Health gains and financial risk protection afforded by public financing of selected interventions in Ethiopia: an extended cost-effectiveness analysis

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Summary

Background **The way in which a government chooses to finance a health intervention can affect the uptake of health interventions and consequently the extent of health gains. In addition to health gains, some policies such as public finance can insure against catastrophic health expenditures. We aimed to evaluate the health and financial risk protection benefits of selected interventions that could be publicly financed by the government of Ethiopia.**

Methods **We used extended cost-effectiveness analysis to assess the health gains (deaths averted) and financial risk protection afforded (cases of poverty averted) by a bundle of nine (among many other) interventions that the Government of Ethiopia aims to make universally available. These nine interventions were measles vaccination, rotavirus vaccination, pneumococcal conjugate vaccination, diarrhoea treatment, malaria treatment, pneumonia treatment, caesarean section surgery, hypertension treatment, and tuberculosis treatment.**

Findings **Our analysis shows that, per dollar spent by the Ethiopian Government, the interventions that avert the most deaths are measles vaccination (367 deaths averted per $100 000 spent), pneumococcal conjugate vaccination (170 deaths averted per $100 000 spent), and caesarean section surgery (141 deaths averted per $100 000 spent). The interventions that avert the most cases of poverty are caesarean section surgery (98 cases averted per $100 000 spent), tuberculosis treatment (96 cases averted per $100 000 spent), and hypertension treatment (84 cases averted per $100 000 spent).**

Interpretation **Our approach incorporates financial risk protection into the economic evaluation of health interventions and therefore provides information about the efficiency of attainment of both major objectives of a health system: improved health and financial risk protection. One intervention might rank higher on one or both metrics than another, which shows how intervention choice—the selection of a pathway to universal health coverage—might involve weighing up of sometimes competing objectives. This understanding can help policy makers to select interventions to target specific policy goals (ie, improved health or financial risk protection). It is especially relevant for the design and sequencing of universal health coverage to meet the needs of poor populations.**

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Introduction

Protection from financial risks associated with health-care expenses is emerging as a crucial component of national health strategies in many low-income and middle-income countries. WHO's World Health Reports of 1999 and 2000 and the World Bank's Flagship course in health finance included provision of financial risk protection as one criterion of good performance for health systems.[1–3] The reduction of these financial risks is one objective of health policy devices such as universal public finance—full public finance irrespective of whether services are provided privately or publicly.

Out-of-pocket medical payments can lead to impoverishment in many countries, with households choosing from many coping strategies to manage health-related expenses.[4,5] These strategies include borrowing money from peers or relatives, or selling assets to pay for their health care. A quarter of individuals in low-income and middle-income countries use these financing mechanisms.[6] Without other options, such as private health insurance, household medical expenditures can often be catastrophic,[7] which is defined as expenditures exceeding a particular fraction of total household expenditures.

Universal public finance implies that the government finances an intervention irrespective of who is delivering or receiving it. Funds for universal public finance can be raised from general taxation, social insurance, external (donor) funding, or a combination of these sources. Recently, the 2010 World Health Report[8] advocated for a path to universal coverage, and identified reliance on direct payments, such as user fees at the point of care, as the greatest obstacle to progress on this path. By reducing some of the financial barriers to access, universal public finance is a key policy device for promoting universal health coverage, and it was stressed by *The Lancet's*

Commission on Investing in Health as a key instrument for progressive universalist pathways to achieve universal health coverage.[9] Although in many high-income countries, universal public finance covers a wide range of necessary health services, in low-income and middle-income countries, universal public finance typically targets a few selected interventions in the form of an essential health package. Consequently, many health services, including preventive and curative care, require payment at the point of care. Although essential care packages have elements in common, such as basic maternal and child health services, no clear consensus has been reached regarding the interventions to be included in a benefits package financed by universal public finance.

