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Recommendations for the Development of a Health Sector Resource Allocation Formula in Malawi

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CHE Research Paper 159

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Summary

This report describes a spreadsheet tool designed to inform the allocation of health service funding to district councils in Malawi. The methods seek to allocate funds between districts so as to provide the opportunity of securing equal access to services for equal need for the interventions contained in Malawi's Essential Health Package (EHP). The relevant funding streams for allocation relate to the available budgets for drugs and other recurrent transactions (ORT), but excludes costs relating to personnel.

Section 1[1] gives a brief introduction to the flow of funds in publicly funded health systems, and the rationale for using a funding formula to devolve funds to geographically defined administrative entities, such as the district councils in Malawi. It argues that the use of a formula can promote three classes of health system objective, related to efficiency, equity and politics. Funding formulae are in widespread use in developed countries, and are increasingly being applied in low and middle income settings. The intention of most formula is to estimate the expected costs to a locality of delivering some standard level of access to health services, assuming a standard level of efficiency (and, where appropriate, standard levels of user charges).

Section 2 summarizes the budgetary arrangements for the health sector in Malawi. The principal budgetary streams to which the analysis in this report refers are the drugs and ORT budgets. Personnel budgets are the responsibility of the Department for Human Resources Management and Development, and are not considered further here. As well as government funds, there are significant financial contributions from donor funds and local revenue generation. The primary administrative function addressed in this report is the allocation of drug and ORT funds to geographically defined district councils.

Malawi has a specified EHP comprising 106 interventions, arranged into 11 thematic headings. Whilst the EHP is intended to focus health system resources on the highest value interventions, the funds currently available at the national level are inadequate to secure 100% coverage of the EHP for all citizens in need. The resource allocation tool presented in this report seeks to allocate funding between districts on an equitable basis, so that each district can in principle deliver the EHP to its citizens to a uniform extent, as constrained by the nationally available funds.

Section 3 outlines the principal features of most resource allocation mechanisms, indicating the technical and political choices that must be addressed when developing a formula. The issues covered include: specifying the objectives of the formula; defining the devolved entities in receipt of funds; specifying the services covered by the formula; counting the population; adjusting for population medical needs; measuring costs; and treating cross-border flows.

The methods adopted are described in section 4. They first entail for each intervention specifying a target population group and multiplying by an estimate of the probability of requiring the intervention in a year. This is multiplied by an estimate of the unit cost of the intervention to derive the total spending need for that intervention in the district. The calculations for each intervention are summed to derive the total district allocation. This gives the costs of securing 100% coverage for all treatments. A variant of this model is developed by multiplying each treatment calculation by an estimate of 'realistic' coverage, to acknowledge that there will be differences between districts in the extent to which they can secure 100% coverage. These methods are implemented in an extensive spreadsheet, which forms the principal output of this project. All allocations are presented as a percentage share of the national budget, so the formula can operate at whatever funding level

[1] This section draws in part on the report Smith, P. (2008), *Formula funding of health services: learning from experience in developed countries*, Discussion Paper HSS/HSF/DP.08.1, Geneva: World Health Organization.

is available, with the implication that any shortfall in funding will be shared on an equal percentage basis across all districts.

The results are summarized in section 5. Under the full coverage model, the relative per capita spending needs vary from about one third of the national average in one district, to about 5.6 times the national average in another, although this last is an outlier, and most districts lie within a much narrower range. Application of the main formula would imply some very large reductions from current levels of funding (over 50%) in four districts, and more than doubling of allocations to two districts. A change from the 'full coverage' model to the more 'realistic' coverage model yields changes in allocations ranging from a decrease of 16% to an increase of 18%.

Section 6 seeks to put the results in context. It notes the strengths of the Malawi arrangements, most notably the existence of the EHP and the associated costings, and the extent of available data resources. The discussion nevertheless raises further issues for development and clarification, and reiterates the need to treat the tool and the results as a basis for further dialogue rather than a definitive recommendation.

1. Introduction

A key requirement for any health system is to ensure that the available public funds are directed to local organizations in line with health system objectives. Such funding seeks to give local institutions - such as local governments, local administrations and health authorities - both the financial capacity and the incentive to fulfil their objectives. This report focuses on one particular aspect of the financing mechanism: the use of mathematical formulae to determine the magnitude of funds directed towards local health agencies, with particular reference to District Councils in Malawi. The use of such formulae has become increasingly widespread in health care systems at all levels of development, and offers enormous scope for ensuring that funding is aligned with national health system policies. In particular, a systematic approach towards funding local agencies is an essential prerequisite of successful decentralization policies.

The World Health Organization (WHO) has argued that national governments play a crucial stewardship role in ensuring that health service funds (from whatever source) are used efficiently and equitably, and that health care agencies are incentivized appropriately. Figure 1 offers a schematic representation of the flow of public funds implicit in the finance of most health systems. An important source of central government funds is taxation, paid in a variety of forms by citizens and businesses (A). This might in some low-and middle income countries be augmented by a variety of donor funds (G), creating a pool of revenue available to the central government. The government must then decide on how it will allocate the funds to support locally delivered health services, either wholly or in part.

The central government might pay health care providers directly (E), as in the USA Medicare programme for older people. However, national governments usually devolve health care purchasing powers to local organizations, such as states or various forms of local government, local health authorities, health insurers, or voluntary bodies. We shall refer to these devolved institutions as local agencies, which take the form of District Councils in Malawi. They are often financed wholly or in part by grants-in-aid from the central government funding mechanism (B).

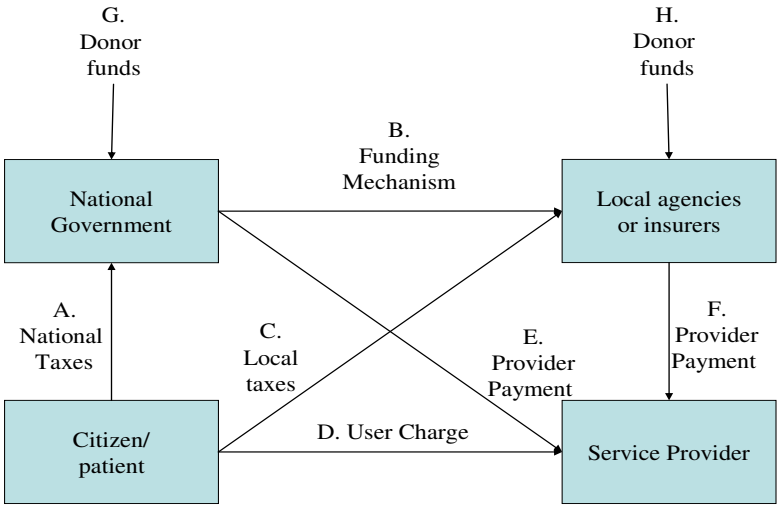


Figure 1: The flow of funds in the health system

Local agencies may be solely reliant on national funds, but are often able to augment their revenue with local taxes (C), and sometimes donor funds allocated directly to the local agency (H). They then purchase services from providers (F). In some circumstances, the distinction between purchaser and provider may be unclear (for example, hospitals may be directly provided by local governments). However, even where there is no explicit payment mechanism, local agencies must in practice purchase their services from vertically integrated providers. Finally, the service user might pay a charge to the local agency or (more commonly) directly to the service provider (D). In some countries this payment might take the form of 'informal' reimbursement of the provider. Of course the relative magnitude of all of these funding sources varies considerably between countries.

This report is centrally concerned with just one of the funding flows represented in Figure 1: the mechanisms for funding local agencies, or purchasers of health services, from national revenues (B). The national government's problem is to design a payment mechanism that is aligned with and promotes its policy objectives. Flows other than B in the diagram are referred to only when they are material to this policy problem.

The rationale for formula funding

There are three broad reasons for adopting a formula funding approach, reflecting efficiency, equity and political objectives[2]. This section summarizes the rationale for formula funding under these three headings.

Economic efficiency has a number of connotations. The two most fundamental notions are allocative efficiency (the extent to which allocations of resources are in line with society's preferences) and managerial efficiency (the extent to which agencies perform functions at least resource cost). Formula funding is intended to address both aspects of efficiency. It seeks both to align resource allocations with national priorities, and to offer incentives that promote technically efficient practices amongst local agencies.

Furthermore, by facilitating the creation of a fixed budget for local agencies, formula funding can help promote technical efficiency. By requiring that local services must be provided within the budget, local planners are encouraged to seek out and reduce inefficiencies in their systems. However, this incentive only works properly if there is adequate monitoring of the performance of the agencies, to ensure that services are delivered in line with intentions, and that efforts to improve efficiency do not result in unintended reductions in levels of output or quality.

Systems of formula funding intrinsically seek to promote some concept of equity. The pursuit of equity might be valued for its own sake, or it might be valued because it secures acceptance for the government's funding regime for local agencies. It is usual to divide equity concerns into the two broad principles of horizontal and vertical equity. A concern with horizontal equity suggests equal treatment of equals, whilst a concern with vertical equity suggests that those who are in more need (however that need is defined) should in some sense with higher priority. In practice, many stated equity principles are often vague or misleading.

Therefore, when put into operation, equity principles usually translate into a more operationally tractable policy objective of enabling local agencies to deliver some 'standard' benefit package of health services. The standard benefit package is usually defined in terms of a basket of health care and other services. The chosen benefit package implies a certain level of expected expenditure in each locality, which we term the area's 'spending need'. This will depend on the geographical,

[2] Smith, P. (2003). Formula funding of public services: an economic analysis, *Oxford Review of Economic Policy,* 19(2), 301-322.

demographic, epidemiological, social and economic characteristics of the area. The characteristics to be taken into account in calculating an area's expected expenditure will be determined by data availability and the nature of the chosen package.

The funding formula will usually indicate the total costs of delivering the stated benefits package (up to some standard of access and quality). In the absence of any other funding source, it is expected that the funds will be provided by the national government. However, it may be the case that local agencies have some access to funds from other sources, such as user charges, private patients, charitable donations and donor funds. If this is the case, then there is a need to calculate what would be a 'reasonable' expectation of funds from such sources, and this is deducted from the estimate of total costs to indicate the government's net liability. For example, the formula might assume a certain expected level of user charges for some services, if such charges are levied.

Note that, if the local agency has some discretion over the nature of local health services, the objective is to enable local administrations the *opportunity* to deliver a standard level of service at a standard local tax rate, whilst charging users a standard charge (which may be zero). Local agencies may then have the freedom to vary some elements of the package of services (or user charges). It will then usually be the case that - if a local agency chooses (say) to augment the package, it must do so from within its available resources, and cannot expect additional funding.

