Progress on catastrophic health spending in 133 countries: a retrospective observational study

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Summary

Background The goal of universal health coverage (UHC) requires inter alia that families who get needed health care do not suffer undue financial hardship as a result. This can be measured by the percentage of people in households whose out-of-pocket health expenditures are large relative to their income or consumption. We aimed to estimate the global incidence of catastrophic health spending, trends between 2000 and 2010, and associations between catastrophic health spending and macroeconomic and health system variables at the country level.

Methods We did a retrospective observational study of health spending using data obtained from household surveys. Of 1566 potentially suitable household surveys, 553 passed quality checks, covering 133 countries between 1984 and 2015. We defined health spending as catastrophic when it exceeded 10% or 25% of household consumption. We estimated global incidence by aggregating up from every country, using a survey for the year in question when available, and interpolation and model-based estimates otherwise. We used multiple regression to explore the relation between a country's incidence of catastrophic spending and gross domestic product (GDP) per person, the Gini coefficient for income inequality, and the share of total health expenditure spent by social security funds, other government agencies, private insurance schemes, and non-profit institutions.

Findings The global incidence of catastrophic spending at the 10% threshold was estimated as 9·7% in 2000, 11·4% in 2005, and 11·7% in 2010. Globally, 808 million people in 2010 incurred catastrophic health spending. Across 94 countries with two or more survey datapoints, the population-weighted median annual rate of change of catastrophic payment incidence was positive whatever catastrophic payment incidence measure was used. Incidence of catastrophic payments was correlated positively with GDP per person and the share of GDP spent on health, and incidence correlated negatively with the share of total health spending channelled through social security funds and other government agencies.

Interpretation The proportion of the population that is supposed to be covered by health insurance schemes or by national or subnational health services is a poor indicator of financial protection. Increasing the share of GDP spent on health is not sufficient to reduce catastrophic payment incidence; rather, what is required is increasing the share of total health expenditure that is prepaid, particularly through taxes and mandatory contributions.

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Introduction

Although, globally, the share of health spending by patients themselves at the point of care (so-called out-of-pocket payments) has been falling, out-of-pocket spending as a share of income has not been declining. This fact has prompted concerns about the two aspects of universal health coverage (UHC): first, that everyone—poor and rich alike—should receive needed health care (referred to as service coverage);[1] and second, that families who do get needed care do not suffer undue financial hardship as a result (referred to as financial protection).[2] Strong performance on one UHC dimension does not guarantee strong performance on the other. A low incidence of catastrophic payments (ie, out-of-pocket payments that are

especially large relative to a family's total income or consumption) might reflect people getting needed care but being protected from out-of-pocket costs. However, a low incidence of catastrophic payments could also mean people not getting (and not paying for) needed care. The two dimensions of UHC need to be examined together.

The second dimension of UHC (financial protection) can be captured through two indicators.[2,3] In this Article, we aimed to present global estimates for one of these indicators—namely, catastrophic out-of-pocket spending. This measure is the official indicator for monitoring of UHC financial protection among the Sustainable Development Goals (SDGs; indicator 3.8.2), with large expenditure suggested to be defined as 10%

Research in context

Evidence before this study
In a global study of catastrophic spending from 2007, which was based on data from 116 health surveys covering 89 countries and with a median survey year of 1997, catastrophic spending was defined as spending that absorbs more than 40% of total consumption, net of an allowance for food expenditures. This threshold was set equal to average food spending among households in which the food spending share (as a percentage of total consumption) was in the 45th to 55th percentile range, the assumption being that, at least in low-income and middle-income countries, the daily food intake of this group averages 2000 kcal. The study reported mean and median catastrophic spending incidence of 2·3% and 1·5%, respectively, and estimated that 150 million people globally incur catastrophic spending annually. Catastrophic spending was (partly) correlated with the share of prepayment in total health spending (negative) and the Gini coefficient for income (positive), and in low-income and middle-income countries with the share of gross domestic product (GDP) devoted to health (positive).

Added value of this study
We not only used the official Sustainable Development Goal (SDG) indicator for financial protection but also compared our results with findings obtained when catastrophic spending was defined as occurring if out-of-pocket spending exceeded 40% of non-food consumption—a definition that is close to the one used in two previous global studies. Our data are more recent than those used in two previous studies from 2003 and 2007, extend country coverage from 89 to 133, report trend data for 94 countries, and estimate catastrophic spending incidence globally for 3 years—2000, 2005, and 2010. As in the two previous studies, we analysed country-level correlates of catastrophic spending incidence, but did so using 553 datapoints rather than 116, and explored how catastrophic payments vary with the share of total health spending channelled through different types of publicly and privately financed prepayment arrangements. We also investigated the degree to which catastrophic payment incidence was associated with the fraction of the population covered by a health insurance scheme or by a national or subnational health service, an indicator suggested as a possible measure of universal health coverage (UHC).

Implications of the available evidence
In roughly half of countries, the incidence of catastrophic spending has been rising, at both the 10% and 25% thresholds, whereas in around 40% of countries, catastrophic spending incidence has been increasing using the non-food measure. However, for all measures, the population-weighted median annual rate of change of catastrophic payment incidence has been positive. The incidence of catastrophic spending varies considerably across countries at any given point in time. This variation does not reflect differences in the share of the population covered by a health insurance scheme or by a national or subnational health service: variations exist among countries officially covering the entire population, and incidence changes over time during periods when health coverage arrangements and rates have not changed. What coverage rates miss, and catastrophic payment incidence captures, is the extent of de jure and, more importantly, de facto coverage of different services. Just increasing the share of GDP spent on health does not seem to be sufficient to provide financial protection. We find that the incidence of catastrophic payments decreases with both the share of health spending that is channelled through social security funds and the share channelled through other government financial protection arrangements; evidence suggests that the negative association is stronger for government financial protection arrangements.

and 25% of total household expenditure. A companion paper[4] presents results for the second widely used indicator of financial protection—namely, medical impoverishment.[3,5] Impoverishment is not an official SDG indicator but supplements the catastrophic payment indicator by trying to highlight the poverty implications of out-of-pocket spending.

