by 27% to calculate the funds available for direct costs. This rendered the figure of GH₵1,020, which was assumed to be the maximum available budget during the scenario analysis (see Appendix A.3).

[21] The incidence of a disease indicates the new number of cases in a given period (usually annually), whereas the prevalence indicates the total number of cases at any given point in time. In determining the population in need of each intervention, prevalence was used in cases of chronic conditions (as not only new cases need treatment), while incidence was used for non-chronic conditions.

[22] Aboagye et al. (2010) researched three Ghanaian facilities (referral, district and mission) and found that overhead cost made up between 20-42% of total cost of healthcare delivery.

CALCULATIONS

Costs per intervention

For each case treated, we multiplied the unit price for each item needed (e.g. syringe, amoxicillin) by the average number of units needed, in order to obtain the average cost for HR, medicines, consumables and in-patient days, respectively. The four cost items were summed to obtain the average cost per case treated. The formula used was:

$$C_i = \sum HR_{ij} * C_j + \sum D_{ik} * C_k + \sum S_{il} * C_l + IP_i * C_{IP}$$

where C_i = average cost per case treated for intervention i, HR_{ij} = number of HR units j per case treated for intervention i, C_j = cost of HR unit j, D_{ik} = number of drug units k per case treated for intervention i, C_k = cost of drug unit k, S_{il} = number of consumable units l needed per case treated for intervention i, C_l = cost of consumable unit l, IP_i = in-patient days per case treated for intervention i, C_{IP} = lodging cost per in-patient day.

The total cost per intervention was calculated by multiplying the average cost per case treated times the population in need.

$$C_{ti} = C_i * pop_i$$

where C_{ti} = total cost of intervention i, C_i = cost per case treated for intervention i, pop_i = population in need for intervention i.

Net health benefit per intervention

Through dividing the total cost per intervention (which is expressed in GH₵) by the estimate of the productivity of Ghana's healthcare system (which is expressed in GH₵/DALY), the cost of each intervention in terms of DALYs was obtained. Subtracting this from the gross number of DALYs averted by the intervention, rendered the net health benefit.

$$\Delta h_i = h_i - C_{it}/k$$

where Δh_i = net health benefit of intervention i, h_i = gross health benefit of intervention i, C_{it} = total cost of intervention i, k = productivity of the Ghana healthcare system. C_{it}/k = cost of intervention i expressed in DALYs.

Appendix A.2 –
Details on the population in need for each intervention

In order to calculate the population in need for each intervention, the target group was used for preventive interventions. For curative interventions, either the incidence or the prevalence of the addressed condition was used. The incidence of a disease indicates the new number of cases in a given period (usually annually), whereas the prevalence indicates the total number of cases at any given point in time. Prevalence was used in cases of chronic conditions (as not only new cases need treatment), while incidence was used for non-chronic conditions.

Rank	Intervention	Target population	Information used	Population in need
1	Drug treatment uncomplicated malaria (<5)	Children < 5	Incidence uncomplicated malaria	3,358,476
2	Full combination DOTS	Total population	Incidence smear-positive + smear-negative + extra-pulmonary + multi-drug resistant cases	44,029
3	Full DOTS	Total population	Incidence smear-positive + smear-negative + extra-pulmonary cases	44,020
4	Minimal DOTS plus resistant cases	Total population	Incidence smear-positive + multi-drug resistant cases	25,977
5	Minimal DOTS	Total population	Incidence smear-positive cases	25,097
6	Emergency obstetric care	Live births and still births	Incidence obstructed labour + severe pre-eclampsia + maternal sepsis	35,432
7	Skilled maternal and immediate new-born care	Live births and still births	Live births and still births	876,577
8	Use of insecticide treated bed nets	Total population	Total population	3,774,440
9	Inguinal hernia repair	Total population	Incidence inguinal hernia	59,447
10	Community-based support for low birthweight babies	Live births	Low birthweight babies	43,595
11	Drug treatment sexually transmitted infections (STIs)	Adults 15-49	Prevalence STIs	5,713,958
12	Malaria vaccination	Infants < 1	Infants < 1	851,630

13	Voluntary Counselling and Testing (VCT)	Adults 15-49	Twice annual prevalence over 5-year period	125,524
14	Antivenom for snakebites	Total population	Incidence of venomous snake bites	10,417
15	Emergency neonatal care (ENC)	Live births	Incidence severe neonatal infections + neonatal jaundice + severe asphyxia + low birth-weight	104,627
16	Oral rehydration solution (ORS) for diarrhoea in <5s	Children < 5	Incidence diarrhoeal disease	7,928,521
17	Cataract surgery	Total population	Incidence cataract blindness	48,000
18	Tetanus toxoid vaccination (as part of antenatal care)	Pregnant women	Pregnant women	877,816
19	Drug treatment childhood pneumonia	Children < 5	Incidence childhood pneumonia	1,095,649
20	Iron supplementation for pregnant women	Pregnant women	Pregnant women	877,816
21	Syphilis detection and treatment (as part of antenatal care)	Pregnant women	91% of pregnant women (comparator is 9% coverage)	798,813
22	Corticosteroids for preterm labour	Live births and still births	Incidence pre-term labour	122,894
23	Anti-retroviral therapy (ART, first- and second-line treatment, intensive monitoring)	HIV-infected population	Prevalence HIV	313,809
24	Anti-retroviral therapy (ART, first- and second-line treatment, no intensive monitoring)	HIV-infected population	Number on first-line treatment	280,208
25	Pre-referral rectal drug treatment malaria for <5s	Children < 5	Incidence severe malaria	176,762