By financing interventions fully, universal public finance increases coverage in poor population groups.[8,10] Traditionally, economic assessments of health interventions (cost-effectiveness analysis) have focused on health improvement and have estimated an intervention cost per health gain, in dollars per death averted or dollars per disability-adjusted life-year averted.[11] Extended cost-effectiveness analysis (ECEA)[12–14] supplements traditional economic evaluation with financial risk protection evaluation (ie, assessment of the number of cases of poverty averted). This analysis enables the design of benefits packages that quantify financial risk protection and health that can be purchased for a given expenditure on specific interventions. In this respect, ECEA can inform discussion of some of the policy questions raised by the World Health Report 2013[15] about how to select and sequence the health services to be provided, to improve service coverage, and to increase financial risk protection for households.

In this Article, we apply ECEA to measure health and financial risk protection benefits for nine interventions that could be publicly financed by the Government of Ethiopia. Ethiopia has Africa's second largest population at about 92 million people, 82% of whom live in rural areas.[16] It is a low-income country with a gross domestic product (GDP) per person of about US$360, a growth rate of 7–8% per year, about 30% of its population living below the national poverty line, and a large share (roughly a third) of health expenditures financed by out-of-pocket payments.[17] Recently, Ethiopia's Ministry of Health has outlined an ambitious Health Sector Development Program for 2010–15,[18] which aims to scale up coverage of key interventions, many of which we explore in this analysis. Ethiopia expects to achieve its targets in large part due to the Health Extension Program—a community-based health services delivery programme that has helped to expand access to primary health care.[19,20]

Methods

Interventions

We selected interventions that encompassed a range of health conditions, different age groups (children *vs* adults), various incidences, and health expenditures (table 1). These interventions were among the national priorities of Ethiopia's Ministry of Health.[18] The interventions included were: measles vaccination; rotavirus vaccination; pneumococcal conjugate vaccination; diarrhoea treatment; malaria treatment; pneumonia treatment; caesarean section surgery; tuberculosis directly observed treatment short course; and treatment of hypertension. These interventions are a subset of health priorities taken from the list of interventions that the government aims to make universally accessible.[18] These specific ones were selected because they had the most data available and encompassed a range of conditions, ages, incidences, expenditures, and resources needed, thus showing the broad trade-offs between health and financial risk protection benefits. Our analysis is therefore illustrative, rather than comprehensive or prescriptive.

Assumptions

We analysed the effects of universal public financing—whereby individuals would not need to spend any money out of pocket to cover the direct medical costs—for each of the nine interventions. Full public finance is applied to the present coverage of the intervention plus a specified (10 percentage point) increment in intervention coverage (table 1). 10 percentage points are thought to represent an achievable increment amount within a short period (ie, 1 year), in view of existing health system capacity. We acknowledge that the amount of information diffusion, implicit and explicit demand creation, and availability of services could all increase after the implementation of universal public finance. Generally, the expected increment would depend on various issues, including present coverage, with, for example, low and high coverage seeing lower increases (low coverage because of low access; high coverage because of difficulties to improve further) than average coverage. We therefore explore the sensitivity of our findings to the selection of different incremental scenarios (5 and 20 percentage point increases).

For each intervention, we estimated both the total number of deaths averted and the total financial risk protection afforded owing to a reduction in out-of-pocket expenditures associated with treatment, per year. The amount of death and medical impoverishment prevented by public financing of each intervention depends on intervention coverage, intervention effectiveness, and household expenditures for treatment of related diseases.

Despite some services being provided free of charge by the government (ie, essential services related to family health, control of communicable diseases, hygiene and environmental sanitation, treatment for major chronic illnesses, and health education and communication),[27] 34% of health expenditure is financed privately in Ethiopia.[17] This expenditure consists of direct outlays by households (including gratuities and in-kind payments) for health services. For consistency, we assume that an individual's out-of-pocket burden for treating a disease or condition before universal public finance is 34% of the

