Going beyond horizontal equity: an analysis of health expenditure allocation across geographic areas in Mozambique

Running head: Equity in public health expenditure allocation across geographic areas

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Key words: horizontal equity, vertical equity, public health expenditure, benefit incidence analysis, resource allocation formulae, donor expenditure, Mozambique.

Abstract

In contexts where health services are mostly publicly provided and access is still limited, health financing systems require some mechanism for distributing financial resources across geographic areas according to population need. Equity in public health expenditure has been evaluated either *ex ante*, by comparing allocations across spending units to equitable shares established using resource allocation formulae, or *ex post* by using benefit incidence analysis to look at the distribution of expenditure across individual service users, but typically without linking this distribution to allocation practices.

In this paper, we apply benefit incidence analysis in an innovative way to assess horizontal and vertical equity in the geographic allocation of outpatient recurrent healthcare expenditure across districts in Mozambique. We compare the actual distribution of expenditure with horizontal and vertical equity benchmarks, set according to measures of socio-economic status and need for health care. We quantify the observed inequities and the relative contributions of service use and resource allocation. We analyse government and donor expenditure separately and combined, for the years 2008 – 2011 to compare changes over time and funding source. We use data from a number of national routine sources.

Results show improvements in both horizontal and vertical equity, along with the gradual alignment of government and donor resource allocation over time, which resulted in almost horizontally and vertically equitable resource allocation in 2011. However, inequities in the distribution of expenditure across beneficiaries still existed and were driven by inequities in service use. The discrepancy between economic and need indicators highlighted initial differences in government and donor expenditure targets, raising questions about the purpose of public health expenditure and confirming the importance of clearly defining equity objectives to inform and evaluate resource allocation policies.

1. Introduction

In contexts where health services are mostly publicly funded, the allocation of resources across levels of care and geographic areas is a key determinant of equitable service provision and access (Kutzin, 2013; WHO, 2010). Governments are ultimately responsible for establishing appropriate mechanisms to guarantee access to health care services and financial protection to citizens. In low and middle-income countries (LMICs) in particular, where access is still limited and resource scarcity is pronounced, distributing financial resources across geographic areas according to population need, is indispensable to enable providers to deliver the services required (Diderichsen, 2004; Green, 2007).

Equity in the allocation of public financial resources has been assessed using either resource allocation formulae (RAF) or benefit incidence analysis (BIA), two different but complementary approaches. In the literature on LMICs, the separate use of these two approaches has so far provided only limited information to policy makers on how they can better allocate their resources to meet the needs of their populations (Anselmi, Lagarde, & Hanson, 2014).

RAFs identify for each geographic area the equitable share of resources based on the population, adjusted by the relative need for healthcare, providing a normative benchmark to evaluate allocations (McIntyre et al., 2007; Rice & Smith, 2002). RAFs were originally developed to promote horizontal equity by allocating resources to allow equal treatment of individuals with equal healthcare needs (Rice & Smith, 2002; Adam Wagstaff, Doorslaer, & Paci, 1991). In high income settings service utilisation, adjusted for supply and demand side influences, is used as an indicator of healthcare need to estimate the relative cost of people with different characteristics (Gravelle, Sutton, Morris, Windmeijer, & Leyland, 2003; Smith, 2008). By contrast, in LMICs, where important differences in access to services exist across geographic areas, morbidity, mortality or deprivation are used as proxies for healthcare need. RAFs are then used in LMICs on vertical equity grounds to target resources towards deprived groups to accelerate their health improvements (Diderichsen, 2004; Mooney, 2000; Mooney & Jan, 1997). However, the lack of consideration for how resources allocated according to these benchmarks ultimately reach the intended beneficiaries represents the major limitation of the RAF approach (Sheldon & Smith, 2000).

Unlike RAFs, that are helpful *ex ante* to allocate resources across spending units, BIA evaluates the *ex post* distribution of public expenditure across beneficiaries according to their service use. BIA combines the cost of providing services with measures of their use to attribute a monetary benefit

from public health expenditure to each individual approximated by the average cost of the service used. Individuals are aggregated in subgroups, typically defined according to socio-economic status, to analyse the relative distribution of the monetary benefit across the population (Demery, 2000; O'Donnell, van Doorslaer, Wagstaff, & Lindelow, 2008).

BIA was originally conceived to analyse the redistributive implications of public expenditure in social sectors (Demery, 2000; Van de Walle & Nead, 1995) and even when applied to the health sector it has almost exclusively been used to explore whether public subsidies reach the poor (Castro-Leal, Dayton, L.Demery, & K.Mehra, 2000; O'Donnell et al., 2008; A. Wagstaff, 2012). From a strict health sector perspective, inequalities across socio-economic status could be deemed horizontally inequitable unless they are associated with inequalities in need for health care. However, the existing BIA studies have implicitly assumed a vertical equity perspective and considered a pro-poor distribution of expenditure to be desirable, either because inequalities in health tend to disadvantage the poor (Mahal et al., 2000; O'Donnell et al., 2007; Adam Wagstaff, 2002) or because, from a public finance perspective it redistributes economic resources (Demery, 2000; Lanjouw, Pradhan, Saadah, Sayed, & Sparrow, 2001; Van de Walle, 1992). Only a few recent studies have explicitly assessed vertical equity, by comparing the distribution of subsidy and need, measured by self-assessed health, across socio-economic status (Akazili, Garshong, Aikins, Gyapong, & McIntyre, 2012; Ataguba & McIntyre, 2012; Chuma, Maina, & Ataguba, 2012; Mtei et al., 2012). However, none of the existing studies analysed vertical equity by ranking individuals according to their need for health care, nor have they quantified vertical inequity to allow inter-temporal and cross-settings comparisons.

BIA results are driven by the interplay of two separate factors: the expenditure in different services and the individual use of those services (Castro-Leal et al., 2000). Some BIA studies have analysed the individual utilisation of healthcare services by economic groups to infer the redistributive implications of funding different levels of care (O'Donnell et al., 2007), but not different geographic areas. Even in studies that accounted for differences in expenditure across regions or provinces (Mahal et al., 2000), BIA results have not been interpreted in light of the resource allocation practices that generate them. However, disentangling the relative contributions of service use and resource allocation is important to identify the type of policy required to redress existing inequities. Additionally, since international aid constitutes on average 16% (up to over 80%) of health expenditure in low income countries (WHO, 2012), analysing separately government and donor allocations is critical to further inform resource allocation decisions.