The formulaic approach to funding has become popular not just because it can lead to more efficient and equitable outcomes than other methods, but also because it can serve a health system's more general objectives. Of course, those objectives often include equity and efficiency criteria. But they may also include important political considerations such as: allowing the criteria for funding to be set out explicitly; treating the budget-setting process systematically; promoting accountability; avoiding the need for case by case scrutiny of budgets; binding politicians, bureaucrats and other parties to a set of distributional rules; and helping to provide a non-partisan solution to intense political conflicts.

A persistent feature of the political debates about funding formulae is the tension between the technical accuracy of formulae (intended to promote efficiency and equity) and a desire for simplicity (intended to promote political accountability). Politicians and the media frequently complain about the complexity of many funding mechanisms, and its adverse impact on accountability. At the same time, interest groups, politicians and localities also frequently complain that local 'special circumstances' are not accommodated within a funding mechanism. This lack of sensitivity to local spending needs usually implies a wish to search for more intricate formulae which would reflect the special circumstances more satisfactorily.

Many systems of formula funding include damping mechanisms (often referred to as the 'pace of change') that reduce the year-on-year changes in an organization's budget, thereby lessening the immediate impact of the formula. For example, in England the original recommendations of the NHS Resource Allocation Working Party (RAWP) took 15 years to take full effect. Such damping serves two principal purposes: reducing political turbulence and reducing local organizational problems associated with big changes in funding. They are usually applied as a political adjustment after 'pure' (undampened) budgetary targets are calculated using the resource allocation formula.

Approaches to formula funding

There are numerous ways in which the local allocation of health system funds could be determined, each with distinct advantages and disadvantages. At its crudest, the distribution could be based on political patronage, perhaps rewarding localities according to their political support in the past, or their importance for the government in the future. While politically desirable, this approach holds

no persuasive economic arguments. Another approach in widespread use is to distribute public funds to local health agencies according to historical precedent. Such mechanisms minimise year-on-year disruption to existing services but leave the government hostage to history and perpetuates existing unfairness. A third possibility is to allocate funds according to bids submitted by localities, or to make allocations contingent on some measure of local performance. While this mechanism could be agreeable it is technically and administratively challenging. Finally, financial allocations could be made according to how much localities actually spend. This, however, creates perverse incentives encouraging excessive and inefficient expenditure.

In practice, most systems of financing local health administrations contain an element of all four types of mechanism. As outlined, however, in many circumstances, such approaches contradict principles of good public finance, as they breach requirements of fairness, or encourage spending in excess of efficient levels. Therefore a fifth approach – allocation by mathematical formula – is increasingly becoming a favoured approach to determining local financial allocations. It can be defined in broad terms as the use of mechanical rules to determine in advance the level of public funds a devolved local agency should receive for delivering a specified health service.

Under formula funding, mathematical rules that determine the magnitude of the funding received by a local agency are specified *in advance*. Those rules might be very simple (for example, a fixed amount of *per capita* funding *per annum*) or very complex. They might also be to some extent augmented by other funding mechanisms (for example, additional specific grants from the national government, or local taxes). The overarching objective of formula funding is to contribute to the creation of a budget for the local agency with which it is expected to fulfil its duties, in the form of organizing and/or purchasing local health services.

There are two broad approaches to formula funding. The first reimburses the local entity on the basis of some measure of local activity, for example a count of the number of service users. Such *case payment* mechanisms are widespread in health care, for example using counts of inpatients, and the highly developed systems of diagnosis-related groups (DRGs) in place in many developed countries. They are especially relevant when an unambiguous indicator of a patient's need for the service can be established. However, they can be vulnerable to perverse incentives to create unwarranted or inappropriate service utilization. Further, if the case payment doesn't cover the actual cost of treatment, service providers may 'cream-skim' only lower cost patients within reimbursement groups. Case payment mechanisms have a useful role to play in funding some elements of local health care, especially for those parts of the health system for which a reliable count of the expected number of patients can be derived. Such counts can be derived from local surveys or modelling exercises, but should be as independent as possible from the actual data and performance of local providers, as they may otherwise be distorted by variations in existing provider performance.

The second approach to formula funding reimburses local agencies according to the *expected* level of local activity at a broad population level. Typically, this 'capitation' approach takes a measure of the size and characteristics of a locality's population, for example in the form of risk factors such as levels of disease and poverty, and infers the expected level of local service expenditure, providing local agencies with a fixed budget without reference to actual local health service use. These methods have become known as capitation funding methods because they are based on population counts. They can circumvent some of the perverse incentives inherent in case payment, but their effectiveness depends on how successfully the capitation payments are adjusted to account for variations in population characteristics.

Whichever approach is adopted, three institutional requirements must be in place for formula funding to be relevant. First, the organization and purchasing of health services must be to some extent devolved to the local agencies. Second, there must be adequate data, available on a consistent basis across all local agencies, to which can be applied a mechanical formula that determines the level of funding to be allocated to those organizations. Third, there must exist some incentive to adhere to the financial allocation implied by the formula. Formula funding is a mere ritual if the recipients of funds can with impunity ignore the allocations implied by the limits.

In the developed world, formula funding is becoming the dominant mechanism for devolving health system finances. Outside the United States, capitation methods have become ubiquitous as the means of funding devolved local governments, local health authorities or social health insurance funds, although the level of sophistication used varies markedly between countries. Increasingly the approach is being adopted in low and middle income countries.

2. Malawi's health sector and budget

Since the Local Government Act (1998) and National Decentralisation Policy (1998) the Ministry of Local Government & Rural Development (MoLGRD) through district councils has been responsible for the delivery of health services at the district level. Consequently, the national health budget in Malawi is currently programmed through four channels otherwise known as budget votes, namely; Ministry of Health and central hospitals (Vote 310); District Councils (Vote 900); National Local Government Finance Committee (Vote 121); Subvented organisations (health regulatory bodies). Further, there are four main budget components; personnel emoluments (PE) budget; drug budget; other recurrent transactions (ORT) budget; development budget (Part I & Part II).

As part of continued progress towards decentralisation, district councils had their PE budgets devolved to them in 2017/18. The Department for Human Resources Management and Development (DHRMD) is responsible for the allocation of districts' PE budgets. The drug and ORT budgets are held by the National Local Government Finance Committee (NLGFC). Districts make drug requests to Central Medical Stores Trust (CMST), with the NLGFC paying CMST directly. The district councils, through the district health office (DHOs), allocate their health sector resources across the district between the district hospital, health centres, dispensaries, village clinics etc. The Ministry of Health holds its own PE and ORT budgets as well as the development budget for the health sector. Other cost centres like central hospitals (falling under Vote 310), Christian Health Association of Malawi (CHAM)[3] facilities and the subvented organisation (e.g. Health Services Commission) receive their funding directly from the Ministry of Finance.

Community, primary and secondary health care functions are devolved to district councils. However, tertiary care (central hospitals) are not devolved. Central hospitals serve a regional, as opposed to local, function acting as referral centres. To access services at a central hospital a patient must be referred from a lower level of care or, if not referred, pay a bypass fee. However, a vast majority of services provided at central hospitals remain primary care services.

In addition to the national budget, health financing at district level benefits from donor finances and some local level revenue collection. District hospitals have paying wards which offer more privacy and reduced waiting times. The DHO retains the revenue generated through the paying wards for reinvestment in the district health system. Donors finance a significant proportion of the health sector, particularly interventions targeted at nutrition, HIV/AIDS, malaria and tuberculosis.

In 2017/18 the health budget in Malawi comprised the 3rd largest share of the total government budget (Education: 18.1%, Agriculture: 15.5%, Health: 9.9%). The health budget increased by 25% in nominal terms and 9% in real terms on the previous fiscal year. Despite this, a large proportion of the drug budget is often spent in the first six months of the fiscal year, leading to shortages and problems accessing treatment for patients.

Current resource allocation formula

The Ministry of Health currently uses historic allocations to determine the target share of the drug and ORT budget for each district council. The amount allocated to each council is annually adjusted by a proportion based on the total budget for allocation. As such, relative allocations to district councils rarely change, as can be seen in table 1.

[3] Estimates suggest CHAM provides approximately one-third of Malawi's health care.

Table 1: District Council Allocations

District Council	2017/18 Health Sector ORT budget	2018/19 Health Sector ORT budget	2017/18 Drug budget	2018/19 Drug budget	2018/19 PE budget
Balaka	220,612,691	231,643,325	314,001,106	400,912,126	912,601,208
Blantyre	514,375,365	540,094,134	732,117,599	934,757,292	2,198,962,080
Chikwawa	272,682,396	286,316,516	388,112,642	495,536,676	1,400,480,983
Chiradzulu	236,094,282	247,898,996	336,036,269	429,046,308	1,623,494,355
Chitipa	177,394,957	186,264,704	252,488,706	322,373,973	693,139,718
Dedza	360,158,741	378,166,678	512,618,938	654,504,537	1,490,177,344
Dowa	314,752,843	330,490,485	447,992,092	571,989,903	1,532,251,872
Karonga	180,836,455	189,878,278	257,387,037	328,628,092	1,076,512,864
Kasungu	334,275,283	350,989,047	475,778,651	607,467,385	1,473,415,164
Likoma	48,183,841	50,593,033	68,580,730	87,562,896	38,026,200
Lilongwe	758,050,423	795,952,944	1,078,943,692	1,377,579,892	4,791,019,118
Machinga	252,896,102	265,540,907	359,950,534	459,579,699	1,439,273,673
Mangochi	418,765,014	439,703,264	596,034,059	761,007,771	1,921,967,370
Mchinji	261,985,886	275,085,180	372,888,149	476,098,262	1,768,457,144
Mzimba North	143,658,116	150,841,022	204,470,590	261,065,128	
Mzimba South	282,082,316	296,186,431	401,491,677	512,618,838	2,522,332,769
Mulanje	316,457,737	332,280,624	450,418,692	575,088,152	1,766,597,534
Mwanza	148,531,085	155,957,639	211,406,355	269,920,615	445,328,136
Neno	171,937,732	180,534,618	244,721,360	312,456,736	657,162,480
NkhataBay	278,396,023	292,315,824	238,716,215	304,789,453	1,443,963,390
Nkhotakota	274,518,365	288,244,283	390,725,801	498,873,121	1,381,630,569
Nsanje	193,350,858	203,018,401	275,198,962	351,370,103	911,434,972
Ntcheu	307,506,428	322,881,749	437,678,169	558,821,233	1,891,719,984
Ntchisi	169,212,977	177,673,626	240,843,179	307,505,130	762,420,223
Phalombe	207,275,337	217,639,104	295,017,866	376,674,597	652,435,851

Rumphi	175,801,740	184,591,827	250,221,056	319,478,670	763,021,828
Salima	240,046,159	252,048,467	341,661,031	436,227,923	1,554,360,136
Thyolo	360,055,014	378,057,765	512,471,302	654,316,038	1,279,806,729
Zomba	359,743,236	377,730,397	512,027,543	653,749,452	1,439,774,803
Total	**7,979,637,400**	**8,378,619,270**	**11,200,000,000**	**14,300,000,000**	**39,831,768,497**

The PE budget for is unavailable in disaggregated form by district for 2017/18

All Districts received a 5% and 28% increase to their ORT and drug budget respectively from 2017/18 to 2018/19, resulting in each district receiving the same relative share of the budgets.