	Description	Target population	Coverage before UPF (%)	Coverage after UPF (%)	Source(s)
Rotavirus vaccine	Routine immunisation through EPI two-dose vaccine	Children <1 year of age	0%	10%	Ethiopia Central Statistical Agency and ICF International[21]
Pneumococcal conjugate vaccine	Routine immunisation through EPI three-dose vaccine	Children <1 year of age	0%	10%	Ethiopia Central Statistical Agency and ICF International[21]
Measles vaccine	Routine immunisation through EPI one-dose vaccine	Children <1 year of age	56%	66%	Ethiopia Central Statistical Agency and ICF International[21]
Diarrhoea treatment	Provision of oral rehydration solution for mild diarrhoea (outpatient visit) and of intravenous fluids for severe diarrhoea (inpatient visit)	Children <5 years of age	32%	42%	Ethiopia Central Statistical Agency and ICF International[21]
Pneumonia treatment	Provision of oral antibiotics (eg, amoxicillin) for mild pneumonia (outpatient visit), and of injectable antibiotics (eg, penicillin/ampicillin) and oxygen for severe pneumonia (inpatient visit)	Children <5 years of age	27%	37%	Ethiopia Central Statistical Agency and ICF International[21]
Malaria treatment	Provision of artemisinin combination therapy for mild malaria (outpatient visit) and of intravenous treatment (eg, quinine) for severe malaria (inpatient visit)	Children <5 years of age	24%	34%	Ethiopia Central Statistical Agency and ICF International[21]
Caesarean section surgery	Surgical delivery for pregnant women in need of caesarean section	Pregnant women in need of caesarean section	Urban 83%; rural 15%	Urban 83%; rural 25%	Ethiopia Central Statistical Agency and ICF International[21]
Tuberculosis treatment	Provision of directly observed treatment, short course	Adults (15–49 years of age)	50%	60%	WHO[22]
Hypertension treatment	Provision of hydrochlorothiazide, amlodipine, and enalapril for high blood pressure	Adults (40–59 years of age) at high risk*	34%†	44%†	Zenebe,[23] Bovet et al,[24] Elzubier,[25] and WHO[26]

UPF=universal public finance. EPI=Expanded Programme on Immunization. *34% of adults are at high risk in ubran areas and 5% of adults are at high risk in rural areas.†60% compliance. Universal public finance—ie, full public finance—is applied to the current coverage of the intervention plus a specified (10%) increment in the intervention coverage. 10% is thought to represent an achievable increment amount within a short period (ie, 1 year), in view of existing health system capacity.

Table 1: **Interventions financed by hypothetical provision of universal public finance in Ethiopia**

	Disease burden	Case-fatality rate (%)	Health-care use (%)	Household out-of-pocket payments before UPF (2011 US$)	Unit costs borne by government after UPF (2011 US$)	Effectiveness (%)
Rotavirus vaccine[21,28,29–35]	3·9 under-5 deaths per 1000 livebirths	0·34%	Inpatient: 1·5%; outpatient: 31%	Inpatient: 17; outpatient: 3	3·0*	49%
Pneumococcal conjugate vaccine[21,28,29,32–34,36–39]	8·0 under-5 deaths per 1000 livebirths†	Pneumonia 11%; meningitis 73%; non-pneumonia non-meningitis disease 58%	Inpatient: pneumonia 9%, meningitis 75%, non-pneumonia non-meningitis disease 75%; outpatient: pneumonia 27%, meningitis 75%, non-pneumonia non-meningitis disease 75%	Inpatient: 28; outpatient: 15; meningitis: 62 (inpatient and outpatient)	4·6*	80%
Measles vaccine[28,29,32–34,40–42]	4·0 under-5 deaths per 1000 livebirths	3·5%	Inpatient 2·5%; outpatient: 50%	Inpatient: 5; outpatient: 0·5	1·0	85%
Diarrhoea treatment[21,28,29,33,34,43–45]	14·7 under-5 deaths per 1000 livebirths	0·15%	Inpatient: 0·5%; outpatient: 31%	Inpatient: 17; outpatient: 3	Inpatient: 49; outpatient: 7	93%
Pneumonia treatment[21,28,29,33,34,37,46]	22·1 under-5 deaths per 1000 livebirths	2·6%	Inpatient: 9%; outpatient: 27%	Inpatient: 28; outpatient: 15	Inpatient: 84; outpatient: 45	70%
Malaria treatment[21,28,29,33,34,47–49]	1·7 under-5 deaths per 1000 livebirths	4·2%	Inpatient: 13%; outpatient: 24%	Inpatient: 14; outpatient: 4	Inpatient: 42; outpatient: 12	91%
Caesarean section surgery[21,28,50–55]	7·5 women in need per 1000 livebirths	30%	Urban: 83%; rural: 15%	Urban: 67; rural: 31	Urban: 197; rural: 92	99%
Tuberculosis treatment[22,56,57]	100 000 annual cases‡	32%	50%	90	263	83%
Hypertension treatment[58–60]	56 annual cases per 100 000 (stroke)§; 35 annual cases per 100 000 (ischaemic heart disease)§	Stroke: 45%; ischaemic heart disease: 66%	75% upon stroke/ischaemic heart disease event	Stroke: 65; ischaemic heart disease: 84	9	Stroke: 39; ischaemic heart disease: 30