Our study updates and extends two previous global studies undertaken in 2003[6] and 2007.[7] We use the official SDG definitions for catastrophic payments and include data for 133 countries (median year 2010). We estimate annual average changes in incidence of catastrophic spending for 94 countries and report global and regional estimates for 2000, 2005, and 2010. We also use multiple regression methods to search for macroeconomic and health system variables that are associated with the incidence of catastrophic spending at the national level. We also aimed to investigate the degree to which catastrophic payment incidence is associated with coverage by a health insurance scheme or by a national or subnational health service,[8] an indicator proposed by some but rejected by others as a possible measure of UHC.[9]

Methods

Catastrophic payments as a measure of financial hardship
We focused on one measure of financial hardship that has been used widely in previous studies,[3,6,7,10–16] typically referred to as catastrophic health expenditure. Catastrophic spending can be measured in different ways (appendix). The idea is, in effect, to measure the incidence of financial hardship caused by health payments—ie, the number of households with health spending that is large relative to their ability to pay.

There is no right or wrong way to measure ability to pay. One key question is whether it is reasonable to expect households to borrow or use savings to finance their health spending, as many do.[17,18] If the answer

is no, ability to pay should be measured using current income. If the answer is yes, then the household's health expenditure—even if financed out of borrowing—represents resources available to the household, and ability to pay should be measured by total consumption gross of health spending. The answer could depend on what type of care is being purchased: a government might be reluctant for households to have to borrow or use savings for acute medical care but be comfortable about them contributing from their savings towards the cost of long-term elder care. The choice of yardstick matters less for the overall incidence of catastrophic spending than for the measurement of inequality in catastrophic spending, with a consumption-based measure of ability to pay leading to more pro-rich inequality than an income-based measure. In any event, because in low-income and middle-income countries it is difficult to measure income with any accuracy, we have little choice but to use consumption, except in a few countries for which consumption is not available; we, therefore, do not report results on inequality in the incidence of catastrophic spending in this Article.

However ability to pay is measured, the question arises as to whether there should be some adjustment for essential items of spending. In some studies, researchers have subtracted from consumption food spending[3] or an allowance for food spending[6,7] to capture the fact that poorer households have fewer resources to devote to non-nutritional needs. Both approaches overlook, however, other non-discretionary spending—eg, related to clothing, shelter, and heating—that in some countries is even more important (relatively speaking) than food expenditure, including for poor populations.[19] Researchers on two studies tried to address this problem, but neither study is universally applicable, with one[19] being better suited to high-income countries and the other[20] being better suited to low-income and middle-income countries. In view of these difficulties, we used total consumption as our ability-to-pay measure, consistent with the official SDG indicator. We do, however, compare our results with data obtained with non-food consumption in the denominator (appendix)— a definition that gets close to that used in the previous two global studies.

The thresholds we used are the two proposed SDG thresholds: 10% and 25% of total consumption. The 10% threshold is the more common of the two in empirical work to date, used in 41% of studies; only 6% used the 25% threshold (appendix). The 10% threshold is somewhat higher than the typical threshold used in national tax systems to ascertain whether out-of-pocket medical expenses are large enough to be tax deductible: in the USA the threshold is 10%, but in Greece and Switzerland the threshold is 5%, whereas in Canada and Korea the threshold is just 3%; in some countries, including Brazil and Colombia, there is no threshold.

Estimating catastrophic spending aggregates

The household surveys we use are nationally represen-tative, so our analysis of a household survey leads directly to a national estimate of the incidence of catastrophic spending for that country in that year. We also estimated the regional and global incidence of catastrophic spending, using UN regions and three reference years: 2000, 2005, and 2010. The process entailed estimating incidence at the country level, then aggregating up. We used surveys from up to 5 years before and up to 5 years after to estimate incidence in each of the three reference years, using a mix of survey datapoints, imputation, extrapolation, and modelling as needed (appendix). Table 1 provides a breakdown of the types of country datapoints used to estimate the global and regional incidence of catastrophic payments. For example, for the reference year 2010, we used actual survey-based datapoints for 101 countries, for which at least one point was available between 2005 and 2015. Together, these countries represent 86·1% of the world's population. For 54 of these 101 countries, the survey was undertaken in 2010, so we relied on the actual survey-based estimate of the incidence of catastrophic payments. For the other 47 countries, we aligned survey estimates to the reference year by projecting the incidence of catastrophic payments, using the elasticity of catastrophic payments with respect to the aggregate share of out-of-pocket spending over total consumption based on national accounts data. For a remaining set of 110 countries (accounting for 13·9% of the world's population), we did not have a datapoint between 2005 and 2015. For 23 of these 110 countries, we used the aggregate share of out-of-pocket spending over total consumption to estimate the value of catastrophic payments in the reference year. Finally, we imputed the incidence of catastrophic payments using the median regional value for the other 87 countries (9·8% of the world's population). The country estimates for the reference year were then aggregated up to the regional and global levels to get the number of people experiencing catastrophic out-of-pocket expenditures. We then calcu-lated the global and regional rates by expressing these numbers as a share of the relevant population, equivalent

	1995–2005 (reference year 2000)		2000–10 (reference year 2005)		2005–15 (reference year 2010)	
	Countries (n)	Proportion of global population (%)	Countries (n)	Proportion of global population (%)	Countries (n)	Proportion of global population (%)
Reference year point	27	38·4%	36	19·9%	54	31·4%
Two points within band	19	6·6%	29	54·0%	13	21·8%
One point within band	61	38·0%	48	15·5%	34	32·9%
Fitted	15	6·9%	11	0·8%	23	4·1%
Regional median	89	10·1%	87	9·8%	87	9·8%

Table 1: Categories of datapoints used for aggregation

to taking a population-weighted average of the relevant country rates.

Aggregate correlates of catastrophic spending

We used multiple regression to investigate not only the partial relation between a country's incidence of catastrophic out-of-pocket health expenditures but also various macroeconomic indicators and health system characteristics. We included two macroeconomic indicators: gross domestic product (GDP) per person and the Gini coefficient for income inequality. We also included total health expenditure (THE) as a share of GDP. To capture the overall share of THE that is prepaid, and the mix across different prepayment programmes, we included the shares of THE spent by social security funds, general government agencies excluding social security funds (referred to hereafter as other government agencies), private insurance schemes, and non-profit institutions serving households.[21] We postulated that, among public sources, what is likely to matter for catastrophic payment incidence is not the source of finance (ie, taxes, non-tax revenues, social insurance contributions, etc) but rather which agent spends the funds and how it operates—eg, the financial incentives it faces, who it covers, the agency's pool size, the services the agency covers, the generosity of its coverage, and the contractual and payment arrangements it has with providers.