26	Anti-retroviral therapy (ART, first-line treatment, intensive monitoring)	HIV-infected population	Number on first-line treatment	219,667
27	Anti-retroviral therapy (ART, first-line treatment, no intensive monitoring)	HIV-infected population	Number on first-line treatment	219,667
28	Drug treatment neonatal pneumonia	Live births	Incidence neonatal pneumonia	229,940
29	Male circumcision	Boys < 1	Boys < 1	425,611
30	Antibiotics in case of preterm premature rupture of membranes (pPROM)	Live births and still births	Incidence pPROM	27,897
31	Drug treatment epilepsy	Total population	Prevalence of epilepsy	137,757
32	Screening hearing loss	Total population	Prevalence hearing impairment	45,385
33	Intermittent preventive treatment malaria during pregnancy	Pregnant women	Pregnant women	877,816
34	Advice in case of heavy alcohol use	Total population	Prevalence heavy alcohol use	296,118
35	Pre-referral rectal drug treatment malaria for >5s	Total population > 5	Incidence severe malaria	50,014
36	Retinopathy screening and photocoagulation for diabetes	Total population	Prevalence of diabetes	748,660
37	Screening children 5-15 for uncorrected refraction error	Children 5-15	Children 5-15	7,157,377
38	Iron supplementation for infants	Infants < 1	Infants < 1	851,630
39	HPV (16,18) vaccination	Girls aged 12	Girls aged 12	310,396

40	Integrated mass drug administration for schistosomiasis and soil-transmitted helminthiasis (children 5-14)	Total population	School-aged children (5-14)	6,560,411
41	Distribution misoprostol for the prevention of post-partum haemorrhage	Pregnant women	Pregnant women	403,796
42	Integrated mass drug administration strategies for schistosomiasis and soil-transmitted helminthiasis (community-wide)	Total population	Total population	28,308,301
43	Pap smear (at age 40) + cervical cancer treatment if necessary	Women aged 40	Women aged 40	164,014
44	VIA (at age 40) + cervical cancer treatment if necessary	Women aged 40	Women aged 40	164,014
45	Drug treatment otitis media	Children 0-14	Incidence otitis media	2,035,324
46	Asymptotic bacteriuria detection and treatment (as part of antenatal care)	Pregnant women	Pregnant women	877,816
47	Preventive drug treatment for patients at risk of a cardiovascular disease (CVD) event	Total population	Prevalence of people at risk of CVD event	587,544
48	VIA (at age 35,40,45) + cervical cancer treatment if necessary	Women aged 35, 40, 45	Women aged 35, 40, 45	493,792

49	First Hepatitis B vaccination within 24 hours of birth	Live births	Live births	871,896
50	Isoniazid preventive therapy all HIV-infected pregnant women	Pregnant women	Prevalence HIV	22,823
51	Pap smear (at age 40) + removal of lesions	Women aged 40	Women aged 40	164,014
52	Breast cancer, treatment stage I	Women	Prevalence of stage I breast cancer	566
53	Drug + psychosocial treatment schizophrenia	Total population	Prevalence schizophrenia	43,170
54	VIA (at age 40) + removal of lesions	Women aged 40	Women aged 40	164,014
55	Isoniazid preventive therapy HIV-infected pregnant women with CD4 < 200	Pregnant women	Prevalence HIV with CD4 < 200	2,282
56	Breast cancer, treatment stage II	Women	Prevalence of stage II breast cancer	850
57	VIA (at age 35,40,45) + removal of lesions	Women aged 35, 40, 45	Women aged 35, 40, 45	493,792
58	Cervical cancer treatment	Women	Prevalence of cervical cancer	8,733
59	Breast cancer, treatment stage IV	Women	Prevalence of stage IV breast cancer	1,104
60	Pap smear (every 5 years at ages 20-65) + removal of lesions	Women aged 20-65	Women aged 20-65 (once every 5 years)	1,422,723
61	Breast cancer, treatment stage III	Women	Prevalence of stage III breast cancer	3,476
62	Breast cancer, treatment all stages	Women	Prevalence of breast cancer	5,996
63	Pap smear (every 5 years at ages 20-65) + cervical cancer treatment if necessary	Women aged 20-66	Women aged 20-65 (once every 5 years)	1,422,723