UPF=universal public finance.*Cost per vaccine dose is assumed to be US$1. †Pneumococcal deaths include pneumonia (90%), meningitis (7%), and non-pneumonia non-meningitis disease (3%). ‡By virtue of recommending smear microscopy, directly observed treatment short course focuses on the detection of smear-positive tuberculosis cases. Thus, our analysis focuses on smear-positive tuberculosis cases only. §54% of stroke incidence in people at high risk; 47% of ischaemic heart disease incidence in people at high risk.

Table 2: **Summary of the parameters used for modelling of universal public finance for nine interventions in Ethiopia**

	Government intervention costs (2011 US$)	Household expenditures averted (2011 US$)	Deaths averted	Cases of poverty averted
Rotavirus vaccine	800 000	180 000	510 (4)	270 (7)
Pneumococcal conjugate vaccine	1 200 000	110 000	1700 (2)	170 (8)
Measles vaccine	260 000	9000	890 (1)	14 (9)
Diarrhoea treatment	50 000 000	26 000 000	3600 (9)	40 000 (4)
Pneumonia treatment	31 000 000	15 000 000	4100 (7)	23 000 (5)
Malaria treatment	670 000	300 000	410 (5)	460 (6)
Caesarean section surgery	420 000	270 000	590 (3)	410 (1)
Tuberculosis treatment	6 900 000	4 400 000	2600 (6)	6700 (2)
Hypertension treatment	1 300 000	730 000	140 (8)	1100 (3)

The numbers in parentheses are the ranking of each intervention in deaths averted per dollar spent and poverty cases averted per dollar spent.

Table 3: **Total government intervention costs, household expenditures averted, deaths averted, and poverty cases averted, for each of the nine interventions provided by universal public finance in Ethiopia**

See Online for appendix

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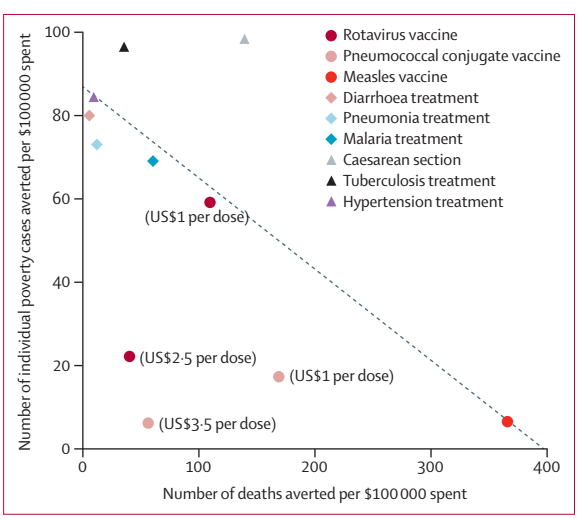

Figure: **Financial risk protection afforded (poverty cases averted) versus health gains (deaths averted), per US$100 000 spent (in 2011 US$), for each of the nine interventions provided through universal public finance in Ethiopia**
Dashed line represents a trend line.

total treatment cost (direct medical cost). In other words, for the purpose of this modelling exercise, before universal public finance, individuals pay 34% of health-care costs and the government pays 66% of the costs. After universal public finance, individuals pay no health-care costs and the government pays all (100%) of them. In this modelling exercise, no other out-of-pocket direct medical costs were included (eg, costs of visits to many providers because of poor health-seeking behaviour). We use secondary data and published studies to estimate the costs of the nine specific interventions analysed here. All costs are expressed in 2011 US$.