In this paper we make several contributions to the existing literature. First, we use BIA to analyse equity in the allocation of resources across geographic areas, by applying the RAFs' horizontal and vertical equity benchmarks to the distribution of the subsidy from public health expenditure across

individuals. Second, we account for the distribution of need across economic status by ranking individuals by objective indicators of need, to separately assess horizontal and vertical equity. Third, we quantify the relative contributions of resource allocation and service use to the existing inequities in the distribution of the subsidy across individuals. Fourth, we analyse the equity of government and donor expenditure, separately and in combination for a four year period.

The paper is structured as follows. Sections 2 and 3 set the context and describe the data. Section 4 details the methods used. Sections 5 and 6 present and discuss results and section 7 concludes.

2. Study setting

Mozambique is a low-income country where health care provision is predominantly publicly funded and provided, with few private clinics, mostly concentrated in the capital (MISAU, 2012c). Central, provincial and district levels constitute the backbone of the top-down hierarchical sector organization. Specialised care is managed at provincial level and provided through provincial or central hospitals. Primary and secondary care are managed at district level and provided through clinics, health centres (HC) and district hospitals (DH). There is generally one DH or HC per district and it is often located in the major urban centre. All district facilities provide basic primary outpatient care, while HCs additionally provide primary and inpatient care and DH provide surgery (MISAU, 2012c). In 2009 there were 10 provinces and 142 district administrations, excluding Maputo City.

While the Ministry of Health (MoH) has the important role of defining policies, promoting health and supervising all national health sector activities, mostly implemented at the provincial and district level. Since the decentralization reform, which began in 2007, provincial and district administrations have gradually been attributed more responsibilities. In collaboration with provincial health administrations, district health administrations are increasingly involved in defining policies and planning activities at local level, managing financial and non-financial resources and hiring human resources to guarantee that health facilities (HF) have the means to operate and deliver services (MISAU, 2012c).

The financial flow follows the hierarchical structure. The state budget is allocated from the Ministry of Finance (MoF) to the MoH and, since the implementation of the financial decentralization reform in 2007, to provincial directorates of health (managed at provincial level but spent on district health care) or directly to district administrations. Official outpatient fees in public HFs are negligible (MZM 2 equivalent to USD 0.07) and exemptions cover the large majority of the population (indigents,

children under-five, pregnant women, chronically ill, patients suffering from malaria, TB and HIV/AIDS) (MISAU, 2012a, 2012c).

The health sector was heavily disrupted by civil war and has been undergoing a gradual reconstruction since the peace agreement in 1992, with a significant involvement of international donors in policy making and in financing and providing healthcare (Pavignani & Durao, 1999). Donor funding represents over 50% of health sector expenditure (MISAU, 2010). One third is allocated through a pooled common fund, which is earmarked for the health sector but not for specific health activities. The rest is made up of earmarked projects, implemented in partnership with the MoH or with local administrations or HFs (MISAU, 2011). Common fund resources are managed by the MoH and allocated to national, provincial and district directorates to top-up the state budget where essential activities were underfunded. Earmarked funds are managed directly by donors, with a variable degree of involvement of local institutions, according to prior agreement (MISAU, 2012c).

In spite of economic growth leading to a decrease in the population living below the poverty line from 69% to 55% and to improvements in health over the last two decades, the Gini coefficient of inequality remains high (0.41) and differences persist across provinces and districts (T. C. Arndt, Jones, & Tarp, 2010). For example, the under-five mortality (U5M) rate fell from 226 to 97 per 1,000 livebirths but U5M estimates vary between 58 and 142 per 1,000 livebirths across provinces and between 103 and 291 per 1,000 livebirths across districts in the same province (Fernandes et al., 2014; INE, 2010a). Differences are related to socio-economic factors, including area of residence, economic wealth and education (Macassa, Ghilagaber, Bernhardt, Diderichsen, & Burstrom, 2003), but also to the availability of material, human and financial resources for healthcare provision (Fernandes et al., 2014). The latters represent one of the major challenges that the government has committed to address (MISAU, 2012c).

3. Data

In the analysis, we use data from five different sources: the Household Budget Survey (HBS) 2008/2009 (INE, 2010b), the MoF annual electronic budget expenditure reports (E-Sistafe –MEX) for 2008-2011 (MF, 2012), the MoH external funding database (IFE) with data extracted for 2008-2011 (MF, 2012), the National Health Information System (NHIS) data for 2008-2011 (MISAU, 2012d), and the 2007 Census survey (INE, 2008, 2010a) and U5M estimates calculated by the National Institute of Statistics (INE, 2010a). The information required for the analysis was extracted as explained below.

Data on individual and household characteristics, including healthcare utilisation, were obtained from the HBS 2008/2009. The dataset consists of a sample of 51,177 individuals (45,356 excluding Maputo

City) stratified at provincial and urban/rural areas level. Data collection took place between August 2008 and September 2009. We use data on household socioeconomic conditions and on the individual number of visits to a health practitioner in a public HF in the 30 days preceding the interview. Household per-capita consumption, spatially and temporally adjusted, was calculated for the third national poverty assessment (C. Arndt & Simler, 2010; T. C. Arndt et al., 2010), and made available along with adult equivalence scales (MPF, UEM, & IFPRI, 1998) by the Ministry of Planning and Development.

Data on the total number of outpatient visits per district were derived from the NHIS. Information on the existing HFs, their staff and equipment availability, and the services delivered is collected monthly at district level and then aggregated at provincial and national level. A statistical summary containing provincial figures is published yearly (MISAU, 2013a, 2013b). To minimize the potential recording bias in the district NHIS data, we average the number of visits across the available years (2008-2011). Yearly provincial outpatient consultation figures from the NHIS were on average only 3% smaller than the totals obtained from HBS data, an indication of that NHIS is capturing the majority of visits.

Data on government expenditure managed by provincial and district administrations were derived from the MoF budget expenditure reports. Records of expenditure managed by provincial health administrations are aggregated by province, although these funds are spent in district HFs. Data on donor earmarked project expenditure were obtained from the MoH-IFE database, which includes information about on- and off-budget projects including expenditure realised, province or district and programme area of implementation.

We merged data from the different sources by district. We exclude Maputo City, the capital, from the analysis due to the unusual presence of private facilities and numerous public facilities providing secondary and specialised care, which generate a specific pattern of expenditure and healthcare utilisation.

4. Methods

4.1. Measuring horizontal and vertical equity

We use BIA to assess horizontal and vertical equity in recurrent expenditure for primary and secondary outpatient care in Mozambique. We distinguish between government managed (provincial and district state budget and donor pooled common fund) and donor managed expenditure (donor earmarked projects). For simplicity we will refer to them as 'government' and 'donor' expenditure. We follow the standard steps required by BIA (O'Donnell et al., 2008), adapting them to the objectives of the study and the data available, as described below.