Figure 2 shows the allocation of the drug and ORT budget across districts in per capita terms for the 2018/19 fiscal year. The graph shows that the per capita allocation of budgets across districts is extremely variable. Likoma Island receives MK13,168 per capita while Mzimba north receives MK840 per capita. The average district allocation per capita is MK2,094.

Although this does not necessarily indicate that the distribution fails the principle of a needs-based allocation, as the health care needs of individuals are not homogenous, it does illustrate that under the current allocation mechanism, some districts would continue to benefit from hugely greater levels of spending per person than others.

A district resource allocation formula was developed in 2008 but current allocation proportions diverge significantly from the recommendation allocation. This formula was based on five weighted factors; outpatient utilisation rate (15%), stunting percentage below -3 standard deviations (50%), bed capacity (15%), land area (5%) and infant mortality (15%). The aggregate health sector budget for reallocation was broken into subtotals according to these factor weights. Each district was then allocated a proportion of each subtotal commensurate with the proportional contribution of the district for that factor.

Prior to 2000, distribution of the health sector budget across districts was based solely on population size. A more refined formula was developed in 2001/02 which considered factors such as OPD utilization, poverty and number of health facilities while placing a majority of the weight in the calculation on historical allocation. Recognizing that such a formula would result in perpetuating existing inequities, the formula was revised to exclude historical allocations and factor in population, poverty, under-5 mortality, remoteness, and presence of CHAM facilities and a district hospital (all factors assumed to be positively associated with healthcare costs).

The Essential Health Package (EHP)

The definition of the national EHP is intended to concentrate the scarce health sector resources of Malawi on a number of key health interventions to which the population can have free access to at the point of delivery. The latest revision of the EHP includes 106 interventions. The interventions are listed under the following thematic headings:

- Reproductive Maternal Neonatal and Child Health (RMNCH)
- Vaccine Preventable Diseases
- Malaria
- Integrated Management of Childhood Illnesses (IMCI)
- Community Health

- Neglected Tropical Diseases (NTDs)
- HIV/AIDS
- Nutrition
- Tuberculosis (TB)
- Non-Communicable Diseases (NCDs)
- Oral Health

See appendix for a more comprehensive description of the EHP.

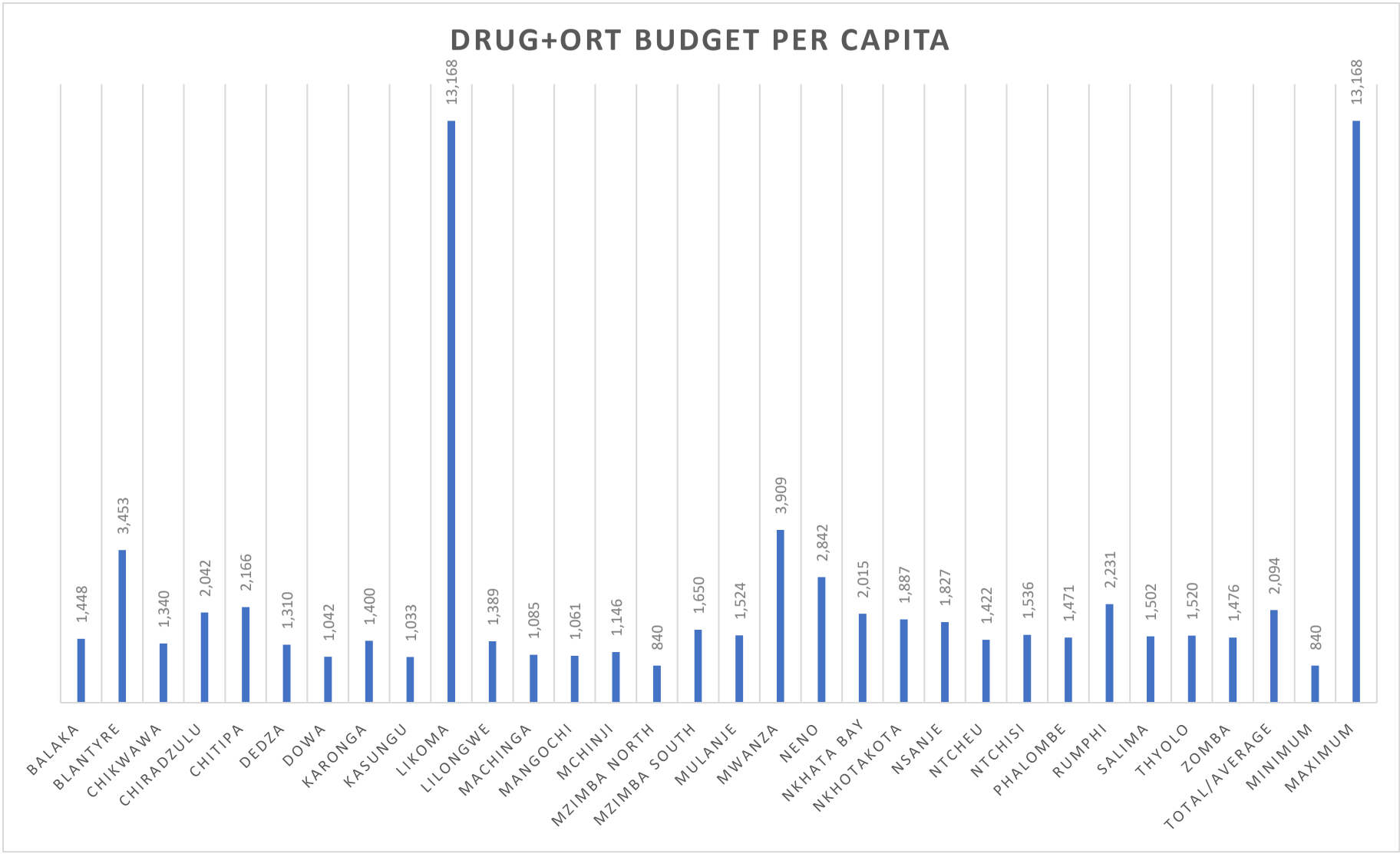


Figure 2: Per Capita District Allocation (2018/19)

Revision of the District Health Resource Allocation Formula

The aim of the research is to produce options for an improved and updated mathematical formula to inform the distribution of the ORT and drug budgets for districts in Malawi. The budgets are intentioned for the provision of interventions included in the Essential Health Package (EHP). The formula should, therefore, seek to reflect local variations in need for health care services included in the EHP. To achieve this the study examines the factors associated with variations in need for EHP services. The options are intended to be suitable for potential implementation from the 2019/20 Fiscal Year.

As previously mentioned, DHOs are charged with purchasing primary and secondary health care services for their designated populations (the district population). The resource allocation formula calculated only addresses the distribution of resources to districts currently held by the National Local Government Finance Committee under Vote 121, namely districts drug and ORT budgets. How districts subsequently use these resources to purchase services from providers (health centres, district hospital, etc.) lies outside the scope of this work. In other words, the work examines the methods of capitation and risk-adjustment for the allocation of resources to district councils and excludes any consideration of the payment method of district councils to health care providers i.e. district hospitals, health centres etc.

It is worth highlighting that Malawi is tentatively considering moving towards a system of Diagnosis Related Group (DRG) payments for central hospitals in the longer-term. However, this report addresses resource allocation given the present situation. This policy would, if enacted, only apply to central hospitals delivering tertiary and specialist services, whereas the resource allocation formula discussed in this paper is related to EHP services which consist of primary and secondary care services. Therefore, theoretically there should be limited interaction.

3. The elements of capitation funding

This section outlines the rudimentary practical considerations that must be taken into account when developing a funding formula for health services. It first considers the objectives of the funding formula, choices about the agencies in receipt of funds, and the scope of the health services to be covered by the funding mechanism. It goes on to discuss the basic data issues associated with counting the population, and varying the capitation payments in line with citizens' health care spending needs (so-called risk adjustment). It then briefly discusses the measures of costs to be used in any analysis. The section concludes with some observations on the statistical issues that arise when seeking to develop empirical funding formulae[4].

The objectives of the funding formula

As noted earlier, funding formulae can have a number of implicit and explicit objectives relating to efficiency, equity and politics. It is essential that explicit and practical objectives are formulated when seeking to make an allocation system operational. In some systems, particularly those with competitive insurance arrangements, the prime objective is to secure efficiency in the operation of the insurance market. However, in most systems of national health insurance, the prime objectives usually relate to equity, an important requirement for promoting national solidarity and support for the health system.

Equity objectives can take a number of forms, but the dominant approach used in formula funding has been to give local agencies the opportunity to provide some standard package of health services. This seeks to ensure that a citizen with a given level of health care need can expect to receive an equal level of access (at an equal price, if user fees are applied) wherever they live. Of course this definition begs the question of what is meant by 'equal health care need', and can give rise to numerous methodological difficulties when seeking to make it operational. However, it has proved to be a robust and practical concept of equity that is in widespread use. We therefore use it as an underlying principle throughout this report.

Entities in receipt of funds

The next basic consideration in formula funding must be: to what local agencies are funds to be distributed? Often this is self-evident. However, there are circumstances when there are choices to be made about what organizations should be the target of funding, and to what level of responsibility to devolve funding. For example, in a federal state, there may exist municipalities, within larger local authorities, within provinces. A simple per capita funding mechanism may be adequate for distributing funds from central to provincial government, because the provinces have broadly similar demographic profiles, and because they have access to a range of other funding sources with which to abate any inaccuracies in estimates of spending need. However, the same formula may be completely inadequate for use at the municipal level, because of the much greater heterogeneity of social and demographic circumstances amongst those organizations, and the more serious implications of any inaccuracy in the formula.