The number of deaths averted by each intervention is estimated on the basis of incidence and mortality data (ie, the burden attributed to the disease before universal public finance), intervention effectiveness and coverage, and the case-fatality rate (table 2). Financial risk protection is measured by estimation of the total number of cases of poverty averted for each intervention, depending on individual income (a proxy for which can be extracted from the income distribution of Ethiopia derived from its GDP per head [$360 in current US$] and its Gini index [34]), the national poverty line, the population targeted, disease incidence, health-care use, and out-of-pocket payments. The number of poverty cases averted is measured as the number of individuals who no longer fall below the national poverty line.[61] Specifically, in the population targeted, we estimate the individuals' expected income before and after universal public finance (depending on incidence, treatment costs, intervention coverage, and effectiveness), and subsequently count how many people have their expected income move up across the poverty line after the implementation of universal public finance.

Statistical analysis

The appendix provides full details of the mathematical derivations used for the analysis. Table 2 lists all the parameters used for the selected interventions. We used R statistical software version 3.1.0 for all analyses.

Role of the funding source

The funder of the study had no role in study design, or data collection, analysis, or interpretation. SV and all coauthors had full access to all the data in the study. SV and DTJ had final responsibility for the decision to submit for publication.

Results

The total intervention costs, the extent of health gains, and financial risk protection provided vary substantially across the nine interventions financed through universal public finance (table 3). The total number of deaths averted by the interventions per US$100 000 spent ranges from seven (for diarrhoea treatment) to 367 (for measles vaccination; figure). The total number of poverty cases averted varies substantially, from six (for measles vaccine) to 98 (for caesarean section) per $100 000 spent.

Measles and pneumococcal conjugate vaccinations are the two interventions that prevent the highest number of deaths per $100 000 spent, since the measles vaccine averts 367 deaths and pneumococcal conjugate vaccine 170 deaths. The measles vaccine is very effective (85% efficacy), is quite inexpensive (US$1·0 per child), and the disease is highly fatal (3·5% case-fatality rate). By contrast, diarrhoea treatment prevents the smallest number of deaths per $100 000 spent (roughly seven), since the intervention is not so cheap (US$6 for outpatient visits and $34 for inpatient visits) and diarrhoea is rarely fatal (0·15% case-fatality rate). Similarly, treatment of hypertension averts only 11 deaths per $100 000 spent, partly because of the low estimated incidence of stroke and ischaemic heart disease (<100 per 100 000 population) and the low effectiveness of this treatment (39% effective

at preventing stroke and 30% effective at preventing ischaemic heart disease).

Conversely, caesarean section averts the highest number of poverty cases (98 cases averted) because the associated out-of-pocket costs are large (US$30–70) and the number of pregnant women in need of caesarean section is substantial (around eight per 1000 pregnant women). Similarly, tuberculosis treatment and hypertension treatment lead to the second and third highest number of poverty cases averted (96 and 84 poverty cases averted, respectively), since they also create substantial out-of-pocket payments (US$65–90). Measles vaccination averts the smallest number of poverty cases (six), since the out-of-pocket payments by the beneficiary are small ($5 for inpatient visits and $0·50 for outpatient visits). Overall, adult treatment interventions (tuberculosis treatment, caesarean section, and hypertension treatment) provide the greatest financial risk protection. The vaccine interventions (measles, rotavirus, and pneumococcal conjugate vaccines) produce less financial risk protection (per dollar spent) than the childhood treatment interventions (treatment for malaria, diarrhoea, and pneumonia). In particular, one potential approach for subsequent interpretation could be to infer a trend line (figure) highlighting substitution between health and financial risk protection benefits: for example, a linear approximation (R^2=0·61) points to a reduction of about two poverty cases averted per additional ten deaths averted. Trade-offs inferred from such a trend line or from a frontier (ie, the line joining the caesarean section and measles immunisation points [not shown]) can prove highly sensitive to the interventions included. For example, if the measles vaccine were excluded, the R^2 would be reduced to 0·29.