64	Drug treatment of post-acute ischaemic heart disease (IHD) and stroke	Total population	Prevalence of post-acute IHD and stroke	98,853
65	Drug treatment asthma	Total population	Prevalence (mild persistent) asthma	1,043,002
66	Drug treatment bipolar disorder	Total population	Prevalence bipolar disorder	154,857
67	Drug + psychosocial treatment bipolar disorder	Total population	Prevalence bipolar disorder	154,857
68	Episodic drug + psychosocial treatment unipolar depression	Total population	Prevalence depression	809,667
69	Maintained drug + psychosocial treatment unipolar depression	Total population	Prevalence depression	809,667
70	Standard glycaemic control diabetes	Total population	Prevalence of diabetes	748,660

Appendix A.3 – Scenario analysis

Six different benefits packages were assembled, based on different policy focuses. The net health benefit of the interventions was considered in all packages. The interventions were ranked according to net health benefit and included in decreasing order of net health benefit, until the budget of GH₵1,020 million was reached. See Table A.1 for an overview of the assumptions regarding population and cost coverage that were used in compiling the packages.

Table A.1 – Assumptions for each policy focus

Policy focus	Assumptions
Maximise total health benefit	- Rank interventions according to net health benefit - 100% of the population in need treated - 100% of the total direct cost borne by NHIS
Include a high number of interventions	- Rank interventions according to net health benefit - 50% of the population in need treated - 50% of the total direct cost borne by NHIS
Include only primary care (PC) interventions	- Rank interventions according to net health benefit - Exclude interventions that cannot be offered at the primary care level - 100% of the population in need treated - 100% of the total direct cost borne by NHIS
Include a co-insurance component for part of the interventions	- Rank interventions according to net health benefit PACKAGE A (BASIC) - 100% of the population in need treated - 100% of the total direct cost borne by NHIS PACKAGE B (CO-INSURANCE) - 85% of the population in need treated - 50% of the total direct cost borne by NHIS - Any cost beyond GH₵1,000 per case treated is borne by the NHIS

Appendix A.4 –
Net health benefit vs. cost-effectiveness ratios

In economic evaluations, cost-effectiveness ratios (CERs) have been an often-used tool. An intervention's cost-effectiveness ratio expresses the amount of money the intervention needs in order to avert 1 DALY. In decision-making, the cost-effectiveness ratio is compared to the national cost-effectiveness threshold. If the CER is below the threshold, the intervention is deemed cost-effective; if the CER is above the threshold, the intervention is not considered cost-effective.

However, CERs only give 'value for money' information, while the net health benefit metric also indicates the size of each intervention's effect on total population health. Therefore, net health benefit was used in this research study.

> *Example 4: In Examples 1-3 of Section 2.3, we came across three interventions: Interventions A, B and C respectively. We were informed of the costs and the DALYs averted for each intervention. By dividing the cost by the DALYs averted, we can now calculate each intervention's cost-effectiveness ratio.*

Table A.2

Intervention	Cost (GH₵)	Health benefit (DALYs averted)	CER calculation	CER (GH₵ per DALY averted)
A	3,000	1	= 3,000 / 1	**3,000**
B	3,000	2	= 3,000 / 2	**1,500**
C	9,000	2	= 9,000 / 2	**4,500**

> *Once we know the CERs for the interventions, we can compare them to the national cost-effectiveness threshold. The cost-effectiveness threshold is equivalent to the opportunity cost of taking funding away from activities already ongoing in the system. In Example 2, we were told that the cost-effectiveness threshold is GH₵3,000 per DALY averted. Table A.2 shows that Intervention B is below the threshold (i.e. cost-effective) and Intervention C is above the threshold (i.e. not cost-effective). The CER of Intervention A is the same as the threshold and is therefore neutral.*
>
> *These findings are similar to what we found using net health benefit. We found a positive net health benefit for Intervention B and a negative net health benefit for Intervention C. Intervention A had a net health benefit of zero.*

Table A.3

Intervention	Cost (GH₵)	Health benefit (DALYs averted)	Health opportunity cost calculation (= cost ⁄ cost-effectiveness threshold)	Health opportunity cost (DALYs averted)	Net health benefit calculation (=health benefit – health cost)	Net health benefit (DALYs averted)
A	3,000	1	= 3,000 ⁄ 3,000	1	= 1 – 1	**0**
B	3,000	2	= 3,000 ⁄ 3,000	1	= 2 – 1	**1**
C	9,000	2	= 9,000 ⁄ 3,000	3	= 2 – 3	**-1**

Now let's consider Intervention D. Intervention D costs GH₵15,000 and averts 10 DALYs. The cost-effectiveness ratio of Intervention D is GH₵1,500 per DALY averted (see Table A.4). This is the same as the CER for Intervention B. We might therefore be tempted to say that Intervention B and Intervention D are equally attractive options.

Table A.4

Intervention	Cost (GH₵)	Health benefit (DALYs averted)	CER calculation	CER (GH₵ per DALY averted)
B	3,000	2	= 3,000 ⁄ 2	**1,500**
D	15,000	10	= 15,000 ⁄ 10	**1,500**

However, when we calculate the net health benefit of Intervention D, we see that its net health benefit is much larger than that of Intervention B. Once we take net health benefit into consideration, we prefer Intervention D.