Financial risk is central to any consideration of the administrative level at which the finance is to be directed. Broadly speaking, larger entities are more able to absorb such risk than smaller entities, because any inaccuracy in the formula can be absorbed across a large population. In the same way, agencies such as general local governments, responsible for a broad range of public services, can more readily accommodate inaccuracies in the health services formula by spreading the risk across a

[4] This section drew material from the following sources:
Smith, P. (2008). Resource allocation and purchasing in the health sector: the English experience, *Bulletin of the World Health Organization*, 86(11), 884-888.
Smith, P. (2007). Formula funding of public services, London: Routledge.

larger number of public services, or adjusting local taxes. In contrast, small, single purpose health agencies, reliant for all their income on formula funds, are placed at much greater risk, and so any formula will have to be correspondingly more accurate if serious inequities are to be avoided. In practice, of course, the choice of the entity is likely to be constrained and guided both by existing administrative structures, and by the practical data constraints. As mentioned, in the Malawi context we consider allocations to the district councils.

Services covered by the formula

A closely related issue is the set of health services and categories of expenditure for which funding is to be distributed. In principle, the formula should reflected the expected costs to a local agency of delivering a standard benefits package. However, there are numerous approaches to how this might be done. At one extreme, a formula might be based on line-by-line estimates of needs and costs for each element of the benefits package, possibly implying different formulae for each service in the package. This might entail using statistical models to derive unbiased estimates of the expected number of service users for each service. At the other extreme, a single broad formula might be used for all services, based on simple available metrics, such as demographic variables and mortality rates. In this report wherever feasible we use the first approach, based on Malawi's EHP described above. However, we contrast the results with an approach based on a single 'broad brush' index of health care need based on the standardized mortality rate.

Furthermore, note that the formula may not cover all the categories of expenditure associated with delivering the necessary service. For example, many systems of formula funding do not include allowances for items such as capital spending or medical training, which are frequently funded through other funding mechanisms. The funding formula we have been asked to examine for Malawi relates only to expenditure included in the drug budget and the ORT budget, and therefore excludes costs relating to personnel.

Counting the population

Capitation methods first require a verifiable count of population, disaggregated where necessary into demographic groups. Although the population count used in a capitation system is often uncontentious, it can give rise to difficulties when it relies on local reporting, as there are obvious incentives for local organizations to maximize the population on which their revenues are based.

Disaggregation of the population into demographic groups is a fundamental requirement of most capitation methods, because age and sex are often important predictors of expected health care spending that are readily available from routine data sources. Indeed for some services (such as maternity services) an accurate estimation of the relevant demographic group (women of childbearing age in this case) may be the single most important element of the formula.

Some citizens may not qualify for receipt of public health services, either because they are covered by other insurance arrangements, or because they have chosen to 'opt out' of public health services and instead use private care. There may therefore be a case for excluding such citizens from the formula calculations. This principle can be rather hard to follow if citizens can exercise some choice as to whether or not to use public services, depending on the treatment they require and their personal preferences. In this case, some estimate must be made of the expected costs falling solely on public services. In effect, the possibility that an individual may not use public health services reduces the expected incidence of health care spending needs that are relevant to the public sector, and should in principle be taken into account.

Accounting for Local Needs - Risk adjustment

Although counts of the population can be problematic, it is usually the process known as risk adjustment that leads to most technical debate. The purpose of risk adjustment is to reflect variations in an individual's needs for health service expenditure, beyond simple demographic factors, if that individual is to secure access to the 'standard' package in line with entitlement. In principle, this entails modelling the determinants of (a) the probability of requiring services and (b) the intensity of use associated with that need. In practice these two issues are usually concatenated into a single estimate of expected expenditure on an individual in a specified time period (usually a year).

Key issues to address are the choice of characteristics to include as 'risk adjusters', and the relative weight to attach to each factor. Different technical choices can lead to major changes in payment rates, and there is often little methodological guidance for those seeking to design risk adjustment schemes.

It is important to note that in many circumstances the range of satisfactory data available for risk adjustment purposes may be highly circumscribed. The first criterion in the design of risk adjustment will always be feasibility. Sometimes it may be possible to supplement the basic demographic disaggregation with epidemiological indicators, yielding richer and more refined predictions of spending need. For example, there may be reliable indicators of the numbers in the population suffering from certain diseases. However, such epidemiological refinement must be treated with caution. Its collection may be administratively demanding and it may be vulnerable to misrepresentation by local agencies. Furthermore, a high current prevalence of disease may be the result of poor services in the past, and it may be important to avoid 'rewarding' local agencies for poor historical performance.

An alternative approach is to use statistical models to estimate the *expected* prevalence of the disease in question, rather than the measured prevalence. These models may use social, demographic and epidemiological data to estimate disease prevalence in each administrative area, and may have the advantage that they are estimated on a consistent basis and not reliant on local reporting. Sometimes such statistical models use data that are unrelated to specific diseases, but which are known to be correlated with need for health services. For example, the early approaches to resource allocation in England relied heavily on various forms of standardized mortality rates rather than epidemiological variables, which were either unreliable or not available.

Even where potentially useful data do exist, there is frequently a tension in the design of formulae between a desire to model expected expenditure accurately, and a desire to avoid perverse incentives. For example, the best predictor of an individual's current health care expenditure is his or her previous history of expenditure and utilization. Such variables are often used in systems of competitive health insurance in order to model individual expenditure accurately[5]. However, policy makers in other countries have sought to avoid the use of such data in the design of health service formulae, on the grounds that they may offer a perverse incentive for providers to increase provision in order to secure an increased capitation payment for the individual in the future.

Any proposed risk adjuster must be reliably and consistently recorded across all recipients of funds. There will often be a need for a strong audit function to reassure all localities that payments are fair. A suggestion that some localities are manipulating information may be seriously corrosive. For this reason, a national government may often feel unable to use some otherwise suitable metrics as risk adjusters because they cannot be satisfactorily verified. Risk adjusters should also be plausible, in

[5] Wynand, P.M.M. Van den Ven, Ellis, R. (2000). Risk-adjustment in competitive health plan markets.

the sense of being manifest drivers of the need for health care services. Another persistent theme in the literature is the tension between parsimony in the use of risk adjusters and the need to model spending needs sensitively. Generally speaking, simple funding mechanisms are often preferred because they can be more readily understood and therefore promote accountability. However, there will often be an element of rough justice in a simple funding formula, so those local agencies that feel they are adversely affected by the choice of a simple mechanism will press for 'refinement', in the form of an increased number of risk adjusters and added complexity. Balancing simplicity and sensitivity of the funding mechanism is a key role for the national government.

In summary, numerous criteria for selecting risk adjustment characteristics have been indicated. For example, they should be:

- feasible, with low administrative cost;
- consistently, reliably, verifiably and universally recorded across all administrative areas;
- not vulnerable to manipulation or fraud;
- plausible predictors of expected health service expenditure;
- encourage efficient delivery of health services, and be free from perverse incentives;
- respect confidentiality requirements;
- parsimonious predictors of the need for health services, thereby promoting transparency and accountability.

In practice, this often severely limits the choice of variables, as in many situations there exists only very restricted information on the characteristics of individuals or areas that conforms to such criteria.

Measuring costs

Capitation formulae seek to model the expected annual costs associated with each individual, assuming he or she has access to the chosen standard benefit package. Loosely speaking, the estimation of those costs poses three broad modelling challenges: estimating the probability of the need for services; estimating the 'intensity' of service use associated with that need; and estimating the costs of providing those services. As discussed above, much of the methodological debate surrounds the first two of those challenges. However, it may also be important to model the third element – the costs to the local agency – with some care if there are significant legitimate input price variations between localities.

If there are inescapable variations in the input prices paid by localities, then it is important that the formula reflects this accurately. For example, the wages necessary to attract skilled health care workers may vary greatly within some countries, so some cost variation between localities may be necessary to allow the standard benefits package to be delivered. It is important to note that the methodology to derive these adjustments should ideally avoid use of specific public sector input prices in the localities. To use local health service wage rates as a basis for a local area cost adjustment might encourage inefficiency, as it allows localities to increase pay above the level that is strictly necessary yet not suffer any budgetary consequences.

The estimation of costs should also in principle reflect any cost sharing arrangements. For example, if the national government or a donor organization agrees to reimburse separately the local agency for costs on individual patients in excess of some threshold, the cost variable should be constructed so as to reflect the expenditure limit. Or if patients are expected to bear some of the costs of pharmaceuticals, the expected user charge should be reflected in a reduced estimate of net costs to the agency. In short, the measure of costs used in any modelling work should reflect only relevant costs falling on the local agencies.

Cross-border flows

One final consideration that must sometimes be addressed occurs when patients who are the responsibility of one local agency (that is, who live within the borders of the health authority) use services provided by a different health authority. It will usually be the case that the net flow of cross-border patients is not asymmetric, for example if patients in more rural areas tend to use facilities located in larger urban centres outside the borders of their local health authority. In principle, this complication is of little significance if there is a strict divide between the providers of services and the local agencies who fund them – then funding can 'follow the patient' to the provider, regardless of where the provider is located.

However, in many health systems, the provider is funded predominantly by a block contract with the local health authority, or is even owned by the authority. Then, if there is an inflow of patients from other localities, the provider might be expected to provide care to a population for which it is not adequately funded. In this case, there will often be a need for some adjustment to the allocations to local agencies to reflect cross-border flows. This could take the form of a bilateral transfer of funds from an agency that is 'exporting' patients to the importing agency. The transfer should reflect the net flow of patients between the localities.

Such financial transfers may be based on the unit costs calculated as part of the funding formula. However, they do not require any change to the initial funding formula methodology. The initial calculations should reflect the spending needs of a locality regardless of where the patient receives services. The adjustment for any cross-border flows then entails a separate adjustment between individual local agencies, which will often be made only after the net flow of patients becomes known.

4. Methods

Four variant resource allocation formulae were developed as part of this report; crude population, standardised mortality ratios, EHP intervention need and EHP intervention need augmented for implementation constraints. All the formulae calculate capitation payments attempting to capture expected district level expenditure with varying degrees of complexity. The first three formulae attempt to capture progressively more detailed information on drivers of health care need. The final formulae attempts to incorporate some measure of variations in district's ability to supply health care or the district population's ability to access care.

i) Crude population allocation

As outlined above, the simplest capitation method entails accounting only for the size of the population for which the local agency is responsible. The Population and Housing Census (2008) population projections were used to estimate district-level population's figures[6]. The population projections provide gender and age disaggregated district level population figures in Malawi between 2008-2030. One district – Mwanza – was missing data on the age and sex distribution of its population[7]. As projections of Mwanza's total projected district population were available the distribution of its population across age and gender was simulated using the average distributions of all other districts. This requires the weak assumption that the age and gender distribution of Mwanza do not differ significantly to other districts in Malawi. In recognition of the plausibility of this assumption and the anticipated updating of the population estimates with the 2018 census data once available, this method was deemed acceptable.