4.1.1. Calculating Individual benefit

We define the subsidy received by individual *i*, in household *h*, in district *d,* as the individual monetary benefit (BEN_{ihd}) associated with one outpatient visit to a clinic, HC or DH and calculated as:

$$BEN_{ihd}=VIS_{ihd} * EXP_{dt} \quad (1)$$

where VIS_{ihd} is the number of visits reported by individual *i* in the month prior to the interview, multiplied by a month-specific scaling factor (inverse share of monthly to yearly visits), which standardizes the individual utilisation in the 30-day recall period to one year. Data on total monthly and yearly visits are derived from the HBS using the survey's household weights.

EXP_{dt} is the unit cost of an outpatient visit in district *d,* in year *t*, calculated by dividing the outpatient recurrent expenditure by the number of visits, at district or provincial level according to the level of disaggregation of the available expenditure data:

$$EXP_{dt} = \frac{PEXP_{pt}^{G}+PEXP_{pt}^{D}}{PVIS_p} + \frac{DEXP_{dt}^{G}+DEXP_{dt}^{D}}{DVIS_d} \quad (2)$$

where $PVIS_p$ and $DVIS_d$ are the yearly number of outpatient consultations provided by primary and secondary HFs in province *p* and district *d*. $PEXP_{pt}^{G}$ is provincial government recurrent expenditure (provincial state budget and donor pooled fund) for primary and secondary care in province *p*, in year *t*. $DEXP_{dt}^{G}$ is district state budget recurrent expenditure, in district *d* and in province *p*, in year *t*. Based on available records of district expenditure from yearly provincial reports (MISAU, 2012b), we estimate that HFs providing inpatient services absorb half of the district budget, and spend one-third of their budget on outpatient care. $PEXP_{pt}^{D}$ and $DEXP_{dt}^{D}$ include donor earmarked project expenditure in year *t,* in province *p* or more specifically in district *d*, according to the available data. We subtract

10% of total expenditure to account for management overheads, and consider one-third of the remaining funds to be spent on outpatient services.

We assume that individuals use outpatient healthcare services provided in their district of residence so that VIS_{ihd} can be associated with a district specific unit cost, EXP_{dt}.

Unlike most BIA studies, we account for resource allocation through differences in expenditure across geographic areas, calculating BEN_{ihd} from disaggregated province and district expenditure. Since official outpatient fees are negligible, and exemptions cover the large majority of the population, we assume that outpatient care is free for users at the point of delivery.

4.1.2. Individual ranking variable

To assess horizontal equity, we follow O'Donnell et al. (2008) and rank individuals by economic status proxied by household adult equivalent per-capita consumption (AEC_{hd}):

$$AEC_{hd} = CON_{hd} a_{hd} \quad (3)$$

where CON_{hd} is the household consumption per-capita, adjusted by spatial and temporal differences in price, and a_{hd} is the adult equivalent adjustment factor.

To assess vertical equity, we construct a composite index of relative need for healthcare ($NEED_{ihd}$). $NEED_{ihd}$ is the average of three measures of need, standardised on a scale from 0 to 1 and capturing the dimensions typically included in need-adjusted RAFs developed in LMICs (Diderichsen, 2004; McIntyre et al., 2007). Individual demographic characteristics, household deprivation and district health status are included in $NEED_{ihd}$ as follows:

$$NEED_{ihd} = \frac{1}{3}\left(I_{ihd}^{Dem} + I_{hd}^{Dep} + I_{d}^{Mor}\right) \quad (4)$$

I_{ihd}^{Dem} is an indicator of individual need, based on the age-gender group to which individual *i* belongs (0-1 year, 1-4 year, 5-14 year, 15-49 year, over 50). For each age-gender group we calculate the average monthly number of visits at national level (U) and we calculate:

$$I_{ihd}^{Dem} = \frac{\mathrm{U}_{ihd} - \mathrm{U}_{min}}{\mathrm{U}_{max} - \mathrm{U}_{min}} \quad (5)$$

where U_{ihd} is the specific value of U for the age-gender group to which *i* belongs to and $\mathrm{U}_{\min}$ and $\mathrm{U}_{\max}$ are the minimum and maximum U across age-gender groups.

I_{hd}^{Dep} is a household indicator of need for healthcare based on household non-economic deprivation S_{hd}, which we calculated using an eight indicator Multidimensional Poverty Index (MPI), adapted from (Alkire, Conconi, & Roche, 2013):

$$I_{hd}^{Dep} = \frac{S_{hd} - S_{min}}{S_{max} - S_{min}} \quad (6)$$

where S_{min} and S_{max} are the minimum and maximum levels of deprivation across households. Of the eight indicators, five are related to living standards (having electricity, improved sanitation, improved drinking water, house flooring, cooking fuel), one to nutrition (household having less than two meals during the day preceding the interview) and two to education (five years of schooling and children's school attendance).

Finally I_d^{Mor} is a district indicator of need based on U5M rates (M_d) derived from Census data:

$$I_d^{Mor} = \frac{M_{hd} - M_{min}}{M_{max} - M_{min}} \quad (7)$$

where M_{min} and M_{max} are the minimum and maximum U5M rates across districts.

4.1.3. Benefit distribution and equity assessment

We calculate two benefit and two service use distributions, relative to the rankings based on AEC_{hd} and $NEED_{ihd}$, and we derive the relative concentration curves by plotting the cumulative proportions of monetary benefit received and service used against the cumulative proportion of population (O'Donnell et al., 2008).

We measure **horizontal (in)equity** as the difference between the actual distributions of benefit and of need across individuals ranked by AEC_{hd}, represented by the relative concentration curves, $\mathcal{C}_{BEN\_AEC}$ and $\mathcal{C}_{NEED\_AEC}$. $\mathcal{C}_{NEED\_AEC}$ is the equity benchmark, where individuals with the same need use the same amount of services and receive the same unit subsidy, irrespectively of their economic status. This method corresponds to an indirect standardization for need (Adam Wagstaff & van Doorslaer, 2000).