Table A.5

Intervention	Cost (GH₵)	Health benefit (DALYs averted)	Health opportunity cost calculation (= cost ⁄ cost-effectiveness threshold)	Health opportunity cost (DALYs averted)	Net health benefit calculation (=health benefit – health cost)	Net health benefit (DALYs averted)
B	3,000	2	= 3,000 ⁄ 3,000	1	= 2 – 1	**1**
D	15,000	10	= 15,000 ⁄ 3,000	5	= 10 – 5	**5**

While CERs tell us whether an intervention is good 'value for money', it does not give information about the impact of the intervention on total population health. An intervention that is very good value for money could be treating a condition that is very rare in Ghana (e.g. Guinea worm). In that case we might prefer to adopt an intervention that is slightly worse in terms of 'value for money' but treats a highly prevalent condition (e.g. malaria). The net health benefit measure accounts for this.

Appendix A.5 –
Full list interventions covered in Packages 1A-4B

A.5.1 – Interventions covered in Packages 1A and 1B

Interventions covered in Package 1A

No.	Intervention	Cost of 100% coverage (GH₵)	Net health benefit 100% coverage (DALYs averted)
1	Drug treatment uncomplicated malaria (<5)	68,940,786	12,820,037
2	Emergency obstetric care	53,365,641	928,757
3	Skilled maternal and immediate new-born care	155,860,721	584,307
4	Use of insecticide treated bed nets	8,034,841	563,234
5	Inguinal hernia repair	17,670,578	543,857
6	Community-based support for low birthweight babies	173,180	448,793
7	Drug treatment sexually transmitted infections (STIs)	95,191,967	356,121
8	Malaria vaccination	60,885,282	341,687
9	Voluntary Counselling and Testing (VCT)	2,450,355	283,701
10	Antivenom for snakebites	2,747,548	242,473
11	Emergency neonatal care (ENC)	168,365,667	228,165
12	Oral rehydration solution (ORS) for diarrhoea in <5s	24,532,174	223,437
13	Cataract surgery	3,320,518	185,470
14	Tetanus toxoid vaccination (as part of antenatal care)	8,892,408	172,138
15	Drug treatment childhood pneumonia	9,984,074	159,043
16	Iron supplementation for pregnant women	5,356,436	152,278
17	Syphilis detection and treatment (as part of antenatal care)	6,879,992	144,485
18	Corticosteroids for preterm labour	23,263,811	141,609
19	Pre-referral rectal drug treatment malaria for <5s	3,966,078	135,167
20	Drug treatment neonatal pneumonia	1,444,579	122,035
21	Male circumcision	32,268,254	104,203
22	Antibiotics in case of preterm premature rupture of membranes (pPROM)	183,200	96,461
23	Drug treatment epilepsy	20,317,319	66,645
24	Screening hearing loss	113,468	60,770
25	Intermittent preventive treatment malaria during pregnancy	1,048,458	44,865
26	Advice in case of heavy alcohol use	2,113,017	42,424

27	Pre-referral rectal drug treatment malaria for >5s	1,122,177	41,620
28	Retinopathy screening and photocoagulation for diabetes	8,186,646	39,281
29	Screening children 5-15 for uncorrected refraction error	13,892,595	39,138
30	Iron supplementation for infants	5,939,454	37,318
31	HPV (16,18) vaccination	8,192,909	20,496
32	Integrated mass drug administration for schistosomiasis and soil-transmitted helminthiasis (children 5-14)	29,590,408	18,511
33	Distribution misoprostol for the prevention of post-partum haemorrhage	2,572,930	15,849
34	Pap smear (at age 40) + cervical cancer treatment if necessary	4,989,564	11,701
35	Drug treatment otitis media	20,649,480	9,442
36	Asymptotic bacteriuria detection and treatment (as part of antenatal care)	14,067,295	8,178
TOTAL		**886,573,808**	**19,433,699**

Interventions covered in Package 1B

No.	Intervention	Cost of 100% coverage (GH₵)	Net health benefit 100% coverage (DALYs averted)
1	Drug treatment uncomplicated malaria (<5)	68,940,786	12,820,037
2	Emergency obstetric care	53,365,641	928,757
3	Skilled maternal and immediate new-born care	155,860,721	584,307
4	Use of insecticide treated bed nets	8,034,841	563,234
5	Inguinal hernia repair	17,670,578	543,857
6	Community-based support for low birthweight babies	173,180	448,793
7	Drug treatment sexually transmitted infections (STIs)	95,191,967	356,121
8	Malaria vaccination	60,885,282	341,687
9	Voluntary Counselling and Testing (VCT)	2,450,355	283,701
10	Antivenom for snakebites	2,747,548	242,473
11	Emergency neonatal care (ENC)	168,365,667	228,165
12	Oral rehydration solution (ORS) for diarrhoea in <5s	24,532,174	223,437
13	Cataract surgery	3,320,518	185,470
14	Tetanus toxoid vaccination (as part of antenatal care)	8,892,408	172,138
15	Drug treatment childhood pneumonia	9,984,074	159,043
16	Iron supplementation for pregnant women	5,356,436	152,278