Finally, we assessed the sensitivity of our findings with respect to a change in coverage increment (5% or 20%; table 4). For the vaccines, when coverage increment changes, health and financial risk protection benefits per dollar spent are maintained. For all the other interventions, when coverage increment decreases (to 5%), per dollar spent, financial risk protection benefits increase and health benefits decrease; conversely, when coverage increases (to 20%), per dollar spent, financial risk protection benefits decrease and health benefits increase.

	Government intervention costs (2011 US$)	Household expenditures averted (2011 US$)	Deaths averted	Cases of poverty averted
5% increase in coverage				
Rotavirus vaccine	400 000	90 000	250 (3)	140 (7)
Pneumococcal conjugate vaccine	600 000	55 000	840 (2)	80 (8)
Measles vaccine	130 000	5000	450 (1)	10 (9)
Diarrhoea treatment	38 000 000	26 000 000	1800 (9)	40 000 (4)
Pneumonia treatment	23 000 000	15 000 000	2000 (7)	23 000 (5)
Malaria treatment	480 000	300 000	210 (5)	460 (6)
Caesarean section surgery	340 000	266 000	290 (4)	410 (1)
Tuberculosis treatment	5 600 000	4 400 000	1300 (6)	6700 (2)
Hypertension treatment	1 000 000	730 000	70 (8)	1100 (3)
20% increase in coverage				
Rotavirus vaccine	1 600 000	350 000	1000 (4)	540 (4)
Pneumococcal conjugate vaccine	2 400 000	220 000	3300 (3)	340 (8)
Measles vaccine	520 000	19 000	1800 (1)	30 (9)
Diarrhoea treatment	75 000 000	26 000 000	7200 (9)	40 000 (5)
Pneumonia treatment	47 000 000	15 000 000	8100 (7)	23 000 (6)
Malaria treatment	1 030 000	300 000	820 (5)	460 (7)
Caesarean section surgery	570 000	270 000	1200 (2)	410 (1)
Tuberculosis treatment	9 500 000	4 400 000	5200 (6)	6700 (2)
Hypertension treatment	2 000 000	730 000	280 (8)	1200 (3)

The numbers in parentheses are the ranking of each intervention in deaths averted per dollar spent and poverty cases averted per dollar spent.

Table 4: **Total government intervention costs, household expenditures averted, deaths averted, and poverty cases averted, for each of the nine interventions provided by universal public finance in Ethiopia, after a 5% or a 20% increase in coverage**

Discussion

We present results for an ECEA of universal public financing of nine health interventions in Ethiopia. In particular, our approach assesses the consequences of universal public finance in protecting families against financial impoverishment, in addition to the dimension of health gains. This type of analysis is not possible with a traditional cost-effectiveness analysis, and emphasises potential trade-offs for policy makers as they choose between alternative pathways to universal health coverage (panel).

The introduction of universal public finance for key interventions could bring major financial risk protection benefits in addition to substantial health gains. Our findings align well with several expectations. First, if we assess health gains per dollar spent, the results fall within the range of previously reported cost-effectiveness analysis estimates.[11] Second, the conditions with large out-of-pocket payments are associated with high financial risk protection, and low-cost interventions (eg, treatment for hypertension) can lead to large poverty alleviation benefits. In addition to cost-effective interventions for which efficient purchase of health gains is realised (eg, the measles vaccine), there are so-called financial risk protection—cost-effective interventions for which efficient purchase of financial risk protection benefits is realised (eg, hypertension treatment).

Although ECEA is neutral with respect to what ought to be prioritised and included in a benefits package, the method allows policy makers to take both health and financial risk protection into account when making decisions. Consequently, scarce health-care resources could be more effectively targeted in accordance with specific policy objectives. For example, although potentially discarded on the grounds of health benefits, hypertension treatment might be included in a benefits package based on financial risk protection benefits. Similarly, based on our calculations, public financing of a