Household datasets

To measure a country's incidence of catastrophic spending, we required microdata (ie, unit record data) from nationally representative household surveys containing information on out-of-pocket health spending and on total household consumption. We set out to assemble as large a dataset as possible of such surveys. We derived the dataset from household surveys available to us as of March, 2017. We undertook inventories of the microdata catalogues of the International Household Survey Network and the World Bank, and of several household survey collections. We also searched for household surveys online, and obtained microdata from household surveys used by other researchers.[6,7] Through this process, we identified 1566 potentially suitable household survey datasets, from 155 countries. Of these, 171 were inaccessible and 424 lacked key variables. The remaining 971 datasets were subject to a quality assurance process that entailed comparing consumption per person and the health budget share with World Bank and WHO data, then checking every datapoint and every country's time series manually (appendix). At the end of this confirmation process, we were left with 553 datapoints from 133 countries spanning the period 1984–2015. These datapoints break down across countries (figure 1) and collections (appendix). Only one datapoint was available for 37 of 133 countries; the remaining 96 countries had multiple surveys. The 133 countries in

our final dataset accounted for 93% of the world's population in 2015, with variation across UN regions: Africa (88%), Asia (95%), Europe (89%), Latin America and the Caribbean (89%), North America (100%), and Oceania (63%).

Ability to pay defined as total consumption or income

In low-income countries it is hard to measure income, in part because many families produce and consume some of their food on a family plot and this does not show as income.[22] Consumption is, therefore, used more widely; we have used consumption in this Article except for a few middle-income and high-income countries, for which we have used income in the absence of data for consumption. Ideally, a consumption aggregate should capture consumption across a broad range of categories, such as that proposed by the Classification of Individual Consumption according to Purpose (COICOP), published by the UN Statistics Division, including the use value of durables and the value of the flow of services that the household receives from occupying its dwelling.[22,23] We did not attempt to reconstruct a consumption aggregate for our datapoints, which would be a massive undertaking, but rather we relied on datasets for which an aggregate already exists.

Out-of-pocket spending

Out-of-pocket spending includes not only payments made by the user at the point of use but also cost-sharing and informal payments, both in kind and in cash, but it excludes payments by a third-party payer.[21] Many household expenditure surveys include questions on health spending, but, being general surveys, most have some shortcomings in terms of identifying out-of-pocket health spending. First, it is sometimes not clear whether the spending reported is gross or net of any reimbursement by third parties (eg, private insurance company or government agency), in which case out-of-pocket spending could be overestimated. We excluded countries and surveys for which this uncertainty is a problem (eg, France), in case we overestimated the extent to which health spending is a source of financial hardship. Second, recall periods are sometimes inappropriate, particularly in general expenditure surveys, in which the last 3 months and the last 12 months are used frequently, periods that are too long for items such as outpatient care and medicines. Multipurpose surveys are better in that spending data are gathered via a health module that varies recall period by type of service.[24] Third, variations in comprehensiveness probably exist across surveys. A review of 100 survey questionnaires found that, in 80% of surveys, questions were asked about spending on pharmaceutical products, hospital services, medical services, and paramedical services.[24] Nonetheless, it is difficult to be sure the surveys are equally comprehensive.
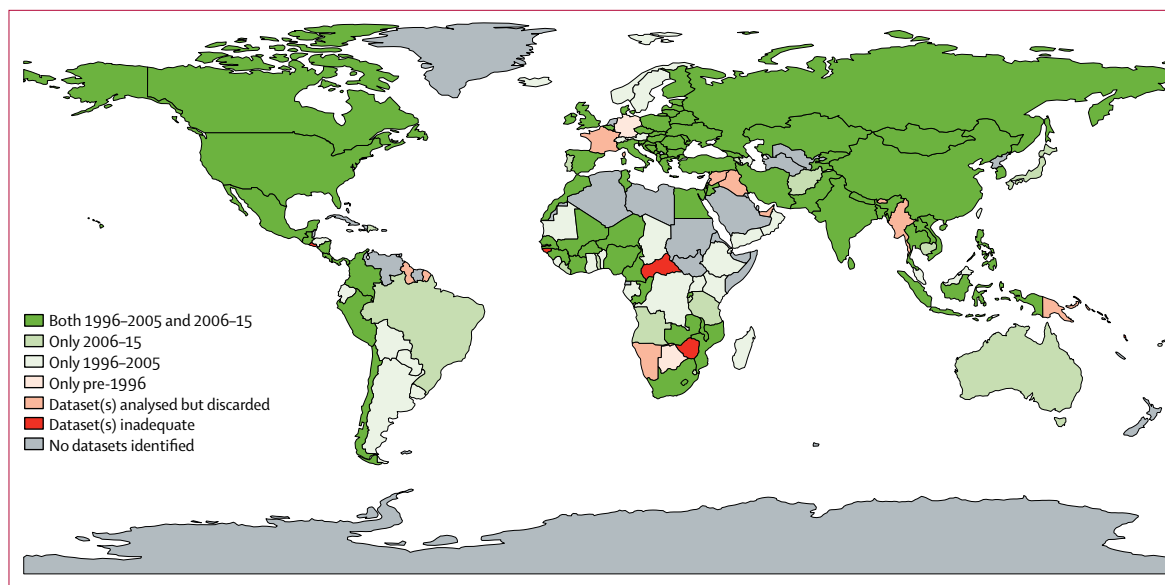
Figure 1: Data availability for catastrophic health expenditure, by country

Data for macroeconomic and health system indicators

We obtained GDP and THE from the World Bank's Open Databases and the Gini coefficient for income from Milanovic's All the Ginis (ALG) dataset.[25] We obtained proportions of THE channelled through social security schemes, other government agencies, private insurance, and non-profit institutions from WHO's Global Health Expenditure Database (GHED). We filled gaps in the ALG and GHED datasets by carrying forward the most recent datapoint and carrying backward the oldest datapoint; for countries with data missing completely for the share of THE channelled through social security, private insurance, and non-profit institutions, we assumed they did not use the financing agency with missing data. Further details of data sources are in the appendix.