17	Syphilis detection and treatment (as part of antenatal care)	6,879,992	144,485
18	Corticosteroids for preterm labour	23,263,811	141,609
19	Pre-referral rectal drug treatment malaria for <5s	3,966,078	135,167
20	Drug treatment neonatal pneumonia	1,444,579	122,035
21	Male circumcision	32,268,254	104,203
22	Antibiotics in case of preterm premature rupture of membranes (pPROM)	183,200	96,461
23	Drug treatment epilepsy	20,317,319	66,645
24	Screening hearing loss	113,468	60,770
25	Intermittent preventive treatment malaria during pregnancy	1,048,458	44,865
26	Advice in case of heavy alcohol use	2,113,017	42,424
27	Pre-referral rectal drug treatment malaria for >5s	1,122,177	41,620
28	Retinopathy screening and photocoagulation for diabetes	8,186,646	39,281
29	Screening children 5-15 for uncorrected refraction error	13,892,595	39,138
30	Iron supplementation for infants	5,939,454	37,318
31	HPV (16,18) vaccination	8,192,909	20,496
32	Integrated mass drug administration for schistosomiasis and soil-transmitted helminthiasis (children 5-14)	29,590,408	18,511
33	Distribution misoprostol for the prevention of post-partum haemorrhage	2,572,930	15,849
34	Pap smear (at age 40) + cervical cancer treatment if necessary	4,989,564	11,701
35	Drug treatment otitis media	20,649,480	9,442
36	Asymptotic bacteriuria detection and treatment (as part of antenatal care)	14,067,295	8,178
37	First Hepatitis B vaccination within 24 hours of birth	14,429,873	3,383
38	Drug + psychosocial treatment schizophrenia	21,674,873	703
39	Cervical cancer treatment	39,495,777	-2,069
40	Breast cancer, treatment all stages	26,230,093	-8,420
TOTAL		**988,389,345**	**19,427,296**

A.5.2 – Interventions covered in Package 2

No.	Intervention	Cost of 50% coverage (GH₵)	Net health benefit at 50% coverage (DALYs averted)
1	Drug treatment uncomplicated malaria (<5)	34,470,393	6,410,019
2	Emergency obstetric care	26,682,820	464,379
3	Skilled maternal and immediate new-born care	77,930,361	292,154
4	Use of insecticide treated bed nets	4,017,421	281,617
5	Inguinal hernia repair	8,835,289	271,928
6	Community-based support for low birthweight babies	86,590	224,397
7	Drug treatment sexually transmitted infections (STIs)	47,595,983	178,061
8	Malaria vaccination	30,442,641	170,844
9	Voluntary Counselling and Testing (VCT)	1,225,177	141,851
10	Antivenom for snakebites	1,373,774	121,236
11	Emergency neonatal care (ENC)	84,182,833	114,083
12	Oral rehydration solution (ORS) for diarrhoea in <5s	12,266,087	111,719
13	Cataract surgery	1,660,259	92,735
14	Tetanus toxoid vaccination (as part of antenatal care)	4,446,204	86,069
15	Drug treatment childhood pneumonia	4,992,037	79,522
16	Iron supplementation for pregnant women	2,678,218	76,139
17	Syphilis detection and treatment (as part of antenatal care)	3,439,996	72,243
18	Corticosteroids for preterm labour	11,631,905	70,804
19	Pre-referral rectal drug treatment malaria for <5s	1,983,039	67,583
20	Drug treatment neonatal pneumonia	722,290	61,017
21	Male circumcision	16,134,127	52,102
22	Antibiotics in case of preterm premature rupture of membranes (pPROM)	91,600	48,230
23	Drug treatment epilepsy	10,158,659	33,323
24	Screening hearing loss	56,734	30,385
25	Intermittent preventive treatment malaria during pregnancy	524,229	22,433
26	Advice in case of heavy alcohol use	1,056,508	21,212
27	Pre-referral rectal drug treatment malaria for >5s	561,088	20,810
28	Retinopathy screening and photocoagulation for diabetes	4,093,323	19,641
29	Screening children 5-15 for uncorrected refraction error	6,946,298	19,569