This methodology, in effect, puts a constant 'price' on the head of every citizen, regardless of other characteristics, with the budget allocated across districts on the basis of their population counts. Given the combined 2018/19 drug and ORT budget, a value of MK1,485 is allocated to each citizen. As outlined above, health care needs of individuals clearly vary considerably depending on a number of factors, for instance age, morbidity or social factors. Expected health care expenditures are, therefore, not expected to be equal across all individuals in actuality.

ii) Standardised mortality rates allocation

The second scenario based allocations on district mortality rates. Mortality, one of the key component metrics of health (with morbidity), is frequently utilised as a proxy for health care need. However, comparing crude morality rates also captures differences in district demographic structures, notably the age distribution, as most causes of morality vary significantly with age. Populations with a significant number of very old or young individuals would be expected to have relatively higher mortality rates.

Using age-sex standardised mortality rates corrects for between district variation in age and gender distributions, by calculating a weighted average of the age-sex specific mortality rates of a given population, thereby capturing only variations in mortality not attributing to these differences. District specific age-sex mortality rates (ASMR) are available from the Population and Housing census (2008), which were applied to district populations accordingly. Unfortunately the ASMR relate to 2007 and should be updated as soon as new data becomes available. However, as the interest is in the relative mortality rates of districts the relevance of the data relies on the weaker

[6] It should be noted that a 2018 census is in the final stages of development and once available should be used to update district population estimates.

[7] The NSO was contacted in an attempt to obtain the raw data but we were unable to obtain a response and subsequently imputed the missing data.

assumption that the relative ASMR have remained constant over time rather than the absolute values.

While the district age-sex disaggregated population figures clusters populations into 4 year windows i.e. 0-4, 5-9 etc. the ASMR relate to specific single year ages i.e. 0, 1, 5 etc. Therefore, the ASMR relates to the lower bound of the population age group. This has the likely effect of overstating the mortality rate for the youngest population clusters and marginally understating it for all other clusters.

Age-sex specific mortality rates per 1,000 and number of deaths were calculated for each age cluster in each district. The standard population used was the aggregation of the age-gender specific populations. The age-sex specific mortality rates per 1,000 for each district was then applied to this standard population to give the expected number of deaths by age and gender for each district assuming a common demographic distribution.

$$\text{Standardised mortality rate} = \frac{\text{Observed number of deaths}}{\text{Expected number of deaths}}$$

Once the expected number of deaths for each district is calculated, this can act as a proxy for relative need with the budget allocated according to the proportion of expected deaths in each district.

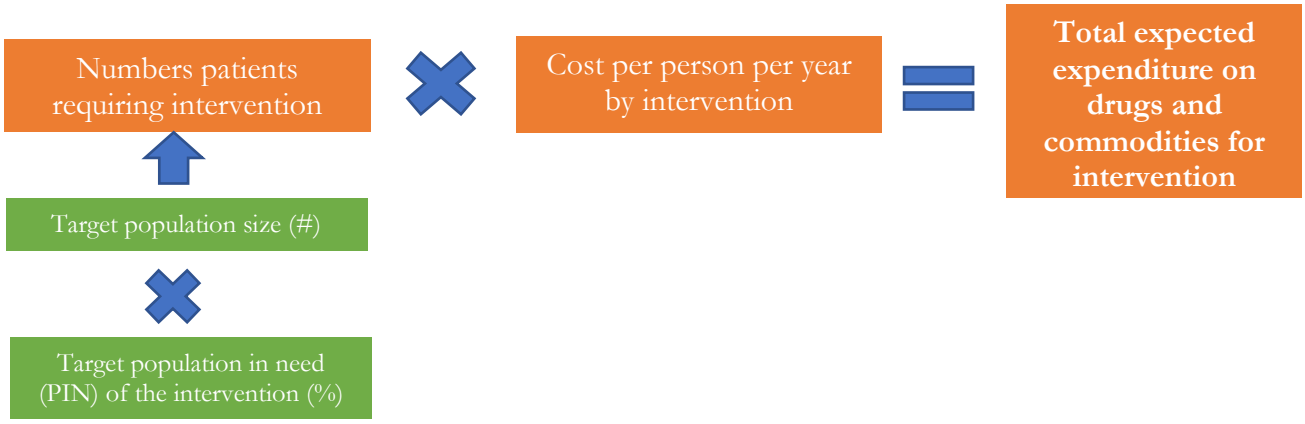
While using the standardised mortality rate improves on the per capita formula by capturing district variations in mortality, separate from their demographic structure, there remain a number of issues. As previously outlined, the formula should reflect the expected cost of delivering a standard package of services local agencies are expected to provide. Therefore, while the above formula based on standardised mortality rates may bring the district allocation closer in line with districts relative health care need than a per capita allocation, it does not account for the services districts are expected to provide.

iii) EHP intervention need (full coverage)

As previously stated, in Malawi, the EHP outlines the services expected to be provided free at the point of access, and therefore any allocation of resources should be associated with the expected costs of providing these services.

In this scenario, calculation of district capitation payments was based on the expected EHP expenditure each district faced in a given fiscal year. Districts expected expenditure on each EHP intervention is a factor of two variables; the number of patients requiring treatment with the intervention and the unit cost of providing the intervention. The number of patients requiring treatment with the intervention is itself a function of the population size of those targeted to receive the intervention within the district and the percentage of the target population in need of the intervention. For instance, the target population for management of eclampsia is pregnant women, of which 1.80% are expected to require the procedure. The district expected expenditure on this intervention is then 1.80% of the pregnant women living within the district boundaries multiplied by the unit cost of providing the intervention. In order to undertake the calculations EHP interventions were grouped according to their thematic areas as outlined in the Health Sector Strategic Plan II (2017-2022). The total expected expenditure for each thematic grouping was totalled by district. The total district expected EHP expenditure is then the aggregation of the expected expenditure by each thematic group.

Methodology for calculating expected intervention expenditure (full coverage)



In order to scale the expected EHP expenditures down to the size of the budget available for allocation, each district's proportion of the national expected EHP expenditure was calculated, with districts assigned the corresponding proportion of the total budget available.

Intervention unit costs were based on pre-existing data outlining the drug and supplies cost of EHP interventions. Unit costs were calculated by multiplying the unit cost of drugs and commodities required for each intervention by the units required per person per year and the proportion of patients who receive each commodity, giving a cost per person per year.

Target populations for interventions were guided by target populations specified in the Health Sector Strategic Plan II (HSSPII) (2017-2022) for each EHP intervention. However, calculation of district specific target populations was required. Further, on a number of occasions the HSSPII indicated target population was deemed excessively vague and more specific target populations were calculated.

Target populations were calculated in a variety of ways based on data availability. Many target populations referred simply to specific age groups, for example, children aged under 5. For such cases, districts corresponding age cluster was extracted from the Population and Housing Census (2008) using the 2018 district population projections. For some interventions more specific target populations were outlined requiring particular calculations and assumptions. Table 2 outlines how each target population used was calculated[8].

A number of general assumptions were required in the calculation of the expected intervention expenditure by district. First, it is assumed that all individuals within a district who require an intervention receive it. Second, the population in need (PIN) for each intervention is constant across districts. Third, there is no variation in the cost of delivering a specific intervention i.e. the cost of treating each individual with a given intervention is constant or the cost reflects a representative average cost of treatment for the intervention.

[8] It should be noted that some alternative calculations of target populations using different methodologies are presented in the spreadsheets in order to show how different methodologies and data given different figures. It is the choice of the stakeholders which data and methodology they deem most reliable.

Table 2: Selected target population calculations

Target population	Data source & calculation	Assumptions
Pregnant women	Data: - Females 15-49 years (Population & Housing Census, 2008) - % women aged 15-49 pregnant (Demographic & Household Survey, 2015/16) Calculation: $\text{Females } 15-49 \text{ years} \times \left(\frac{\%\text{ women aged } 15-49 \text{ currently pregnant}}{100}\right)$	- No women outside the age range 15-49 are pregnant or the proportion of women pregnant outside this age range is proportional across districts. - Data was not available on the percentage of women pregnant in Blantyre, Lilongwe, Mzuzu and Zomba city. The percentage from their corresponding district was used.
Births	Data: - Live births (2016) (District Health Information System 2) Calculation: N/A	
Population >15 years who suffered fever or malaria in past 2 weeks	Data: - Proportion who suffered incidence of sickness in past 2 weeks (Integrated Household Survey 4, 2016/17) - Of those who suffered sickness proportion who suffered malaria or fever (Integrated Household Survey 4, 2016/17) - Population >15 (Population & Housing Census, 2008) Calculation: $\left(\frac{\%\text{ suffering sickness}}{100}\right) \times \left(\frac{\text{Of those }\%\text{ suffering malaria or fever}}{100}\right) \times \text{population} > 15 \text{ years}$	- Assumption that the 2 week period in which the survey was taken does not suffer any systematic differences with the rest of the year which effect the geographical distribution of malaria.
Population 0-4 years who suffered fever or malaria in past 2 weeks	Data: - Proportion who suffered incidence of sickness in past 2 weeks (Integrated Household Survey 4, 2016/17) - Of those who suffered sickness proportion who suffered malaria or fever (Integrated Household Survey 4, 2016/17) - Population 0-4 years (Population & Housing Census, 2008)	- Assumption that the 2 week period in which the survey was taken does not suffer any systematic differences with the rest of the year which effect the geographical distribution of malaria.