Role of the funding source

The funders had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all data in the study and had final responsibility for the decision to submit for publication.

Results

The incidence of catastrophic out-of-pocket payments in the most recent surveys varied strikingly across countries. At the 10% threshold, incidence ranged from 0·3% in Zambia in 2010 to 44·9% in Lebanon in 1999 (figure 2A). Mean incidence across countries was 9·2% (SD 7·6) and median was 7·1% (IQR 3·4–13·4). Incidence was inevitably lower at the 25% threshold (figure 2B), with mean and median incidences of 1·8% (SD 2·1) and 1·0% (IQR 0·34–2·5), respectively. The rank correlation between the two catastrophic payment measures was 0·877, so for the most part low incidence at the

10% threshold compared with other countries (which could be interpreted as good performance) was mirrored by low incidence at the 25% threshold compared with other countries, but exceptions were noted. Using non-food consumption in the denominator and setting the threshold at 40% gave a population-unweighted mean catastrophic incidence of 2·1% (SD 2·7) and resulted in catastrophic payments being more concentrated in the world's poorest regions—Africa and Asia (appendix). This alternative measure correlates less strongly with the official SDG measures than they do with each other (rank correlations are 0·554 and 0·709).

Aggregating across countries, estimates showed that, in 2010, 808·4 million people incurred catastrophic spending at the 10% threshold, equivalent to 11·7% of the world's population (table 2). At the 25% threshold, these figures were 179·3 million people and 2·6% of the world's population, and using 40% of non-food consumption as the threshold, the figures were 208·2 million people and 3·0% of the world's population. Estimates for 2010 revealed variations across UN regions, with Latin America and the Caribbean having the highest incidence at the 10% threshold (14·8%), and Oceania having the lowest (3·9%).

Figure 3 shows the average annual change in the incidence of catastrophic out-of-pocket payments at the 10% and 25% thresholds across all available surveys, for 94 countries for which surveys were available for 2 years or more. At the 10% threshold, the average annual change ranged from –2·7% per year in Congo (Brazzaville [2005–11]) to 3·3% per year in Armenia (2010–13). In 48 of 94 countries, the incidence of catastrophic out-of-pocket spending increased over time. At the 25% threshold, catastrophic payment incidence rose in 54% of countries. The population-unweighted
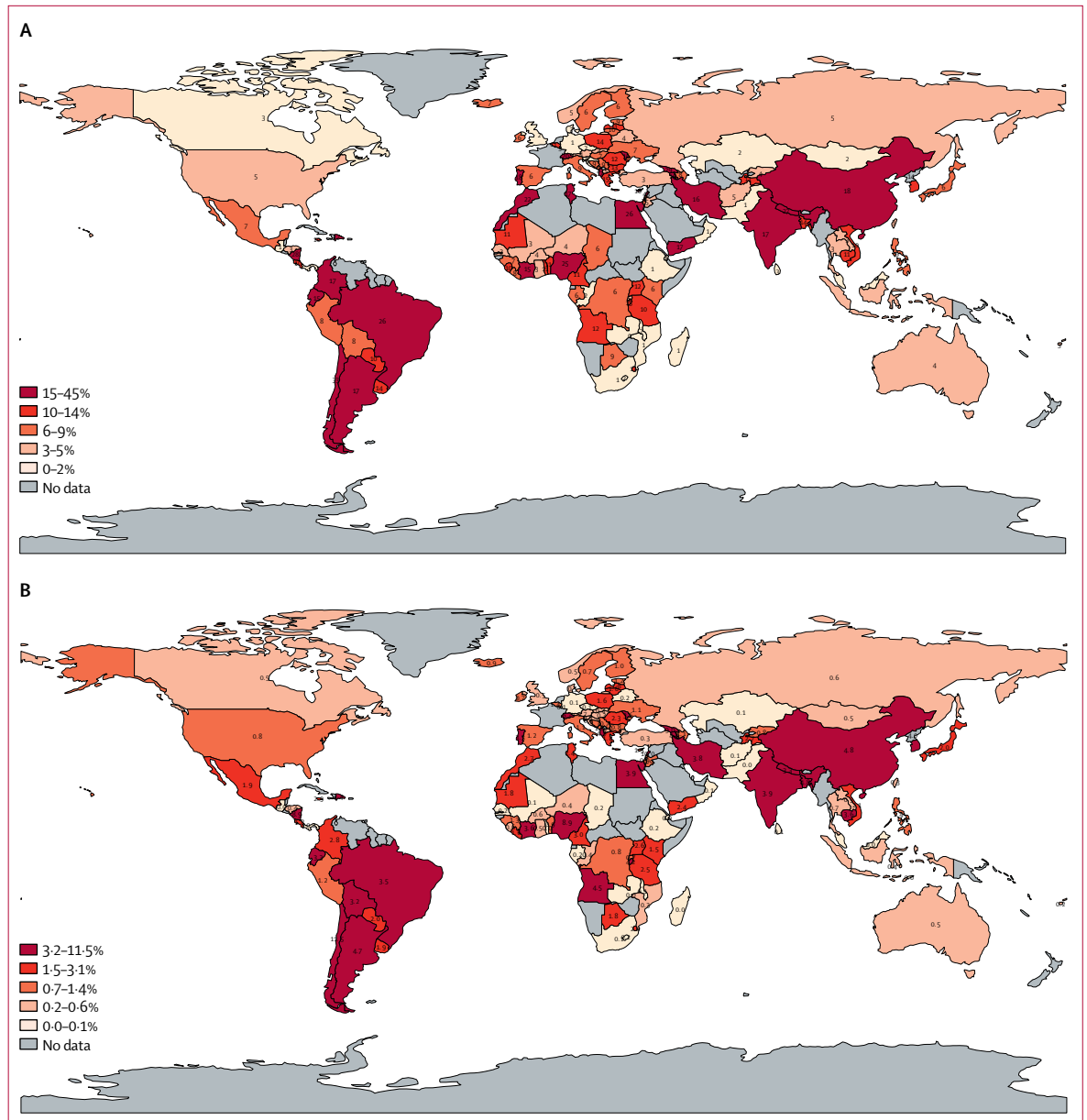
Figure 2: **Incidence of catastrophic health spending at the 10% (A) and 25% (B) thresholds, latest year**

median change in catastrophic out-of-pocket payment incidence was 0·03% per year (IQR –0·18 to 0·41) for the 10% threshold and 0·01% per year (–0·05 to 0·07) for the 25% threshold, whereas the population-weighted figures were 0·45% per year (–0·13 to 1·02) and 0·22% per year (0·00 to 0·31), respectively. The discrepancy in these values indicates that catastrophic payment incidence has been falling more slowly or rising more quickly in more populous countries. The rank correlation between the annual average changes in the two catastrophic payment measures was 0·880; thus, for the most part, relative improvements at the 10% threshold were mirrored by relative improvements at the 25% threshold.