***Panel*: Research in context**

Systematic review

The 2010 World Health Report[8] advocated for a path to universal health coverage, and *The Lancet*'s Commission on Investing in Health[9] outlined alternative potential pathways to achieve this goal. The World Health Reports of 1999 and 2000[1,2] and the World Bank's Flagship course in health finance[3] included provision of financial risk protection as one criterion of good performance for health systems. Traditionally, economic analyses of health interventions have focused on health improvement per dollar spent. Extended cost-effectiveness analysis (ECEA)[12–14] supplements traditional economic evaluation with estimation of financial risk protection provided by health financing policies. Universal public finance is unique in that the government finances an intervention irrespective of who is delivering or receiving it. By contrast, although much has been written about the impoverishing effect of health expenditures, little attention has been paid to how public resources can be used efficiently to protect against this risk. In this Article, we apply ECEA to measure both health and financial risk protection benefits for a bundle of nine (among many other) interventions to be universally publicly financed by the Government of Ethiopia.

Interpretation

Our approach incorporates financial risk protection into the economic evaluation of health policy. This step allows policy makers to establish how much financial risk protection is being purchased with a given benefits package, in addition to the assessment of health that is being bought with incremental increases in public spending. The approach can inform the design of essential health packages on the pathway to universal health coverage.

10% increase in tuberculosis treatment and a 10% increase in malaria treatment would provide similar health benefits per dollar spent. However, tuberculosis treatment provides substantially more financial risk protection than malaria treatment and therefore is likely to be the better investment until resources are available for both. This analysis also provides policy makers with information about how they might sequence the development of health-care packages as the health and financial needs of populations evolve and resource envelopes change. Finally, health policies can be compared with policies from other sectors aimed at poverty reduction (eg, education, transportation, and development).

Our analysis has some limitations. Most importantly, with respect to our Ethiopian case study, we studied a small number of Ethiopia's health priorities.[18] This selection was largely because of scarce data availability, with nonetheless the intent to include a range of conditions, ages, incidences, expenditures, and resources needed across interventions, so as to illustrate broad health–financial risk protection trade-offs. The analysis is therefore illustrative: it is neither comprehensive nor prescriptive. Specifically, through its Health Extension Program,[19,20,62] Ethiopia has introduced community-based primary health care. The programme proposes 17 packages of basic services in four subdomains: disease prevention and control; family health; hygiene and environmental sanitation; and health education and communication. Every community builds a health post; two health extension workers from the community are trained to provide households with disease prevention advice, accessible services at health posts, and referrals to health centres.[19] Therefore, a detailed case study should represent this comprehensive design; our analysis presents a selective primary health-care view, largely because of low data availability and our aim to be illustrative. Thus, several key interventions from these subdomains, including prevention of mother-to-child transmission of HIV, family planning and reproductive health, and treatment of neglected tropical diseases, were not included.

Similarly, integration of services including reduced costs through economies of scope and synergistic effects rather than single interventions was not considered. Therefore, the selection of an optimum bundle of existing and new packages for the Health Extension Program, with comprehensive assessment of opportunity costs, health, and financial risk protection benefits remains to be done in future work. Importantly, in doing so, one should learn from other low-income and middle-income countries that have introduced publicly funded services towards universal health coverage.[63] For example, Rwanda's experience suggests that mutual health insurance increased health-care use and financial risk protection.[64] Through its Health Transformation Program, Turkey substantially enhanced equity with an improved level and distribution of health, more fairness in financing, and insurance coverage rising from 2 to 10 million people within 10 years.[65] In another example, Thailand's health reforms increased insurance coverage and significantly reduced child mortality in the poorest groups.[66]

Second, ECEA is only one method for priority setting. In addition to cost-effectiveness analysis or ECEA, decision-making should also include other ethical, social, political, and economic considerations, such as benefit to cost ratios;[9] the strengths and weaknesses of the host health systems; and use several criteria including those related to disease (eg, severity), targeting only specific individuals (eg, high-risk individuals) rather than a wider group of individuals, and other non-health consequences (eg, education).[67,68] By introducing ECEA, we intend to address some of these well understood limits of cost-effectiveness analysis[69] such as financial risk protection (one important dimension of universal health coverage), but much remains to be done in addressing how to improve these extensions and to deal with the concerns about cost-effectiveness analysis that ECEA does not yet address. Unlike most other ECEAs,[12–14] in this report, we did not disaggregate results by income quintile and did not directly address the issue of equity. If a government were to prioritise interventions, there would be equity implications and the need for disaggregated analyses. We focused on financial risk protection because of scarce data and to be parsimonious in adding dimensions to health benefits.