	Calculation: $\left(\frac{\%\text{ suffering sickness}}{100}\right) \times \left(\frac{\text{Of those \% suffering malaria or fever}}{100}\right) \times \text{population } 0-4 \text{ years}$	
Number of children <5 years -3 standard deviations below weight-for-age	Data: - Children < 5 years (Population & Housing Census, 2008) - Proportion of children <5 years -3 standard deviations below weight-for-age (Demographic & Household Survey, 2015/16) Calculation: $\text{Children} < 5 \text{ years} \times \left(\frac{\%\text{ children} < 5-3 \text{ SD below weight}-\text{for}-\text{age}}{100}\right)$	- This target population is applied to the nutrition intervention 'management of severe malnutrition'. In the EHP tool this intervention had a target population children 1-59 months with a population in need of 1.15%. As the average proportion of children <5 -3 SD below weight-for-age across all districts is 2.5% this was deemed a usable replacement for the target population with a new assumed 100% population in need. The intention is this would capture more of the district variation in expected expenditure for this intervention.
Number of children <5 years not fed minimum dietary diversity	Data: - Children < 5 years (Population & Housing Census, 2008) - Proportion of children aged 6-23 months fed minimum dietary diversity (Demographic & Household Survey, 2015/16) Calculation: $\text{Children} < 5 \text{ years} \times \left(\frac{\%\text{ children aged } 6-23 \text{ months fed minimum dietary diversity}}{100}\right)$	- Assumes the proportion of children fed minimum dietary diversity is constant for those aged 6-23 months and those aged <5 years, or at least the relative proportions across districts are constant.
HIV+ population	Data: - Population 15-49 years (Population & Housing Census, 2008) - HIV prevalence among population 15-49 years (Demographic & Household Survey, 2015/16) Calculation: $\text{Population } 15-49 \text{ years} \times \left(\frac{\text{HIV prevelance (\%) among } 15-49 \text{ years}}{100}\right)$	

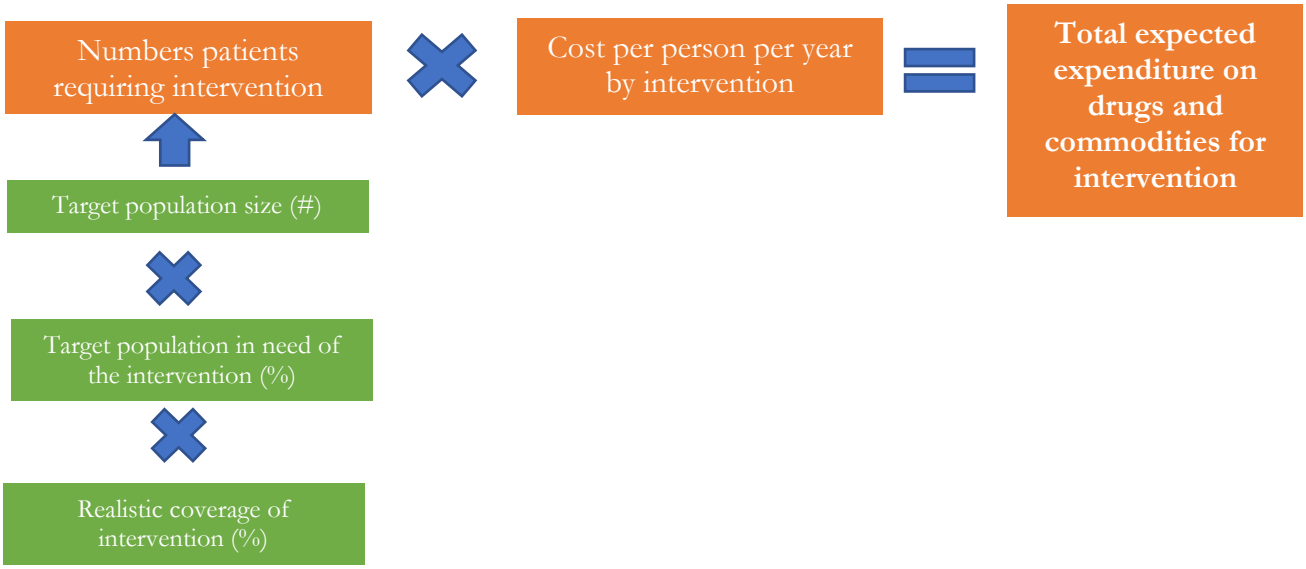
Pregnant women with HIV/AIDS	Data: - Females 15-49 years (Population & Housing Census, 2008) - % women aged 15-49 pregnant (Demographic & Household Survey, 2015/16) - HIV prevalence among population 15-49 years (Demographic & Household Survey, 2015/16) Calculation: $$\left(\text{Females } 15-49 \text{ years} \times \left(\frac{\%\text{ women aged } 15-49 \text{ currently pregnant}}{100}\right)\right) \times \times \text{ HIV prevelance } (\%) \text{ among } 15-49 \text{ years}$$	
Population with mental illness	Data: - Proportion of population chronically illness (Integrated Household Survey, 2016/17) - Of those chronically ill, proportion with mental illness (Integrated Household Survey, 2016/17) - Population (Population & Housing Census, 2008) Calculation: $$\left(\frac{\%\text{ suffering chronic illness}}{100}\right) \times \left(\frac{\text{Of those, }\%\text{ suffering mental illness}}{100}\right) \times \text{population}$$	- As this target population is applied to treatment of depression there is an assumption that depression is distributed across districts in proportion to all mental illness.
Population with epilepsy	Data: - Proportion of population chronically illness (Integrated Household Survey, 2016/17) - Of those chronically ill, proportion with epilepsy (Integrated Household Survey, 2016/17) - Population (Population & Housing Census, 2008) Calculation: $$\left(\frac{\%\text{ suffering chronic illness}}{100}\right) \times \left(\frac{\text{Of those, }\%\text{ suffering epilpsy}}{100}\right) \times \text{population}$$	

iv) EHP intervention need (realistic coverage)

The final scenario builds on the previous scenario by removing the assumption that all patients requiring an intervention are treated. Instead, an estimate of the national average attainable coverage level for each intervention is applied for all districts. The attainable coverage level is the proportion of individuals in need of the intervention who could receive it on the basis of current constraints in the national health care system. These may operate both on the supply side, in terms of the health system's capacity to deliver an intervention, and on the demand side, through the limited update by those with capacity to benefit from an intervention.

We drew upon estimates of attainable coverage levels used in the development of the Malawian Essential Health Package[9]. These were mainly estimated by disease and were only available at the national level. This replaces the assumption of full coverage with an assumption that attainable coverage for each intervention is constant across all districts, but varies by intervention type. It leads to changes in percentage allocations to districts because the epidemiology of diseases (e.g. prevalence, incidence) differs across districts. This approach aims to adjust allocations based upon the potential for resources to be productively used in the direct delivery of interventions, some of which can be delivered at greater levels of coverage than others.

Methodology for calculating expected intervention expenditure (realistic coverage)



This approach could be further developed by using a variable reflecting variations in attainable intervention coverage by district. The Integrated Household Survey 2016/17, for instance, includes a variable of self-reported difficulty in accessing care due to distance from a facility by district. This would allow for greater variations in coverage across districts, but would assume constant coverage across interventions. However, although such an approach could be useful in that resources would less likely be committed to districts that may struggle to utilize them, it would penalize districts with more limited current health system capacity. Whereas this may partly be justified because increasing attainable coverage through infrastructural expansion (e.g. construction of new clinics) is unlikely to be feasible in the short term, in reality district management teams have a limited range of options to support intervention outreach efforts.

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

Assumptions and Limitations

There are a number of general assumptions and shortcomings in all the resource allocation formulae presented which warrant discussion. All of the scenarios assume that district populations are geographically captive populations who both live and seek health care within a single district. This may not be the reality faced by many districts where populations migrate across district borders in order to seek care. This is particularly true for urban districts which include referral hospitals. However, without reliable data on cross-border flows for health care seeking, it is not possible to currently incorporate this phenomenon into any resource allocation formula. As previously noted, the population in need for interventions is assumed to be constant in each district, as there is no source of data which provides an indication of variations in of the population in need between districts. One solution to this has been to attempt to define as specifically as possible the target population for each intervention for each district. Doing so reduces the influence that the population in need has on the final calculation of patients requiring provision of an intervention. However, this has not been possible in all cases, and a number of interventions remain 'targeted' at an estimated proportion of the whole population.

Population projections are available for Mzuzu, Lilongwe, Blantyre and Zomba city. However, much of the epidemiological data such as HIV prevalence rates only exist at the district level. As such, separate estimates of expected EHP expenditure have been calculated for these cities under the assumption that such rates are constant across the rural and urban parts of their district. For instance, if the HIV prevalence rate is outlined as 7.2% in Lilongwe, it is assumed this is constant for Lilongwe rural and city. This strong assumption can be questioned, but without further data on variations in prevalence is unavoidable.

None of the formulae account for variations in non-government provision of health care across districts or district access to funds from non-governmental sources or own revenue generation capabilities. CHAM and private facilities may not be uniformly distributed across the country and therefore certain districts may benefit from greater proportions of their target population being treated by non-government providers.

Finally, a large proportion of the health sector's resources are provided by external donors. How much influence the Ministry of Health has on the allocation of these resources is open to debate. A recent resource mapping exercise estimates donor contributions to drug and commodities costs as exceeding 90% (RMNCH, Malaria, Nutrition) for some disease programmes. The above scenarios make assumptions around the flexibility of the aggregate drug and ORT budgets. In reality, some proportion of these budgets may not be available for 'reallocation' to different districts or programmes from the current situation. Scenarios acknowledging the possible constraints in resource flexibility and subsequent allocation implications could be explored as part of any further work on resource allocation in Malawi.

5. Results

We must underline that the primary output of this project is the spreadsheet containing the data and calculations made in deriving a set of district allocations using a particular set of assumptions. We see the spreadsheet as a tool with which Malawi policy makers can test alternative models and assumptions in moving towards a preferred funding formula. The results obtained using the assumptions set out in section 4 are merely illustrative, and could be used as a baseline against which alternative formulations can be tested. In this section we set out the results obtained, but must emphasize that we are in no way recommending that these should be adopted as future allocations. Instead we hope that the spreadsheet can be used as a tool to refine, challenge and augment the methods recommended in this report.

The methods used have wherever possible applied the principles used for costing the EHP at the national level. As discussed in section 4, these entail, for each intervention in the package, identifying a target population, and multiplying by the probability of requiring the treatment and the unit cost. The 'full coverage' variant of the model assumes 100% utilization by all people who need the treatment. The 'realistic coverage' variant makes a further adjustment for the reduced probability of a person in need of the treatment actually securing access, in line with the current national coverage levels for each specific intervention.

Note that the aggregate budget requirements for both the 'full coverage' and 'realistic coverage' scenarios appear to be greatly in excess of the national budget currently available. This implies that the chosen EHP may not be currently fully funded, although the multiple funding sources available in Malawi make this difficult to verify. Consequently all capitation payments will be less than expected expenditure for all individuals. However, throughout the spreadsheet and this report, we report the *share of the national budget* allocated to each district under the different scenarios, and not the district's absolute budget. Therefore we implicitly assume that, in the event of a national budget shortfall, each district receives an equal proportionate reduction in the allocation implied by the funding formula. The intention of the risk adjusted capitations under these circumstances is that they reflect the relative health care expenditure needs of individuals and districts. There are other methods of sharing the burden of keeping within the available budget, which could be applied within the model. However, we do not explore them further in this report.