30	Iron supplementation for infants	2,969,727	18,659
31	HPV (16,18) vaccination	4,096,454	10,248
32	Integrated mass drug administration for schistosomiasis and soil-transmitted helminthiasis (children 5-14)	14,795,204	9,255
33	Distribution misoprostol for the prevention of post-partum haemorrhage	1,286,465	7,925
34	Pap smear (at age 40) + cervical cancer treatment if necessary	2,494,782	5,850
35	Drug treatment otitis media	10,324,740	4,721
36	Asymptotic bacteriuria detection and treatment (as part of antenatal care)	7,033,647	4,089
37	Preventive drug treatment for patients at risk of a cardiovascular disease (CVD) event	138,123,673	2,093
38	First Hepatitis B vaccination within 24 hours of birth	7,214,937	1,691
39	Drug + psychosocial treatment schizophrenia	10,837,436	351
40	Cervical cancer treatment	19,747,888	-1,034
41	Breast cancer, treatment all stages	13,115,047	-4,210
42	Drug treatment of post-acute ischaemic heart disease (IHD) and stroke	40,804,664	-11,009
43	Drug treatment asthma	26,933,087	-13,282
44	Drug treatment bipolar disorder	45,658,133	-13,443
45	Episodic drug + psychosocial treatment unipolar depression	101,563,130	-32,477
TOTAL		**846,768,164**	**9,645,530**

A.5.3.1 – Package including all primary care interventions under consideration

No.	Intervention	Cost of 100% coverage (GH₵)	Net health benefit at 100% coverage (DALYs averted)
1	Drug treatment uncomplicated malaria (<5)	68,940,786	12,820,037.18
2	Skilled maternal and immediate new-born care	155,860,721	584,307.14
3	Use of insecticide treated bed nets	8,034,841	563,234.06
4	Inguinal hernia repair	17,670,578	543,856.54
5	Community-based support for low birthweight babies	173,180	448,793.18
6	Drug treatment sexually transmitted infections (STIs)	95,191,967	356,121.01
7	Malaria vaccination	60,885,282	341,687.44
8	Voluntary Counselling and Testing (VCT)	2,450,355	283,701.31
9	Antivenom for snakebites	2,747,548	242,472.52

10	Oral rehydration solution (ORS) for diarrhoea in <5s	24,532,174	223,437.46
11	Cataract surgery	3,320,518	185,470.50
12	Tetanus toxoid vaccination (as part of antenatal care)	8,892,408	172,137.58
13	Drug treatment childhood pneumonia	9,984,074	159,043.49
14	Iron supplementation for pregnant women	5,356,436	152,277.89
15	Syphilis detection and treatment (as part of antenatal care)	6,879,992	144,485.09
16	Corticosteroids for preterm labour	23,263,811	141,608.96
17	Pre-referral rectal drug treatment malaria for <5s	3,966,078	135,166.66
18	Drug treatment neonatal pneumonia	1,444,579	122,034.86
19	Male circumcision	32,268,254	104,203.42
20	Antibiotics in case of preterm premature rupture of membranes (pPROM)	183,200	96,460.91
21	Drug treatment epilepsy	20,317,319	66,645.28
22	Screening hearing loss	113,468	60,769.64
23	Intermittent preventive treatment malaria during pregnancy	1,048,458	44,865.42
24	Advice in case of heavy alcohol use	2,113,017	42,423.67
25	Pre-referral rectal drug treatment malaria for >5s	1,122,177	41,620.36
26	Screening children 5-15 for uncorrected refraction error	13,892,595	39,137.64
27	Iron supplementation for infants	5,939,454	37,317.60
28	HPV (16,18) vaccination	8,192,909	20,496.49
29	Integrated mass drug administration for schistosomiasis and soil-transmitted helminthiasis (children 5-14)	29,590,408	18,510.62
30	Distribution misoprostol for the prevention of post-partum haemorrhage	2,572,930	15,849.46
31	Drug treatment otitis media	20,649,480	9,442.24
32	Asymptotic bacteriuria detection and treatment (as part of antenatal care)	14,067,295	8,177.96
33	Preventive drug treatment for patients at risk of a cardiovascular disease (CVD) event	275,950,783	4,337.16
34	First Hepatitis B vaccination within 24 hours of birth	14,429,873	3,382.96
35	Pap smear (at age 40) + removal of lesions	1,835,581	1,388.88
36	Drug + psychosocial treatment schizophrenia	21,674,873	702.86
37	Drug treatment of post-acute ischaemic heart disease (IHD) and stroke	80,887,502	-21,650.55
38	Drug treatment asthma	53,866,174	-26,564.50
39	Drug treatment bipolar disorder	91,316,265	-26,886.99

40	Episodic drug + psychosocial treatment unipolar depression	203,126,260	-64,953.20
41	Standard glycaemic control diabetes	2,702,563,936	-1,339,133.54
TOTAL		**4,082,887,665**	**16,756,417**