Counter examples exist, however (figure 3); Tanzania and Uganda, for example, have achieved quite large reductions in catastrophic spending at the 10% threshold but not at the 25% level, whereas at the other end of the chart Bulgaria and Moldova have seen catastrophic payment incidence rising at the 10% threshold but not at the 25% threshold.

The trend in annual average change was more encouraging if the sample was restricted to 2005 and onwards. The population-unweighted median annual changes in incidence of catastrophic out-of-pocket payments were –0·07% per year (IQR –0·36 to 0·27) for the 10% threshold and –0·00% per year (–0·08 to 0·08) for

	2000		2005		2010	
	Proportion of population (%)	Number of people (million)	Proportion of population (%)	Number of people (million)	Proportion of population (%)	Number of people (million)
10% threshold (total consumption)						
Global	9·7%	588·5	11·4%	741·3	11·7%	808·4
Africa	8·7%	70·7	10·3%	94·1	11·4%	118·7
Asia	10·4%	381·6	12·2%	479·2	12·8%	531·1
Europe	6·5%	47·4	7·0%	51·2	7·2%	53·2
Latin America and the Caribbean	13·4%	70·5	17·5%	98·3	14·8%	88·3
North America	5·5%	17·2	5·3%	17·4	4·6%	15·6
Oceania	3·5%	1·1	3·4%	1·1	3·9%	1·4
25% threshold (total consumption)						
Global	1·9%	112·8	2·4%	154·9	2·6%	179·3
Africa	1·5%	12·3	1·9%	17·7	2·5%	25·6
Asia	2·1%	77·1	2·8%	108·7	3·1%	128·7
Europe	0·9%	6·5	1·0%	7·3	1·0%	7·2
Latin America and the Caribbean	2·6%	13·6	3·2%	18·0	2·5%	14·9
North America	1·0%	3·1	0·9%	3·0	0·8%	2·6
Oceania	0·5%	0·1	0·4%	0·1	0·5%	0·2

Table 2: Global estimates of catastrophic spending

the 25% threshold; however, the population-weighted figures remained positive at 0·27% per year (–0·08 to 2·01) and 0·10% per year (–0·00 to 0·57), respectively. The trend in annual average change was also more encouraging with the non-food version of the catastrophic payment indicator: catastrophic payment incidence increased in only 38% of countries, whereas the population-unweighted median rate of change was –0·05% per year (IQR –0·15 to 0·04); the population-weighted median, however, remained positive at 0·04% per year (–0·00 to 0·45).

Globally, the number of people incurring catastrophic payments increased between 2000 and 2010, whichever threshold was used and whether or not total consumption or non-food consumption was used in the denominator (table 2). At the 10% threshold, the number of people incurring a catastrophic payment increased from 588·5 million (9·7% of the world's population) in 2000 to 741·3 million (11·4%) in 2005, rising to 808·4 million (11·7%) in 2010. A similar pattern was evident in the numbers for the 25% threshold and indicator. The global trend estimates were based on estimates for all countries, including those that had limited trend data or no data. The pattern of a global increasing incidence of catastrophic payments was, however, consistent with the population-weighted estimates for countries with at least 2 years of data for catastrophic payments. The incidence of catastrophic payments has evolved differently across the various UN regions: the global rise in catastrophic payment incidence has been driven by increases in Africa and Asia; North and South America—and for some indicators, other regions too—have seen reductions.

Incidence of catastrophic spending can vary across countries with similar types of health system. Armenia,