First, using the default multiple comparison approach decision rule we run the dominance test of $\mathcal{C}_{BEN\_AEC}$ against $\mathcal{C}_{NEED\_AEC}$. Second, we calculate horizontal inequity (HI) as the need standardized concentration index (CI) of the benefit distribution, corresponding to the difference between the benefit CI (CI_{BEN_AEC}) and the need CI (CI_{NEED_AEC}):

$$HI = CI_{BEN\_AEC} - CI_{NEED\_AEC} = \frac{2}{\mu_{BEN}} cov(BEN, r) - \frac{2}{\mu_{NEED}} cov(NEED, r) \quad (8)$$

where *BEN* is the benefit received by *i* and μ_{BEN} is its mean, *NEED* is the need for healthcare of i and μ_{NEED} is its mean. $r = \frac{i}{N}$ is the fractional rank of individual *i* with *i*=1 for the lowest *AEC* and *i*=N for the highest *AEC*. HI corresponds to twice the area between $\mathcal{C}_{BEN\_AEC}$ and $\mathcal{C}_{NEED\_AEC}$.

Vertical (in)equity is assessed by ranking individuals in decreasing order of $NEED_{ihd}$, for ease of comparison with the ranking by AEC_{hd}. We compare the concentration curve of benefit ($\mathcal{C}_{\text{BEN\_NEED}}$) to the need Lorenz curve ($\mathcal{C}_{\text{NEED-NEED}}$), to assess progressivity in the distribution of benefit with respect to need (Sutton & Lock, 2000). $\mathcal{C}_{\text{NEED\_NEED}}$ represents the vertical equity benchmark where individual service use is proportional to need and resources are allocated so that the unit benefit is at least equal across individuals (or higher for higher need). There is not a unique vertically equitable distribution, as any distribution where the individual share of benefit is progressive to the share of need would fit that criterion (Mooney, 2000).

After having tested for dominance between $\mathcal{C}_{\text{BEN\_NEED}}$ and $\mathcal{C}_{\text{NEED\_NEED}}$, we calculate the Kakwani index of progressivity, which measures the distance between the two, to quantify vertical (in)equity (VI). VI can be rewritten as the difference between the benefit CI ($CI_{\text{BEN-NEED}}$) and the Gini coefficient of need (G_{NEED}):

$$\text{VI} = CI_{BEN\_NEED} - G_{NEED}$$

VI corresponds to twice the area between the $\mathcal{C}_{\text{BEN\_NEED}}$ and $\mathcal{C}_{\text{NEED\_NEED}}$.

4.2. Disentangling the sources of inequity

Having obtained a measure of equity, we seek to quantify the contribution of the two factors potentially generating inequity in the distribution of benefit from public health expenditure: inequity in geographic resource allocation and inequity in service utilisation.

We rewrite HI and VI as the sum of two components using a method inspired by Sutton, (2002) and Vallejo-Torres & Morris (2013). The first component represents inequity related to service use, measured as the distance between $\mathcal{C}_{\text{VIS\_AEC}}$ and $\mathcal{C}_{\text{VIS\_NEED}}$, and the respective equity benchmarks, $\mathcal{C}_{\text{NEED\_AEC}}$ and $\mathcal{C}_{\text{NEED\_NEED}}$. $\mathcal{C}_{\text{VIS\_AEC}}$ and $\mathcal{C}_{\text{VIS\_NEED}}$ correspond to hypothetical benefit distributions, based on the actual VIS_{ihd} and a constant unit benefit, which represents the realization of a both horizontally and vertically (in the most conservative version) equitable resource allocation. The second component represents inequity related to resource allocation. It is measured as the distance between the observed benefit distribution and the service utilisation concentration curve and quantifies inequity in benefit distribution attributable to differences in the unit cost of an outpatient consultation (EXP_d) across districts.

We rewrite HI as follows:

$$HI = \left(CI_{BEN\_AEC} - CI_{VIS\_AEC}\right) + \left(CI_{VIS\_AEC} - CI_{NEED\_AEC}\right) = HI_{RA} + HI_{USE} \quad (10)$$

where CI_{VIS_AEC} is the service use CI. HI_{USE} measures the horizontal inequity use component and corresponds to the need standardized CI of VIS_{ihd}. HI_{RA} measures the horizontal inequity resource allocation component and corresponds to the difference between the CIs of benefit (CI_{BEN_AEC}) and of service use (CI_{VIS_AEC}) CIs.

We rewrite VI as follows:

$$\mathrm{VI} = (CI_{BEN\_NEED} - CI_{VIS\_NEED}) + (CI_{VIS\_NEED} - G_{NEED}) = VI_{RA} + VI_{USE} \qquad (11)$$

where VI_{USE} is the vertical inequity use component and corresponds to the Kakwani index of the number of visits (v_{hd}). VI_{RA} is the vertical inequity resource allocation component and corresponds to the difference between the CIs of benefit (CI_{BEN_AEC}) and of service use (CI_{VIS_AEC}) CIs.

4.3. Computing equity measures by type of expenditure and over time

We calculate HI and VI and disentangle their service utilisation and resource allocation components, separately for government ($PEXP_{pt}^{D}$=0 and $DEXP_{dt}^{D}$=0 in equation 2), donors ($PEXP_{pt}^{G}$=0 and $DEXP_{dt}^{G}$=0 in equation 2) and combined expenditures in 2008.