In order to facilitate discussion of the principles underlying the methods, this report does not identify the districts by name. Access to the spreadsheet will allow scrutiny of the impact on individual districts, but in this brief results summary, we have chosen to focus on the broad impact of the models on budgetary allocations. Note that we identify spending need for EHP services from whatever source of funding is actually used, whether government funds, donor funds, or other sources.

Figure 3 summarizes the per capita estimates of spending need for EHP services relative to the national average (which is 1.0). It varies from about one third of the national average in one district, to about 5.6 times the national average in another. This outlier result appears to arise from very high prevalence of HIV/AIDS in the affected district. Most districts lie within the range of from half to twice the national average.

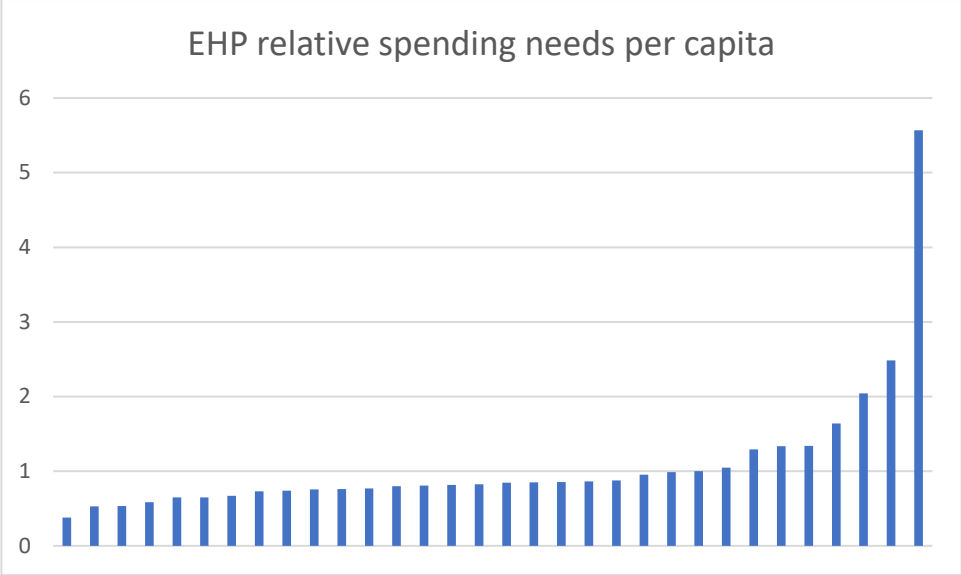


Figure 3: District spending need for EHP services relative to the national average

Figure 4 indicates the percentage change from current allocations implied by the full EHP need funding formula amongst the districts. It implies some very large reductions (over 50%) in four districts, and more than doubling of allocations to two districts. These are of course very large swings that could not be contemplated in a single budgetary round, but they do indicate the highest priority districts for future budgetary increases. The issue of the 'pace of change' of implementing any new formula is discussed further in the concluding section below.

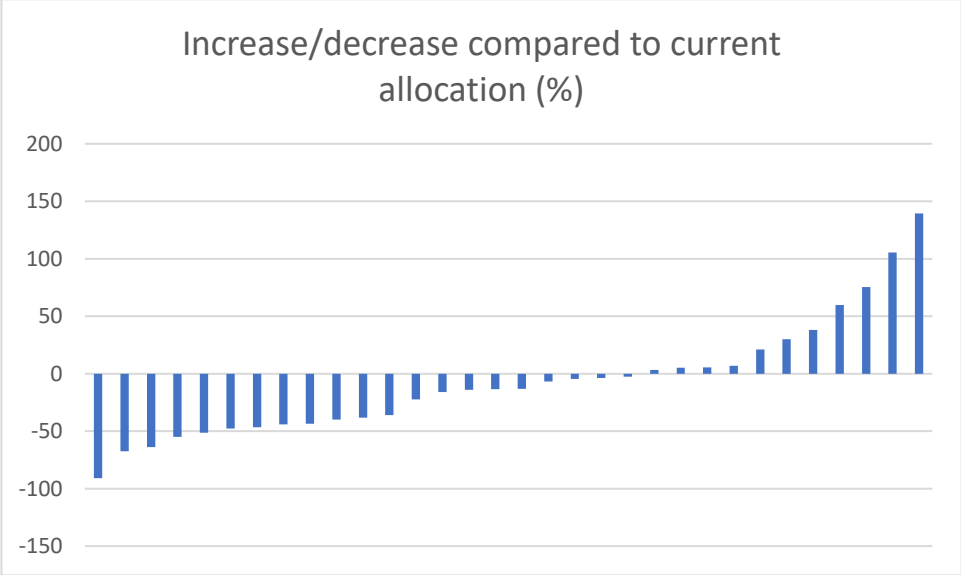


Figure 4: Shift in budgetary share implied by use of the EHP formula (% change)

Figure 5 shows the percentage changes to district allocations that occur when moving from the full coverage model to the more 'realistic' assumptions about specific intervention coverage. The changes range from a decrease of 16% to an increase of 18%, reflecting the budgetary shifts that would occur if a decision were made to incorporate 'ease of delivery or access' into the allocation. We are not necessarily recommending this as an option, but include it to demonstrate the implications of making such a change to the modelling assumptions.

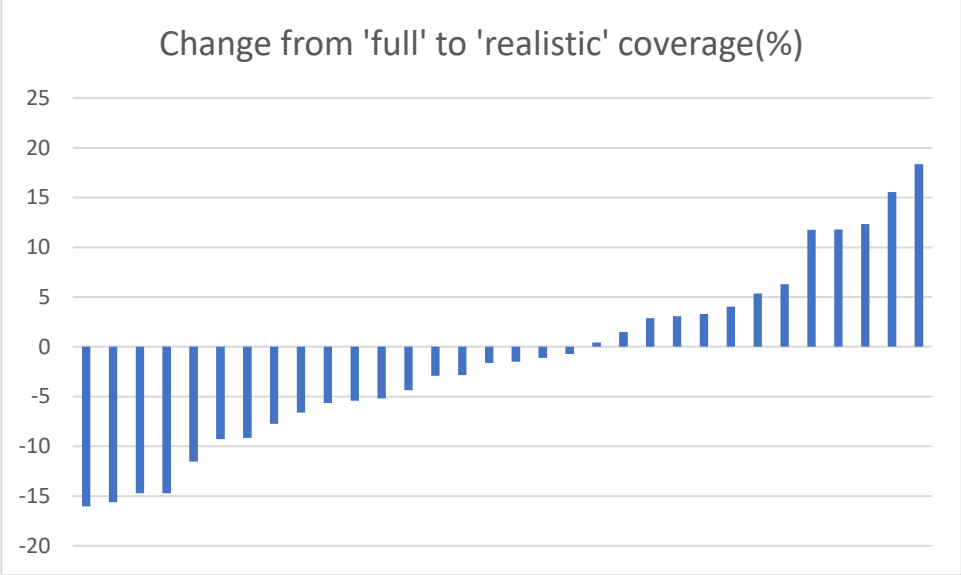


Figure 5: Shift in budgetary share between 'full' EHP need formula and 'realistic' EHP need formula

6. Discussion

This report has introduced a spreadsheet tool designed to inform the allocation of health care funding to district councils in Malawi. The methods seek to allocate funds between districts so as to provide the opportunity of securing equal access to services for equal need for the interventions contained in Malawi's EHP. The funding relates to the available budgets for drugs and ORT, and therefore excludes costs relating to personnel, infrastructure or medical equipment. The methods provide estimates of the spending needs within these budget categories without explicit consideration of the sources of funding (government, donors, NGO, patients etc), so when applying the model specifically to assess government spending need, receipts from other sources may need to be deducted.

The methods used conform to widely accepted approaches to capitation funding of health services. The underlying assumption is that districts should be given the opportunity to deliver a standard level of health services, given the expected level of health care need in their populations. In making this concept operational, and in contrast to many health systems, Malawi has the advantage of an explicit, costed health benefits package (the EHP), which can act as the fundamental basis for informing resource allocation to districts.

Nevertheless, as with all funding formula initiatives, the methods adopted were to some extent constrained by the nature and availability of relevant data. In this respect, Malawi is particularly strong, enabling us to prepare many detailed estimates at the district level of disease prevalence and associated indicators of needs and access. Nevertheless, some of the data items rely on self-reporting or administrative utilization data, which may be misleading. Many systems of formula funding implicitly rely instead on estimates of disease prevalence and incidence arising from national statistical models. Although modelled estimates of disease prevalence are less direct than reported levels, they are prepared on a consistent basis, and may remove some of the biases that can arise in reported data. Future implementation of the tool may therefore consider use of modelled rather than reported prevalence for some diseases.

The methods were able to take advantage of existing estimates of the unit costs of treatment that fall on the drugs budget. There was therefore no need to resort to econometric estimates of expected costs, the approach adopted in many countries without an explicit health benefits package. Whilst this was a major benefit of the Malawi administrative arrangements, it may nevertheless be the case that there do exist some legitimate variations in the unit costs of delivering services across the country. Although such variations are likely to be most pronounced for personnel costs, which are not considered in the current formula, future work might explore the relevance to the budgets covered by the drugs and ORT formula.

Note that the allocations do not necessarily ensure that the EHP can be delivered in each district. Securing that objective would require that access to services and managerial efficiency were equalized across the country, which is unlikely to be feasible at least in the short run.

Furthermore, estimates of spending need are first calculated without reference to the actual national resources available. Our baseline scenario assumes 100% coverage of all items in the EHP, which is clearly infeasible both financially and practically. As a consequence, results are presented as each district's *share* of the national budget, whatever that budget may be. As noted in section 5, this implicitly assumes that, in the event of a national budget shortfall, each district receives an equal proportionate reduction in the allocation implied by the funding formula. That is, the approach assumes that the reductions in coverage required due to the funding shortfall are (in a financial sense) shared equally across the districts. There are other valid methods of sharing the burden of keeping within the available budget, which could be applied within the model. For example, there

could be a requirement that some priority treatments are funded assuming 100% coverage, requiring larger proportionate reductions in other service funding. Such an approach would require a 'within EHP prioritisation' process, a potentially extensive and controversial task itself. None of the scenarios outlined in this report have inferred any sort of prioritisation among EHP interventions.