Azerbaijan, Canada, and the UK all officially cover 100% of their populations automatically with national or regional health services;[8,26] yet the incidence of catastrophic payments was considerably higher in Armenia and Azerbaijan (16% and 8%, respectively, at the 10% threshold) than it was in Canada and the UK (3% and 2%, respectively, at the same threshold). The incidence of catastrophic payments also varied between Hungary (7%), South Korea (13%), Montenegro (9%), and Romania (12%), despite the fact that—in all four countries—100% of the population is officially covered by a national health insurance scheme.[8,26] Moreover, even though—in these eight countries—arrangements and insurance coverage rates have stayed the same in recent years, incidence of catastrophic payments has not always remained unchanged; indeed, in some cases, a clear upward trend was evident (figure 3). The USA is a counter example: insurance coverage rates stayed largely unchanged over the period 1995–2013;[27] yet, the incidence of catastrophic payments fell. Figure 3 also shows that when additional population groups acquired coverage in formal insurance schemes, the incidence of catastrophic payments did not always change in the expected direction: in Mexico, Thailand, and Vietnam, catastrophic payment incidence has indeed fallen as the fraction of the population with insurance coverage has expanded, but this effect has not happened in China, Indonesia, or the Philippines.[13,14,28–30] In short, catastrophic payment incidence cannot be inferred from the fraction of the population covered by health insurance schemes or public health services. This conclusion is not sensitive to the definition of catastrophic expenditures used; the same conclusion is reached when using the non-food definition.
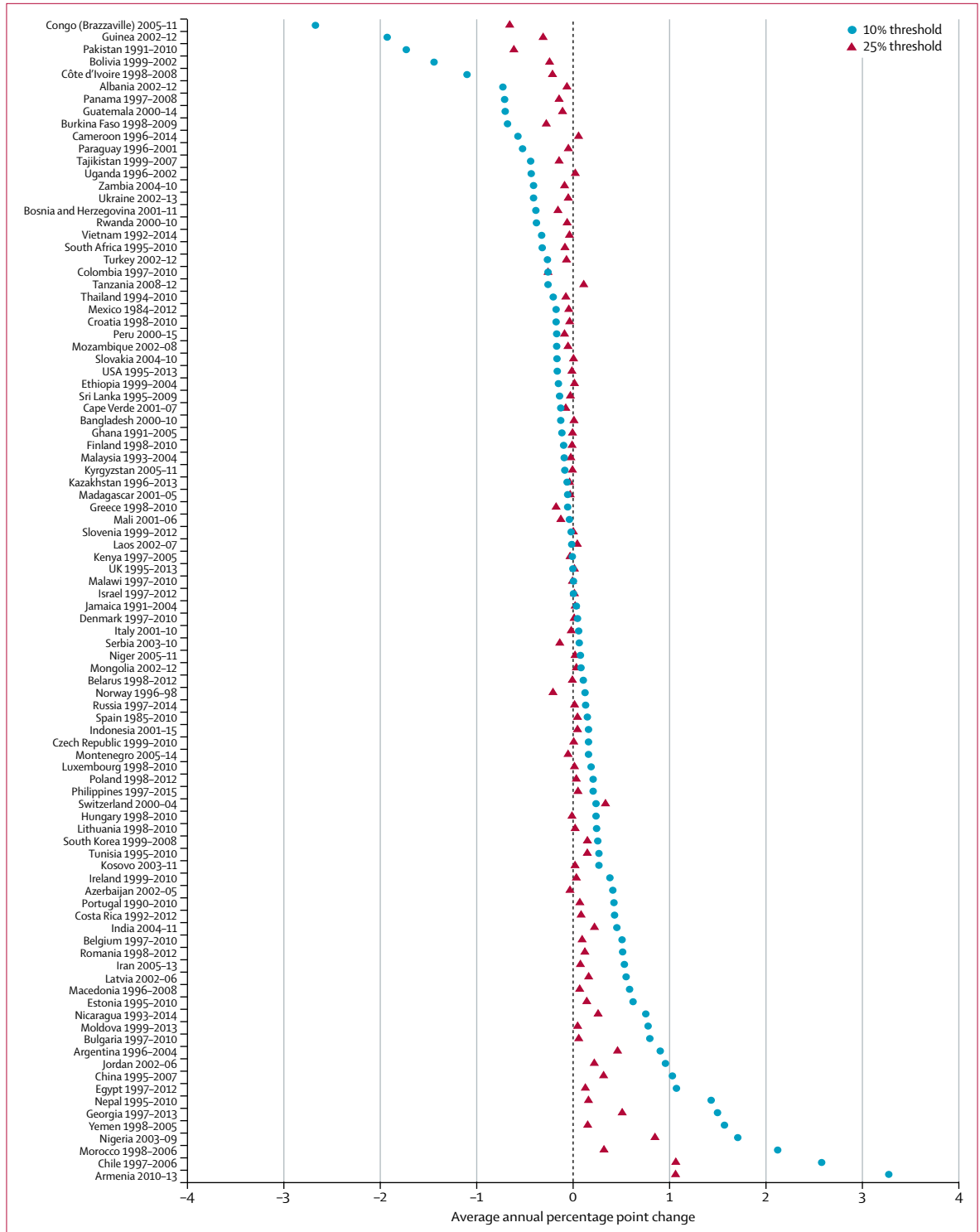
Figure 3: **Annual percentage point change in incidence of catastrophic health spending**
Data were calculated using all surveys available for the country in question by regressing catastrophic expenditure rate on year of survey; the number shown is the coefficient from this regression. Surveys span the period 1984–2015, with a median year of 2005 (IQR 2001–2009). The median first year was 1998 and the median last year was 2010.

	10% threshold			25% threshold		
	25th percentile	Median	75th percentile	25th percentile	Median	75th percentile
GDP per person, 2011 (intl$)	0·205 (p=0·04)	0·216 (p=0·02)	0·230 (p=0·01)	0·060 (p=0·05)	0·064 (p=0·03)	0·069 (p=0·02)
Gini index of income inequality	0·088 (p=0·04)	0·112 (p=0·01)	0·147 (p=0·02)	0·028 (p=0·01)	0·034 (p=0·0006)	0·042 (p=0·01)
THE (% of GDP)	0·728 (p=0·00)	0·682 (p=0·01)	0·616 (p=0·01)	0·165 (p=0·08)	0·161 (p=0·08)	0·154 (p=0·10)
Social security (% of THE)	–0·061 (p=0·07)	–0·120 (p=0·0004)	–0·206 (p=0·0002)	–0·017 (p=0·04)	–0·035 (p=0·0010)	–0·062 (p=0·0018)
Other government agencies (% of THE)	–0·092 (p=0·01)	–0·158 (p<0·0001)	–0·252 (p<0·0001)	–0·016 (p=0·04)	–0·037 (p=0·0005)	–0·066 (p=0·0009)
Private insurance (% of THE)	0·202 (p=0·35)	0·077 (p=0·66)	–0·103 (p=0·45)	0·054 (p=0·41)	0·019 (p=0·71)	–0·031 (p=0·42)
Non-profit institutions (% of THE)	–0·106 (p=0·11)	–0·149 (p=0·10)	–0·209 (p=0·20)	–0·028 (p=0·11)	–0·030 (p=0·24)	–0·034 (p=0·50)
Observations (n)	508	508	508	508	508	508
Social security=other government agencies (probability)	0·249	0·084	0·006	0·814	0·784	0·225

GDP=gross domestic product. THE=total health expenditure.

Table 3: Multiple regressions showing marginal effects of macroeconomic and health systems characteristics on catastrophic spending incidence at different income levels per person

By contrast, incidence of catastrophic health spending at both the 10% and 25% thresholds was significantly and positively associated with GDP per person (table 3). Income inequality also had a positive partial association with catastrophic spending at all income levels, which became stronger at higher income levels. A positive partial association was noted between catastrophic spending and the share of GDP spent on health, but this association became weaker at higher income levels. A negative partial association was recorded between catastrophic spending incidence and the share of THE channelled through social security funds and other government agencies. These effects were stronger at higher income levels per person. The results suggest that an increase in the share of THE channelled through social security schemes might offer somewhat less financial protection than an increase in the share of THE channelled through other government agencies. By contrast with our results for government agencies, no evidence was found to suggest that health spending channelled through private insurance and non-profit institutions provides financial protection.