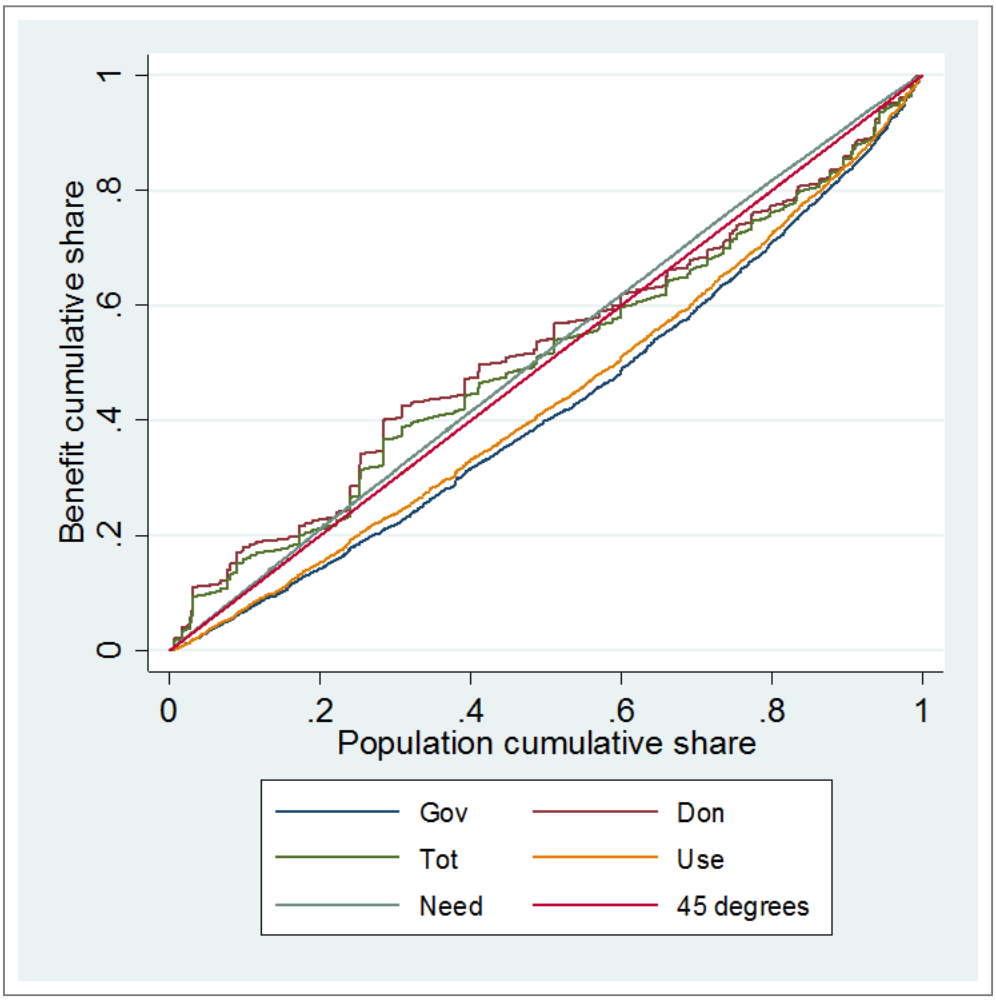
Assuming that AEC_{hd}, $NEED_{ihd}$ and service use are constant over a short time period, we calculate the distribution of benefit for 2009, 2010 and 2011. Since utilisation is held constant, changes in the distribution of benefit over time reflect changes in resource allocation through changes in district expenditure and derived unit benefit (EXP_{dt}).

5. Results

4.5.1. Horizontal equity in Mozambique in 2008

Figure 1 shows the concentration curves of monetary benefit from government, donor and combined recurrent expenditure in primary and secondary outpatient care. $\mathcal{C}_{\text{NEED-AEC}}$ (benchmark for equity in benefit distribution and healthcare use) and $\mathcal{C}_{\text{VIS-AEC}}$ (benchmark for equity in resource allocation) are included for comparison. The relative need standardised HIs are presented in Table 1. $\mathcal{C}_{\text{BEN-AEC}}$ dominating $\mathcal{C}_{\text{NEED-AEC}}$ and HI <0 indicate pro-poor inequalities (and vice versa). HI =0 indicates equity.

Figure 1 Cumulative distribution of benefit from government, donor and total expenditure in primary and secondary outpatient care across individuals ranked by economic status in Mozambique, 2008



The results show that in 2008, the benefit from government expenditure was pro rich (HI^{Gov}=0.18). By contrast, the distribution of benefit from donor expenditure appeared slightly pro-poor (HI^{Don}=-0.02),

although this result was not statistically significant. Not surprisingly, the total public spending on healthcare was also found to be almost equitable (HI^{Tot}=0.01).

Disentangling the two components of inequity, we find that utilisation patterns are pro-rich and drive most of HI (HI_{USE}=0.15). Government resource allocation is very close to horizontal equity (HI_{RA}^{Gov}=0.03), while donor spending is clearly pro-poor (HI_{RA}^{Don}=-0.17) and drives the progressivity of the combined public resource allocation (HI_{RA}^{Tot}=-0.16).

It is important to note that the average AEC_{ihd} is much higher in Q5 than in other quintiles (Q1: 9 MZM, Q2: 17 MZM, Q3: 23 MZM, Q4: 33 MZM and Q5: 69 MZM) and the distribution of AEC_{ihd} is highly concentrated in Q5 which consumes alone almost half of the total (Q1: 6%, Q2: 11%, Q3: 16%, Q4: 22% and Q5: 46%), indicating a very high level of income inequality.

4.5.2. Evolution of horizontal equity in Mozambique from 2008 to 2011

Figure 2 describes the evolution of the benefit distribution by population quintiles between 2008 and 2011 and compares it to the distribution of $NEED_{ihd}$, the horizontal equity benchmark. HI of government, donors and combined expenditure for each year is presented in Table 1.

Figure 2 Benefit from government and donor spending in primary and secondary outpatient care by economic quintiles in Mozambique, 2008-2011

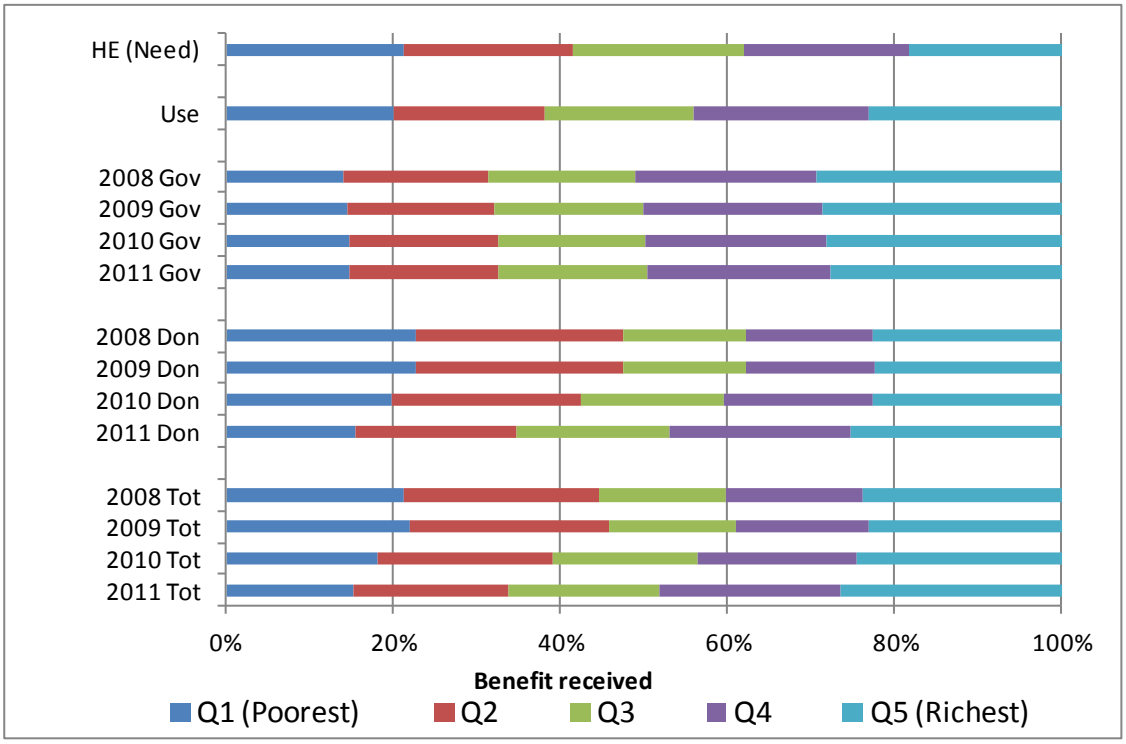


Table 1 Horizontal inequity in benefit from public health expenditure by source of spending, Mozambique, 2008-2011