A.5.3.2 – Interventions covered in Package 3

No.	Intervention	Cost of 100% coverage (GH₵)	Net health benefit 100% coverage (DALYs averted)
1	Drug treatment uncomplicated malaria (<5)	68,940,786	12,820,037
2	Skilled maternal and immediate new-born care	155,860,721	584,307
3	Use of insecticide treated bed nets	8,034,841	563,234
4	Inguinal hernia repair	17,670,578	543,857
5	Community-based support for low birthweight babies	173,180	448,793
6	Drug treatment sexually transmitted infections (STIs)	95,191,967	356,121
7	Malaria vaccination	60,885,282	341,687
8	Voluntary Counselling and Testing (VCT)	2,450,355	283,701
9	Antivenom for snakebites	2,747,548	242,473
10	Oral rehydration solution (ORS) for diarrhoea in <5s	24,532,174	223,437
11	Cataract surgery	3,320,518	185,470
12	Tetanus toxoid vaccination (as part of antenatal care)	8,892,408	172,138
13	Drug treatment childhood pneumonia	9,984,074	159,043
14	Iron supplementation for pregnant women	5,356,436	152,278
15	Syphilis detection and treatment (as part of antenatal care)	6,879,992	144,485
16	Corticosteroids for preterm labour	23,263,811	141,609
17	Pre-referral rectal drug treatment malaria for <5s	3,966,078	135,167
18	Drug treatment neonatal pneumonia	1,444,579	122,035
19	Male circumcision	32,268,254	104,203
20	Antibiotics in case of preterm premature rupture of membranes (pPROM)	183,200	96,461
21	Drug treatment epilepsy	20,317,319	66,645
22	Screening hearing loss	113,468	60,770
23	Intermittent preventive treatment malaria during pregnancy	1,048,458	44,865
24	Advice in case of heavy alcohol use	2,113,017	42,424
25	Pre-referral rectal drug treatment malaria for >5s	1,122,177	41,620

26	Screening children 5-15 for uncorrected refraction error	13,892,595	39,138
27	Iron supplementation for infants	5,939,454	37,318
28	HPV (16,18) vaccination	8,192,909	20,496
29	Integrated mass drug administration for schistosomiasis and soil-transmitted helminthiasis (children 5-14)	29,590,408	18,511
30	Distribution misoprostol for the prevention of post-partum haemorrhage	2,572,930	15,849
31	Drug treatment otitis media	20,649,480	9,442
32	Asymptotic bacteriuria detection and treatment (as part of antenatal care)	14,067,295	8,178
33	Preventive drug treatment for patients at risk of a cardiovascular disease (CVD) event	276,247,346	4,186
34	First Hepatitis B vaccination within 24 hours of birth	14,429,873	3,383
35	Pap smear (at age 40) + removal of lesions	1,835,581	1,389
36	Drug + psychosocial treatment schizophrenia	21,674,873	703
TOTAL		**965,557,401**	**18,235,454**

A.5.4 – Interventions covered in Packages 4A and 4B

Interventions covered in Package 4A

Part (a), basic

No.	Intervention	Cost of 100% coverage (GH₵)	Net health benefit at 100% coverage (DALYs averted)
1	Use of insecticide treated bed nets	8,034,841	563,234
2	Inguinal hernia repair	17,670,578	543,857
3	Community-based support for low birthweight babies	173,180	448,793
4	Voluntary Counselling and Testing (VCT)	2,450,355	283,701
5	Antivenom for snakebites	2,747,548	242,473
6	Oral rehydration solution (ORS) for diarrhoea in <5s	24,532,174	223,437
7	Cataract surgery	3,320,518	185,470
8	Tetanus toxoid vaccination (as part of antenatal care)	8,892,408	172,138
9	Drug treatment childhood pneumonia	9,984,074	159,043
10	Iron supplementation for pregnant women	5,356,436	152,278
11	Syphilis detection and treatment (as part of antenatal care)	6,879,992	144,485
12	Corticosteroids for preterm labour	23,263,811	141,609
13	Pre-referral rectal drug treatment malaria for <5s	3,966,078	135,167
14	Drug treatment neonatal pneumonia	1,444,579	122,035

15	Male circumcision	32,268,254	104,203
16	Antibiotics in case of preterm premature rupture of membranes (pPROM)	183,200	96,461
17	Drug treatment epilepsy	20,317,319	66,645
18	Screening hearing loss	113,468	60,770
19	Intermittent preventive treatment malaria during pregnancy	1,048,458	44,865
20	Advice in case of heavy alcohol use	2,113,017	42,424
21	Pre-referral rectal drug treatment malaria for >5s	1,122,177	41,620
22	Retinopathy screening and photocoagulation for diabetes	8,186,646	39,281
23	Screening children 5-15 for uncorrected refraction error	13,892,595	39,138
24	Iron supplementation for infants	5,939,454	37,318
25	HPV (16,18) vaccination	8,192,909	20,496
26	Integrated mass drug administration for schistosomiasis and soil-transmitted helminthiasis (children 5-14)	29,590,408	18,511
27	Distribution misoprostol for the prevention of post-partum haemorrhage	2,572,930	15,849
28	Pap smear (at age 40) + cervical cancer treatment if necessary	4,989,564	11,701
29	Drug treatment otitis media	20,649,480	9,442
30	Asymptotic bacteriuria detection and treatment (as part of antenatal care)	14,067,295	8,178
31	First Hepatitis B vaccination within 24 hours of birth	14,429,873	3,383
32	Drug + psychosocial treatment schizophrenia	21,674,873	703
33	Cervical cancer treatment	39,495,777	-2,069
34	Breast cancer, treatment all stages	26,230,093	-8,420
TOTAL PART (A)		**385,794,361**	**4,168,221**