Discussion
Our data show substantial variation across countries in the incidence of catastrophic spending in the most recent household survey, ranging from less than 1% to more than 40%. In the latest surveys (median year 2010), the median incidence of catastrophic spending was 7% at the 10% threshold, 1% at the 25% threshold, and 2% with the 40% threshold of non-food. We found no evidence of any link between catastrophic payment incidence and the share of the population that is supposed to have health coverage, and we noted changes over time in catastrophic payment incidence in countries, even during periods when health coverage rates had not changed. What coverage rates miss—and catastrophic payment incidence captures—are the extent of de jure and (more importantly) de facto coverage for different services. Coverage rates also miss the interaction between

insurance coverage and provider incentives and, hence, the possibility that acquisition of coverage could leave people vulnerable to providers taking the opportunity to generate more income by delivering and charging for additional services, not all of which might be medically necessary.

Our regression results are—by their nature—associations and do not necessarily reflect causation. The positive partial relation between catastrophic spending and the share of GDP spent on health could reflect, as previously postulated,[7] greater service availability, more use of expensive technology, and higher prices, all of which are likely to be correlated positively with catastrophic payment incidence; the relation also suggests that simply spending more on health is not sufficient to provide financial protection. The negative correlation between catastrophic payment incidence and the share of health expenditure channelled through social security funds and other government agencies, but the absence of such an association in the case of private insurance and non-profit institutions, suggests an important role for public financial protection arrangements (funded by taxes and mandatory insurance contributions) and a questionable role for private ones (funded through voluntary premiums and contributions). The finding that catastrophic payment incidence is associated less strongly with spending through social security funds than with spending through other government agencies could reflect shallower coverage in social insurance schemes and higher inpatient admission rates and costs.[8,31]

Our findings on trends are mixed. The proportion of countries with rising incidence of catastrophic payments is 50% using the two SDG indicators and less than 50% with the version using non-food consumption. However, adjusting for population size produces a different picture. The population-weighted median annual rate of change of catastrophic payment incidence is positive whatever indicator is chosen. At the global level, we estimate that the number of people with catastrophic spending at the

10% threshold increased from 589 million (10% of the world's population) in 2000 to 741 million (11%) in 2005, and continued to increase, albeit at a slower rate, to 808 million (12%) in 2010. Such an increase is also noted when using other thresholds (ie, 25%), but at a lower rate, and between 2000 and 2005 with other definitions of ability to pay (non-food with a 40% threshold), but not between 2005 and 2010.

Our study has several limitations. First, our data come from various surveys. We have tried to minimise the risks associated with heterogeneity by focusing when possible on one collection for a given country, making use of ex post-harmonised datasets, and cross-checking basic summary statistics from our surveys with other sources. However, despite our efforts to minimise the heterogeneity of surveys within countries, differences in definition probably remain, including in the way ability to pay is measured: mostly, ability to pay is measured using consumption, but in some surveys it is measured using income. This discrepancy is one reason we have not reported results on inequality in catastrophic spending, which is highly sensitive to the choice. Second, we have not looked at persistency of the large out-of-pocket expenditures over time within households. Panel data provide the best opportunity to assess this issue,[32] but availability of such data is very limited. With cross-sectional data, richer information on health status of household members, and some assumptions about the variability of health expenditures over time faced by every household, measuring exposure to medical expenditure risk is possible,[33] but such information is typically not available in the datasets we are using. Third, we do not include the indirect costs associated with care-seeking (eg, transportation costs) when estimating financial hardship, which can represent a substantial burden. Surveys without a particular focus on health-seeking behaviour (most of our surveys are household budget surveys or household income and expenditure surveys), do not have information on cost of transportation related to utilisation of health services. Fourth, care-seeking also has an opportunity cost beyond any monetary price—eg, income losses, assets depletion, and indebtedness. Our datasets do not allow us to capture these costs, so we are not able—as would be possible with a richer dataset—to adjust measures of financial protection to disentangle the short-term and long-term outcomes of coping with health-care cost. Findings of some studies with such richer datasets[34] suggest that people might be able to cope with the cost of care but not with income losses, but evidence is scarce. Fifth, we do not have the space to discuss in detail the conceptual underpinning, advantages, and disadvantages of the different definitions of ability to pay used in this Article.[19,20] Nonetheless, we find a regular pattern at the global level for all three measures—ie, an increase in the incidence of catastrophic expenditures. Sixth, our analysis shows merely one dimension of UHC. A low incidence of

catastrophic spending might simply reflect a situation in which only a few people get the health care they need because facilities are few or inadequate; data for both sides of the UHC coin need to be examined simultaneously. Finally, even though we have more than four and a half times as many datapoints as the previous global study, there are still gaps—some countries are absent, some have only one datapoint, and some are quite old. As such, our global estimates are produced using a combination of survey-based datapoints, interpolated and extrapolated datapoints based on econometric modelling, and imputation using regional medians. Therefore, we did not attempt to conduct inference around our global estimates. Uncertainty around our estimates comes from both sampling error around the survey-based datapoints and non-sampling error associated with the modelled estimates used to align the incidence of catastrophic payments to a specific reference year.

In conclusion, while catastrophic payment incidence has been falling in around half of countries using the SDG indicators, and in more than half of countries using the non-food version of the catastrophic payment indicator, the population-weighted median annual rate of change of catastrophic payment incidence has been rising whatever indicator is chosen. At the global level, we estimate that 808 million people (12% of the world's population) incurred catastrophic health spending at the 10% threshold. This figure is higher than it was in 2000 (599 million [10%]) and in 2005 (741 million [11%]). The incidence of catastrophic payments varies considerably across countries. This variation does not reflect the share of the population that is supposed to be covered by health insurance or national or subnational health services, making catastrophic payments an uninformative indicator of financial protection and pointing to the need to look beyond it when designing health system reforms aimed at accelerating progress towards UHC. Greater use of prepayment, particularly through social security funds and other government agencies, is likely to be key—not merely covering more people but covering a larger share of total health spending.

References

1 Hogan DR, Stevens GA, Hosseinpoor AR, Boerma T. Monitoring universal health coverage within the Sustainable Development Goals: development and baseline data for an index of essential health services. *Lancet Glob Health* 2017; published online Dec 13. http://dx.doi.org/10.1016/S2214-109X(17)30472-2.

2 Boerma T, Eozenou P, Evans D, Evans T, Kieny M-P, Wagstaff A. Monitoring progress towards universal health coverage at country and global levels. *PLoS Med* 2014; **11:** e1001731.