	HI_{USE}	2008			2009			2010			2011		
		GOV	DON	TOT	GOV	DON	TOT	GOV	DON	TOT	GOV	DON	TOT
HI*	0.15	0.18	-0.02	0.01	0.17	-0.02	0.00	0.16	0.03	0.07	0.16	0.12	0.14

** Standardised by need ($CI_{NEED-NEED}$: -0.03, SE: 0.03)*

Three results emerge. First, against a distribution of need concentrated in the poorest quintile (Q1) government spending throughout the period seems to benefit the richest quintile (Q5) proportionally more than the other quintiles, Q2 and Q3 in particular. However, government spending becomes less pro-rich over time, as confirmed by the decrease in HI^{Gov} from 0.18 to 0.16 and by the reduction of the share received by Q5.

Second, in 2008 donor spending seemed to mostly benefit Q1, Q2 and Q5, but over time we observe a redistribution of resources towards Q3 and Q4, that reduces the pro-poor nature of the expenditure, as confirmed by the increase in HI^{Don} from -0.02 to 0.12.

Finally, the allocation patterns of donor and government expenditure seem to gradually converge and almost align by 2011.

The analysis of the sensitivity of the vertical equity measures to the variability of the shares of outpatient and inpatient expenditure and to the assumption of use of service in the district of residence produces negligibly different results.

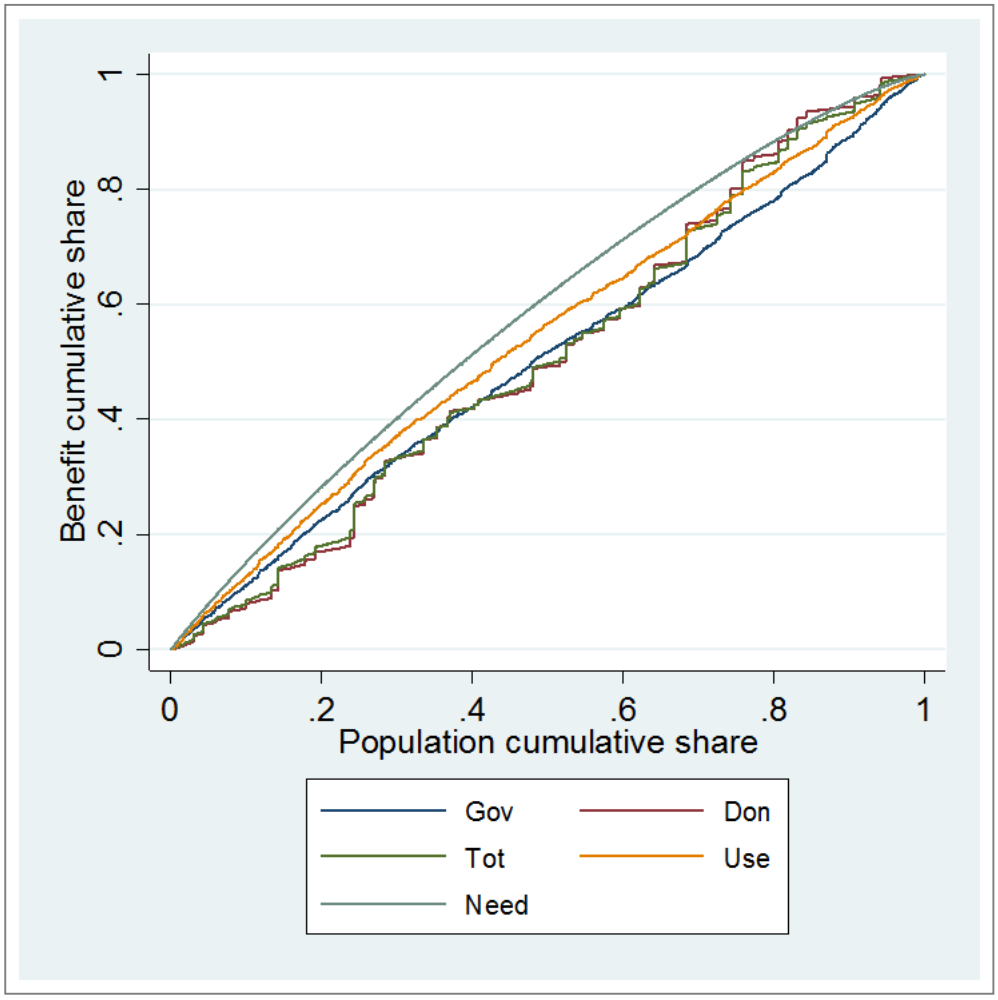
4.5.3. Vertical equity in 2008

Figure 3 shows the concentration curves of benefit from government, donor and combined recurrent expenditure in outpatient primary and secondary care. $\mathcal{C}_{NEED\_NEED}$ and $\mathcal{C}_{VIS\_NEED}$ (benchmark for equity in resource allocation) are included for comparison. VIs are presented in Table 2. If the $\mathcal{C}_{BEN\_NEED}$ dominates $\mathcal{C}_{NEED\_NEED}$ and VI<0, the benefit distribution is progressive with respect to need and therefore vertically equitable (and vice versa). VI=0 reflects the most conservative definition of vertical equity where the distribution of benefit is proportional to need.

In spite of differences in the distributions, in 2008, the benefits from government, donor, and total expenditure were almost equally regressive and vertically inequitable (VI^{Gov}=0.15, VI^{Don}=0.11, VI^{Tot}=0.12). The relative concentration curves were statistically dominated by $\mathcal{C}_{NEED\_NEED}$. Service use was regressive to need (VI_{USE}=0.07) and vertically inequitable. The allocation of resources from

government and donors (and their combination) was regressive, increasing the vertical inequity of the benefit distribution (VI_{RA}^{Gov}=0.08, VI_{RA}^{Don}=0.04, VI_{RA}^{Tot}=0.05).