Third, as is the case with many published cost-effectiveness analyses, our disease models are static

rather than dynamic. Compared with static models, dynamic models can more accurately capture synergies but also have a bigger reliance on additional data and assumptions about disease behaviour. The inclusion of the number of secondary cases prevented would lead to increased numbers of deaths and poverty cases averted (for example, an increase to 41 deaths averted and 97 poverty cases averted per $100 000 spent for tuberculosis treatment). Additionally, the longer term benefits of vaccination in those older than 5 years of age were neglected because the burden of disease is largely concentrated in children younger than 5 years of age.

Fourth, a more comprehensive accounting of household medical payments could be done, including payments caused by poor health-seeking behaviour and visits from many health-care providers. In particular, direct non-medical costs (eg, transportation and housing costs) and indirect costs caused by the disease or condition, including loss of earnings and effect on labour productivity, can be substantial. Fifth, scarce data about the existing mix of public and private provision and purchase of health care affected our choice of interventions. Sixth, we did not do a full uncertainty analysis but rather included a sensitivity analysis, since the purpose of this report is to expose with simplicity a methodological framework for policy makers, and not to provide them with definitive estimates. Finally, we chose to represent financial risk protection in terms of poverty cases averted. Alternatives include a money-metric value of insurance wherein a utility-based framework is used and in which individuals seek to avoid uncertainty,[12] and avoid cases of forced borrowing or sales.[6] We chose the metric of poverty cases averted because of both data availability and simplicity. However, the use of this metric has associated issues— namely, the choice of a poverty threshold and the fact that individuals living below the poverty line might not always be accounted for.[7] Similarly, we relied heavily on secondary data and published studies to estimate effect and costs. Moreover, the health metric of deaths averted was retained for simplicity and ease of communication, which could introduce bias towards high-mortality diseases, and could be replaced by a constructed metric capturing both morbidity and mortality such as the disability-adjusted life-year.

Future studies will expand on this analysis by incorporating other essential features that promote realism of the scenario. For example, financial barriers are not the only barriers that prevent individuals from seeking care: absence of information, low availability of services, and long distances to health-care facilities are also important. In countries with a low density of health workers and weak health infrastructure, such as Ethiopia, health services might not be available even after some of the financial barriers are removed. In particular, expansion of health services to rural areas might need additional investments, such as strengthening of health facilities through training and deployment of skilled health workers, provision of essential equipment, and infrastructural improvement for service delivery.

Acceptability issues related to culture or quality also exist. Universal health coverage does not necessarily ensure quality, but innovations, such as accreditation to participate in universal health coverage schemes[70] instituting basic quality expectations or pay for performance schemes, can improve quality. In turn, these barriers will limit expansion in the amount of coverage initially achievable by universal public finance. To address this situation, we chose a specified coverage increment of 10% for all interventions. However, the expected increment would depend on various issues, including present coverage, which is why we included a sensitivity analysis. Moreover, marginal costs of health-care provision might increase substantially with coverage increase, and these marginal costs can vary depending on the population subgroups targeted (eg, different education or socioeconomic groups). Similarly, significant differences exist in disease incidence or mortality, and health-care use, which vary by population subgroups. For example, poorer children are more likely to die from rotavirus than are those from wealthier families, and richer children are more likely than poor children to be taken to health facilities when they are ill.[13] Finally, ECEA can be applied to the evaluation of other policy devices besides universal public finance, including prepayment mechanisms (eg, who should financially contribute and in which way), conditional cash transfers, or financial incentives.

Contributors

SV and DTJ initiated and conceptualised the study. SV coordinated the research and did the analysis with ZDO, JBB, KAJ, MEK, CP, MGS, and DAW. SV wrote the first draft of the report. All coauthors reviewed the report and provided advice and suggestions. SV and DTJ had final responsibility for the decision to submit for publication.

Declaration of interests

CP was employed by the Bill & Melinda Gates Foundation while contributing to the study. The other authors declare no competing interests.

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