3 Wagstaff A, van Doorslaer E. Catastrophe and impoverishment in paying for health care: with applications to Vietnam 1993–1998. *Health Econ* 2003; **12:** 921–34.

4 Wagstaff A, Flores G, Smitz M-F, Hsu J, Chepynoga K, Eozenou P. Progress on impoverishing health spending in 122 countries: a retrospective observational study. *Lancet Glob Health* 2017; published online Dec 13. http://dx.doi.org/10.1016/S2214-109X(17)30486-2.

5 van Doorslaer E, O'Donnell O, Rannan-Eliya RP, et al. Effect of payments for health care on poverty estimates in 11 countries in Asia: an analysis of household survey data. *Lancet* 2006; **368:** 1357–64.

6 Xu K, Evans DB, Kawabata K, Zeramdini R, Klavus J, Murray CJL. Household catastrophic health expenditure: a multicountry analysis. *Lancet* 2003; **362:** 111–17.

7 Xu K, Evans DB, Carrin G, Aguilar-Rivera AM, Musgrove P, Evans T. Protecting households from catastrophic health spending. *Health Aff (Millwood)* 2007; **26:** 972–83.

8 Paris V, Devaux M, Wei L. Health systems institutional characteristics. Paris: OECD Publishing, 2010.

9 McIntyre D, McKee M, Balabanova D, Atim C, Reddy KS, Patcharanarumol W. Open letter on the SDGs: a robust measure for universal health coverage is essential. *Lancet* 2016; **388:** 2871–72.

10 Berki S. A look at catastrophic medical expenses and the poor. *Health Aff (Millwood)* 1986; **5:** 138–45.

11 Ranson M. Reduction of catastrophic health care expenditures by a community-based health insurance scheme in Gujarat, India: current experiences and challenges. *Bull World Health Organ* 2002; **80:** 613–21.

12 Ekman B. Catastrophic health payments and health insurance: some counterintuitive evidence from one low-income country. *Health Policy* 2007; **83:** 304–13.

13 King G, Gakidou E, Imai K, et al. Public policy for the poor? A randomised assessment of the Mexican universal health insurance programme. *Lancet* 2009; **373:** 1447–54.

14 Limwattananon S, Neelsen S, O'Donnell O, et al. Universal coverage with supply-side reform: the impact on medical expenditure risk and utilization in Thailand. *J Public Econ* 2015; **121:** 79–94.

15 van Doorslaer E, O'Donnell O, Rannan-Eliya RP, et al. Catastrophic payments for health care in Asia. *Health Econ* 2007; **16:** 1159–84.

16 Flores G, Krishnakumar J, O'Donnell O, van Doorslaer E. Coping with health-care costs: implications for the measurement of catastrophic expenditures and poverty. *Health Econ* 2008; **17:** 1393–412.

17 Wagstaff A, Lindelow M. Are health shocks different? Evidence from a multishock survey in Laos. *Health Econ* 2014; **23:** 706–18.

18 Demirguc-Kunt A, Klapper L, Singer D, Van Oudheusden P. The Global Findex Database 2014: measuring financial inclusion around the world—policy research working paper 7255. April, 2015. http://documents.worldbank.org/curated/en/187761468179367706/pdf/WPS7255.pdf (accessed Oct 23, 2017).

19 Thomson S, Evetovits T, Cylus J, Jakab M. Monitoring financial protection to assess progress towards universal health coverage in Europe. September, 2016. http://www.euro.who.int/__data/assets/pdf_file/0005/317543/10-Research-article-monitoring-financial-protection-assess-progress-universal-health-coverage-Europe.pdf?ua=1 (accessed Oct 23, 2017).

20 Wagstaff A, Eozenou PH-V. CATA meets IMPOV: a unified approach to measuring financial protection in health—policy research working paper 6861. May, 2014. http://documents.worldbank.org/curated/en/114091468149393397/pdf/WPS6861.pdf (accessed Oct 23, 2017).

21 Organisation for Economic Co-operation Development. A system of health accounts 2011. Paris: Organisation for Economic Co-operation and Development, 2011.

22 Deaton A, Zaidi S. Guidelines for constructing consumption aggregates for welfare analysis: living standards measurement study working paper, no 135. Washington: World Bank, 2002.

23 Balcazar CF, Ceriani L, Olivieri S, Ranzani M. Rent imputation for welfare measurement: a review of methodologies and empirical findings—policy research working paper 7103. November, 2014. http://documents.worldbank.org/curated/en/313651468152726645/pdf/WPS7103.pdf (accessed Oct 23, 2017).

24 INDEPTH Network. Household out-of-pocket health expenditures tracking for disease specific health account and universal health coverage measure: developing household OOP measurement methodology. Accra: INDEPTH Resource & Training Centre, 2017.

25 Milanovic B. Description of All the Ginis dataset. New York: Luxembourg Income Study, 2016.

26 Smith O, Nguyen SN. Getting better: improving health system outcomes in Europe and Central Asia—Europe and Central Asia Reports. Washington: World Bank, 2013.

27 Obama B. United states health care reform: progress to date and next steps. *JAMA* 2016; **316:** 525–32.

28 Wagstaff A, Lindelow M, Jun G, Ling X, Juncheng Q. Extending health insurance to the rural population: an impact evaluation of China's new cooperative medical scheme. *J Health Econ* 2009; **28:** 1–19.

29 Wagstaff A. Estimating health insurance impacts under unobserved heterogeneity: the case of Vietnam's health care fund for the poor. *Health Econ* 2010; **19:** 189–208.

30 Sparrow R, Suryahadi A, Widyanti W. Social health insurance for the poor: targeting and impact of Indonesia's Askeskin programme. *Soc Sci Med* 2013; **96:** 264–71.

31 Wagstaff A, Moreno-Serra R. Europe and central Asia's great post-communist social health insurance experiment: aggregate impacts on health sector outcomes. *J Health Econ* 2009; **28:** 322–40.

32 Feenberg D, Skinner J. The risk and duration of catastrophic health care expenditures. *Rev Econ Stat* 1994; **76:** 633–47.

33 Flores G, O'Donnell O. Catastrophic medical expenditure risk. *J Health Econ* 2016; **46:** 1–15.

34 Gertler P, Gruber J. Insuring consumption against illness. *Am Econ Rev* 2002; **92:** 51–76.