Figure 3 Cumulative distribution of benefit from government, donor and total expenditure in primary and secondary outpatient care across individuals ranked by need in Mozambique, 2008



4.5.4 Evolution of vertical equity in Mozambique from 2008 to 2011

The evolution of the benefit distribution across need quintiles between 2008 and 2011 (Figure 4) reveals interesting differences in government and donor allocation patterns compared to the vertical equity benchmark. Four main results emerge.

First, in 2008 total expenditure was vertically inequitable (VI^{TOT}=0.12), since government expenditure was benefiting Q5 over Q1 and Q2 (VI^{Gov}=0.15) and donor expenditure was mostly benefiting Q5 and Q4 over Q1 (VI^{DON}=0.11).

Second, overall improvements were attained between 2008 and 2011 through the redistribution of government expenditure from Q5 towards Q1 and donor expenditure from Q2 and Q4 towards Q1. As a result VI^{GOV} reduced to 0.07, VI^{DON} to 0.07 and VI^{TOT} to 0.07.

Third, some discrepancies in government and donor allocation patterns existed in 2008. Interestingly, in spite of VI^{Don} (0.11) being smaller than VI^{Gov}, the share of benefit reaching Q1 from donor expenditure was smaller than from government expenditure. However, a gradual alignment towards vertical equity can be observed by 2011.

Fourth, in spite of this improvement, further redistribution of expenditure from Q5 towards the other quintiles would be required to approach the equity benchmark.

Figure 4 Benefit from government and donor spending in primary and secondary outpatient care by need quintiles in Mozambique, 2008-2011

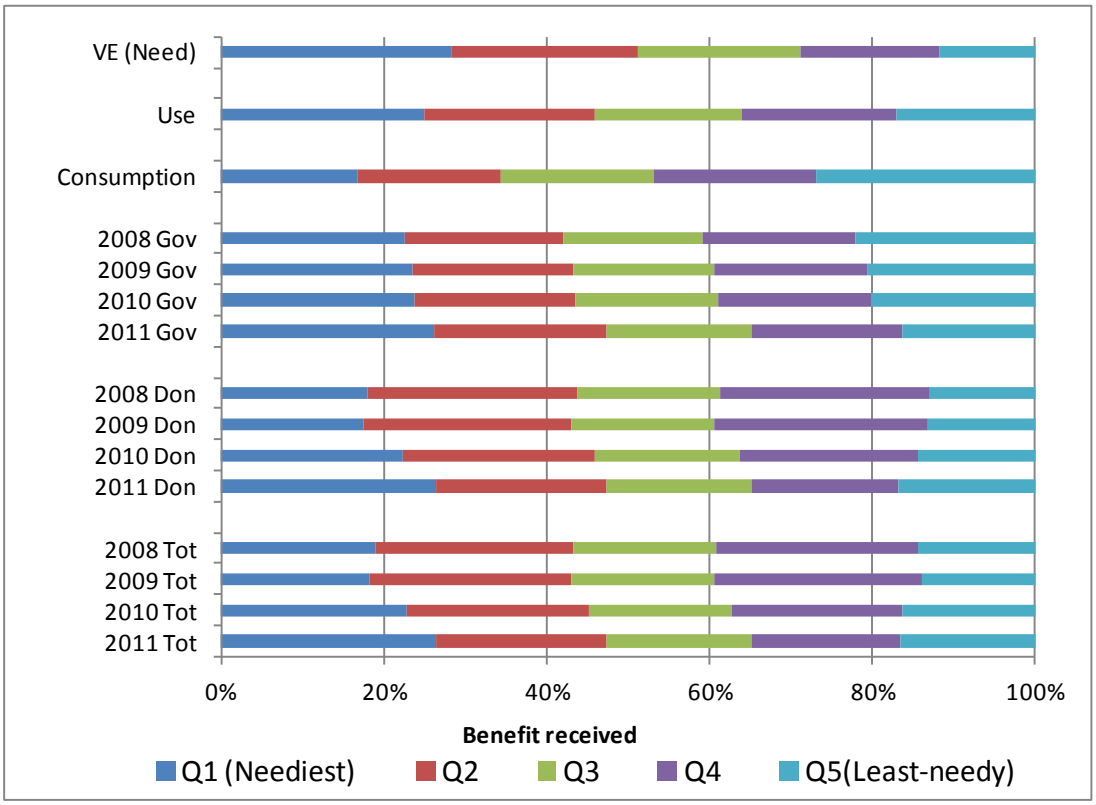


Table 2 Vertical inequity in benefit from public health expenditure by source of spending in Mozambique, 2008-2011

VI_{USE}	2008			2009			2010			2011		
	GOV	**DON**	**TOT**	**GOV**	**DON**	**TOT**	**GOV**	**DON**	**TOT**	**GOV**	**DON**	**TOT**

VI	0.07	0.15	0.11	0.12	0.13	0.12	0.12	0.12	0.09	0.10	0.07	0.07	0.07

The analysis of the sensitivity of the vertical equity measures to the variability of the shares of outpatient and inpatient expenditure and to the assumption of use of service in the district of residence produces negligibly different results.

6. Discussion

In this paper, we sought to quantify the horizontal and vertical equity of government and donor recurrent spending on primary and secondary outpatient care in Mozambique, from 2008 to 2011. We defined the horizontal and vertical equity benchmark based on objective indicators of economic status and need for healthcare. Using health expenditure figures disaggregated at district level, we also aimed to determine the extent to which inequity was driven by access to healthcare (service utilisation) or geographic resource allocation (variation of unit monetary benefit across districts).

We found a pro-rich distribution of government spending, driven by pro-rich service utilisation while resource allocation was already very close to horizontal equity in 2008. The results for resource allocation are not surprising, since a capitation formula, adjusted for poverty and service workload, has been applied since the 1990s to determine the provincial and district allocations of the donor pooled common fund (MISAU, 2012a). Additionally, we also found that donor-earmarked expenditure was pro-poor in 2008.

Similarly to previous studies based on subjective measures of need (Akazili et al., 2012; Ataguba & McIntyre, 2012; Chuma et al., 2012; Mtei et al., 2012), we found vertical inequity in the distribution of monetary benefit from health expenditure. Service utilisation was concentrated in the least needy quintile and resource allocation appeared to initially concentrate resources in least needy areas. Interestingly, while donor expenditure tended to favour the middle quintiles, government expenditure appeared to perform better in targeting the neediest quintile, although overall it was inequitable and favoured the least needy quintile.