Part b (co-insurance)

No.	Intervention	Cost of 50% coverage (GH₵)	Net health benefit at 85% coverage (DALYs averted)
35	Drug treatment uncomplicated malaria (<5)	29,299,834	10,911,962
36	Emergency obstetric care	22,680,397	801,001
37	Skilled maternal and immediate new-born care	66,240,807	530,416
38	Drug treatment sexually transmitted infections (STIs)	40,456,586	323,319
39	Malaria vaccination	25,876,245	303,620
40	Emergency neonatal care (ENC)	71,555,408	230,404
41	Preventive drug treatment for patients at risk of a cardiovascular disease (CVD) event	117,405,122	63,385

42	Drug treatment of post-acute ischaemic heart disease (IHD) and stroke	34,683,965	-1,041
43	Drug treatment asthma	22,893,124	-10,914
44	Drug treatment bipolar disorder	38,809,413	-3,077
45	Episodic drug + psychosocial treatment unipolar depression	86,328,660	-11,219
TOTAL PART (B)		**556,229,561**	**13,137,856**
TOTAL PACKAGE 4A		**941,584,697**	**17,306,077**

Interventions covered in Package 4B

Part (a), basic

No.	Intervention	Cost of 100% coverage (GH₵)	Net health benefit at 100% coverage (DALYs averted)
1	Drug treatment uncomplicated malaria (<5)	68,940,786	12,820,037
2	Emergency obstetric care	53,365,641	928,757
3	Skilled maternal and immediate new-born care	155,860,721	584,307
4	Use of insecticide treated bed nets	8,034,841	563,234
5	Inguinal hernia repair	17,670,578	543,857
6	Community-based support for low birthweight babies	173,180	448,793
7	Drug treatment sexually transmitted infections (STIs)	95,191,967	356,121
8	Malaria vaccination	60,885,282	341,687
9	Voluntary Counselling and Testing (VCT)	2,450,355	283,701
10	Antivenom for snakebites	2,747,548	242,473
11	Emergency neonatal care (ENC)	168,365,667	228,165
12	Oral rehydration solution (ORS) for diarrhoea in <5s	24,532,174	223,437
13	Cataract surgery	3,320,518	185,470
14	Tetanus toxoid vaccination (as part of antenatal care)	8,892,408	172,138
15	Drug treatment childhood pneumonia	9,984,074	159,043
16	Iron supplementation for pregnant women	5,356,436	152,278
17	Syphilis detection and treatment (as part of antenatal care)	6,879,992	144,485
18	Corticosteroids for preterm labour	23,263,811	141,609
19	Pre-referral rectal drug treatment malaria for <5s	3,966,078	135,167
20	Drug treatment neonatal pneumonia	1,444,579	122,035
21	Male circumcision	32,268,254	104,203
22	Antibiotics in case of preterm premature rupture of membranes (pPROM)	183,200	96,461
23	Drug treatment epilepsy	20,317,319	66,645
24	Screening hearing loss	113,468	60,770
25	Intermittent preventive treatment malaria during pregnancy	1,048,458	44,865
26	Advice in case of heavy alcohol use	2,113,017	42,424
27	Pre-referral rectal drug treatment malaria for >5s	1,122,177	41,620
TOTAL PART (A)		**778,492,528**	**19,233,784**

Part b (co-insurance)

No.	Intervention	Cost of 50% coverage (GH₵)	Net health benefit at 85% coverage (DALYs averted)
28	Retinopathy screening and photocoagulation for diabetes	3,479,324	35,162
29	Screening children 5-15 for uncorrected refraction error	5,904,353	36,276
30	Iron supplementation for infants	2,524,268	33,006
31	HPV (16,18) vaccination	3,481,986	19,196
32	Integrated mass drug administration for schistosomiasis and soil-transmitted helminthiasis (children 5-14)	12,575,923	22,142
33	Distribution misoprostol for the prevention of post-partum haemorrhage	1,093,495	14,029
34	Pap smear (at age 40) + cervical cancer treatment if necessary	2,120,565	11,026
35	Drug treatment otitis media	8,776,029	12,498
36	Asymptotic bacteriuria detection and treatment (as part of antenatal care)	5,978,600	9,998
37	Preventive drug treatment for patients at risk of a cardiovascular disease (CVD) event	117,405,122	63,385
38	First Hepatitis B vaccination within 24 hours of birth	14,429,873	2,876
39	Drug + psychosocial treatment schizophrenia	9,211,821	5,292
40	Cervical cancer treatment	26,148,228	2,024
41	Breast cancer, treatment all stages	17,199,168	-4,560
TOTAL PART (B)		**221,905,539**	**262,352**
TOTAL PACKAGE 4B		**1,000,382,988**	**19,496,136**