Improvements towards horizontal and vertical equity, in both government and donor expenditure, were observed between 2008 and 2011. Changes in the geographic allocation of resources led to an alignment of government and donor allocation patterns, implying a reduction of the pro-poor nature of donor funding and a progressive re-distribution of resources toward the neediest quintile. This is not surprising. The shift of responsibility for provincial and district state budget allocation from the MoH to the MoF in 2007 led to an initial underfunding of some areas with lower managerial capacity but also with higher need, which was partially compensated in the following years (MISAU, 2012c).

The end of a few NGO projects and the greater coordination between MoH and donors, resulting in the progressive inclusion of external resources in government planning, may have contributed to the observed improved alignment (MISAU, 2012c).

The allocation of government expenditure shows regular patterns over time, suggesting that it does not adjust to the more irregular donor allocations. Previous studies highlighted an adjustment of government resource allocation to donor funding, known as fungibility (Chunling et al., 2010; Dieleman & Hanlon, 2013). However, we do not find evidence of donor-earmarked expenditure 'crowding out' government recurrent expenditure, suggesting that fungibility may affect resources for new investment, but not the core resources which guarantee the functioning of the health system. The disaggregation by type of expenditure, as well as by type of funding, provides additional insights on the nature of fungibility.

Most BIA studies implicitly (or explicitly) assume that the poorest are also the neediest (Van de Walle & Nead, 1995; Adam Wagstaff, 2002). However, our results show that poverty (measured by per capita consumption) and need for healthcare (proxied using an index including individual demographic characteristics, household non-economic deprivation and district U5M) do not always overlap. Indeed, we find that the correlation between measures of poverty and the indicators of need for healthcare chosen in this study is relatively weak (0.24). Need for healthcare appears to be more concentrated in the poorest quintile, particularly in the 2nd poorest decile, and almost equally distributed among the rest of the population. Household consumption per capita is not correlated, with the average number of consultations per age-gender group (-0.03) and mildly correlated with household (non-economic) deprivation (-0.34) and with district U5M rate (-0.12). All reported Pearson's correlation coefficients are significant at the 1% level. Previous studies in Mozambique highlighted the discrepancy between household consumption measures calculated using different methods to adjust for inflation (Alfani, Azzarri, d'Errico, & Molini, 2012) and between household poverty based on consumption or asset based measures (Lindelow, 2006). These discrepancies suggest that the choice of the measure of economic status should be carefully evaluated, since their degree of correlation with need for healthcare may vary.

If the poorest are not necessarily those who need health services the most, trade-offs in resource allocation are likely to arise, as well as thorny questions about the objectives of public finance in the health sector: should public health expenditure target the poorest or should it target the neediest? Should it re-distribute economic resources from the richer to the poorer districts or should it aim at providing resources to HFs operating in those areas with higher need for service? From a public health perspective, targeting those who need health services the most, would be desirable. However, in LMICs poverty measures have been used as proxies for need since ill-health tend to be

disproportionately concentrated amongst the poor (Adam Wagstaff, 2002) and the use of public expenditure (including health expenditure) has been promoted as a tool to redistribute economic resources, with consequences for the development of the mainstream analytical tools (O'Donnell et al., 2008).

Results show that horizontal inequities in the distribution of the monetary benefit from public expenditure are driven by inequities in healthcare utilisation, which are likely to reflect inequalities in individual, household and community socio-economic and environmental characteristics (Adam Wagstaff, 2002; WHO, 2008). Combinations of policies which act on different causes of ill-health and service uptake, are required to tackle existing inequalities. Since the role of the MoH in most LMIC countries is currently confined to the provision of curative and preventive care, either a re-definition of this role or a cross-sectorial approach is required. The allocation of public resources across and within those sectors would then also need to be reconsidered (Goddard & Smith, 2001). The clear definition of health policy objectives, in particular with respect to equity, is necessary to define the role of the health versus other sectors in promoting equity in health, to evaluate public health expenditure against the appropriate benchmark and, when required, to develop and promote appropriate analytical tools.

BIA analyses the distribution of the monetary benefit across the population, but does not provide any insights on how public health expenditure is effectively transformed into services, or on the quality and the outcomes of those services (Castro-Leal et al., 2000; Lanjouw et al., 2001). Complementary analysis of the managerial capacity and service organization at local level and of the constraints to service utilisation are required to inform policy that effectively benefits the target population. Indeed, pursuing equity in public expenditure may lead to trade-offs with efficiency in public expenditure, especially where differences in management and service delivery capacity exist across geographic areas. Quantifying the dimensions of the trade-off and identifying the mechanisms which generate it is therefore important to inform policy.

The restricted focus of this study on primary and secondary outpatient recurrent expenditure limits the extent to which results can be generalised. However, where a referral system is in place, the equitable provision of primary and secondary care across geographic areas is a necessary condition for equitable access to inpatient and specialised care, for which resources are often allocated based on service workload rather than with attention to geographic distribution. Due to lack of information on geographic distribution of drugs, equipment, and in some case specialized human resources, recurrent expenditure managed at central level to purchase them is not included in the analysis. However, it could be argued that the distribution of drugs and equipment is likely to be correlated with local administrative expenditure.

The use of an average district measure of health status has the advantage of being objective, unlike self-assessed health status which underestimates need among the poor (Mtei et al., 2012), but it masks intra-district inequalities. The exclusion from the analysis of Maputo City, which notoriously receives higher resources, and the use of routine data in service utilisation from NHIS which may systematically underreport service use in the most deprived districts (and therefore inflate the level of individual monetary benefit received) may contribute to further underestimate existing inequities. However, the direction of the main results would remain unchanged.

7. Conclusion

We quantified horizontal and vertical equity in expenditure allocation across geographic areas and disentangled the contributions of resource allocation and service use to observed inequity to discuss the distributive implications of different resource allocation mechanisms and priorities. The allocation of recurrent expenditure in Mozambique is nearly both horizontally and vertically equitable, while inequities in the distribution of monetary benefit are determined by inequities in service use. Between 2008 and 2011, government and donor resource allocation patterns slowly converged, leading to the gradual shift of donor resources towards areas with higher need for healthcare but that are not necessarily the poorest.

The discrepancy between economic and need ranking raises questions about the ultimate objective of public expenditure in healthcare. The equity objectives to be pursued should be clearly defined to identify the target population and the most effective policies to reallocate public expenditure in health services and other sectors.

Further research on the determinants of inequality in healthcare utilisation is required to advance the discussion of equity in resource allocation and in the final distribution of public health services expenditure across the population. A better understanding of how financial resources are transformed into healthcare services is needed to inform effective and efficient allocation policies.

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