Alternatively, funding from other (non-government) sources could be deducted before rescaling district allocations to conform to the national budget. This becomes particularly important when external contributions are unevenly distributed across districts and EHP interventions, as is typically been the case in Malawi. Another potential exclusion from EHP cost estimation is central government funding for specific programs. In the context of Malawi, this would include commodity costs for family planning and immunization programs, which are financed centrally. However, we have not explored such alternatives in this report. Regardless of method chosen, the work further highlights that the aggregate magnitude of district budgets is below that required to deliver the services with which they are charged. This may facilitate conversations around reallocations from expenditures at the central level of the health care system, in development partner allocations or even from outside the health sector.

The tool does not currently consider cross-border flows of patients between districts (or indeed from or to other countries). As noted in section 3, if the costs of services for some patients in one district are borne by services funded by another district, there is no conceptual difficulty in handling such cross-border flows within a funding formula. It necessitates an adjustment to allocations by transferring funds from one district to another to reflect the net flows of patients and the services they use. The main difficulty, therefore, is obtaining accurate estimates of net patient flows and cross-border patterns of health care utilisation. Indeed the parameters used in the funding formula can be used as the basis for such transfers. However, the adjustment for cross-border flows can be applied after calculation of the main funding formula model, and does not necessitate any changes to the formula methodology.

As noted above, the budgets covered by the formula do not include personnel costs. This may have consequences for the drugs and ORT formula if, for example, a shortage of personnel in a district inhibit improvements in coverage of some treatments in the EHP. Ideally, and over time, we would recommend that personnel costs are included in the formula (even if they continue to be paid by the national government) as this will help to align the separate revenue streams.

Further, as mentioned, the estimation of costs should ideally reflect any cost sharing arrangement. Section 3, the elements of capitation funding, can provide insights into where further amendments to the capitation formula may be considered. One avenue which may be pursued, for which data might be available, is the inclusion of cost sharing with CHAM. It is known that government only pays 70% of the pre-agreed cost of CHAM services under the newest memorandum of understanding (MOU). A starting point for inclusion in the formula would be to examine the variations in the proportion of CHAM facilities with active service level agreements in each district compared to public facilities. If an estimate can be made of the proportion of total services in each district are delivered by these facilities, a cost adjustment can be made to closer match the required public health sector expenditure requirements. Similarly, although the model assumes that local governments are fully responsible for the purchase of primary and secondary health services, central (tertiary) hospitals often provide these services as well. Deducting central hospital contributions from the formula could, however, be problematic as it would legitimize the provision of non-tertiary care at these centres, which takes away from capacity for the delivery of tertiary care in the country.

The scenarios presented in the current version of the spreadsheet tool imply some major changes in budgetary allocations for some districts. It is likely that immediate implementation of changes of

such magnitude would be both managerially and politically infeasible. Therefore any implementation of a new funding formula will probably require separate development of a 'pace of change' policy, which limits the year-on-year losses and gains to the budgets of individual districts. The specification of such a policy is more of a political rather than a technical undertaking, but would best be developed through a dialogue between political and technical advisors. The policy might place percentage limits on budget losses and gains in any one year, but could include more contentious considerations, such as a district's previous performance levels. At the very least, the funding formula can indicate to which districts any new money might be best directed to promote system objectives.

This work on the resource allocation formula to district councils touches on a number of areas that, while not strictly relevant, are worth mentioning. This work has been explicit in the fact that the formulae outlined relate only to the allocation of resources to district councils. Once at district level, there is a high degree of local autonomy as to how those resources are spent. This local autonomy is often seen as valuable, allowing districts – with greater local information – to react to local circumstances. Further, as mentioned, following strict allocation rules at a smaller geographical level increases the likelihood of unpredictable variation requiring mechanisms to absorb unanticipated departures from the capitation.

Finally, we must emphatically reiterate that the results arising from the application of the spreadsheet are not presented as our 'recommendations'. Rather the tool and its results are presented as a starting point for policy makers in Malawi to refine, validate and challenge the underlying methods, assumptions and data. It is likely that an extensive dialogue between policy makers at national and local level will be needed before agreement can be reached on the most suitable way of calculating district budgetary allocations. However, we do believe that the tool presented here can serve as a useful mechanism for informing that dialogue.

Appendix

The definition of a standard health benefits package, delivered free at the point of access, was first developed in 2004 in the Programme of Work (2004-2010). The package was revised in 2010 and delivered under the Health Sector Strategic Plan (2010-2016) with the current EHP being defined in 2017 for delivery under the Health Sector Strategic Plan II (2017-2022).

The objective of the EHP is stated as 'to ensure timely universal free access to a quality Essential Health Package, irrespective of ability-to-pay, to all the people in Malawi'. (HSSP II, 2017-2022). The HSSPII explicitly acknowledges that the cost of fully providing the EHP exceeds the resources available for its provision. A number of related issues are outlined which could impact EHP provision including; lack of awareness of the EHP among stakeholders, lack of EHP policy enforcement, inequalities in utilisation and not linking health system inputs to the EHP.

Table 3 below outlines the interventions included in the EHP and the level at which they are provided.

Table 3: Malawi's EHP as defined in the HSSP II

Category	Intervention Package	Intervention	Level of Care
RMNCH	ANC Package	Tetanus toxoid (pregnant women)	Community/ Primary/ Secondary
		Deworming (pregnant women)	Community/ Primary/ Secondary
		Daily iron and folic acid supplementation (pregnant women)	Community/ Primary/ Secondary
		Syphilis detection and treatment (pregnant women)	Community/ Primary/ Secondary
		IPT (pregnant women)	Community/ Primary/ Secondary
		ITN distribution to pregnant women	Community/ Primary/ Secondary
		Urinalysis (4 per pregnant woman)	Primary/ Secondary
	Modern Family Planning	Injectable	Community/ Primary/ Secondary
		IUD	Primary/ Secondary
		Implant	Primary/ Secondary
		Pill	Community/ Primary/ Secondary
		Female sterilization	Secondary
		Male condom	Community/ Primary/ Secondary

	Delivery Package	Clean practices and immediate essential new-born care (in facility)	Primary/ Secondary
		Active management of the 3rd stage of labour	Primary/ Secondary
		Management of eclampsia/pre-eclampsia (Magnesium sulphate, Methyldopa, Nifedipine, Hydralazine)	Primary/ Secondary
		Neonatal resuscitation (institutional)	Primary/ Secondary
		Caesarean section with indication	Secondary
		Caesarean section with indication (with complication)	Secondary
		Vaginal delivery, skilled attendance (including complications)	Primary/ Secondary
		Management of obstructed labour	Primary/ Secondary
		Newborn sepsis - full supportive care	Primary/ Secondary
		Newborn sepsis – injectable antibiotics	Primary/ Secondary
		Antenatal corticosteroids for preterm labour	Primary/ Secondary
		Maternal sepsis case management	Primary/ Secondary
		Cord Care Using Chlorhexidine	Primary/ Secondary
		Hysterectomy	Primary/ Secondary
		Post-abortion case management	Secondary
		Treatment of antepartum haemorrhage	Primary/ Secondary
		Treatment of postpartum haemorrhage	Secondary
		Antibiotics for pPRoM	Primary/ Secondary
Vaccine Preventable diseases	Essential Vaccines Package	Rotavirus vaccine	Community/ Primary/ Secondary
		Measles Rubella vaccine	Community/ Primary/ Secondary
		Pneumococcal vaccine	Community/ Primary/ Secondary
		BCG vaccine	Community/ Primary/ Secondary
		Polio vaccine	Community/ Primary/ Secondary
		DPT-Heb-Hib / Pentavalent vaccine	Community/ Primary/ Secondary
		HPV vaccine	Community/ Primary/ Secondary

Malaria	First Line uncomplicated Malaria treatment	Uncomplicated (adult, <36 kg)	Community/ Primary/ Secondary
		Uncomplicated (adult, >36 kg)	Community/ Primary/ Secondary
		Uncomplicated (children, <15 kg)	Community/ Primary/ Secondary
		Uncomplicated (children, >15 kg)	Community/ Primary/ Secondary
	Complicated Malaria treatment	Complicated (adults, injectable artesunate)	Primary/ Secondary
		Complicated (children, injectable artesunate)	Primary/ Secondary
	Malaria Diagnosis	RDTs	Community/ Primary/ Secondary
		Microscopy for Malaria	Primary/ Secondary
Integrated management of childhood illnesses (IMCI)	ARIs	Pneumonia treatment (children)	Community/ Primary/ Secondary
		Treatment of severe pneumonia (Oxygen)	Primary/ Secondary
	Diarrhoeal Disease	ORS	Community/ Primary/ Secondary
		Zinc	Community/ Primary/ Secondary
		Treatment of severe diarrhoea (IV Fluids)	Primary/ Secondary
	Nutrition	Community management of nutrition in under-5 - Plumpy Peanut	Community/ Primary
		Community management of nutrition in under-5 - micronutrient powder	Community/ Primary
		Community management of nutrition in under-5 - vitamin A	Community/ Primary
	Malaria Diagnosis	RDTs for under-5	Community/ Primary
Community Health	Community Health Package	Growth Monitoring	Community/ Primary
		Vermin and Vector Control & Promotion	Community/ Primary
		Disease Surveillance	Community/ Primary
		Community Health Promotion & Engagement	Community/ Primary
		Village Inspections	Community/ Primary
		Promotion of hygiene (hand washing with soap)	Community/ Primary

		Promotion of Sanitation (latrine refuse, drop hole covers, solid waste disposal, hygienic disposal of children's stools)	Community/ Primary
		Occupational Health Promotion	Community/ Primary
		Household water quality testing and treatment	Community/ Primary
		Home-based care of chronically ill patients	Community/ Primary
		Child Protection	Community/ Primary
NTDs	Treatment and MDA	Schistosomiasis mass drug administration	Community/ Primary
		Case finding and treatment of Trypanosomiasis	Primary
		Trachoma mass drug administration	Community/ Primary
HIV/AIDS	HIV Prevention	Cotrimoxazole for children	Community/ Primary/ Secondary
		PMTCT	Community/ Primary/ Secondary
	HIV Testing	HIV Testing Services (HTS)	Community/ Primary/ Secondary
	HIV Treatment	HIV Treatment for all ages – ART & Viral Load	Community/ Primary/ Secondary
Nutrition		Vitamin A supplementation in pregnant women	Community/ Primary/ Secondary
		Management of severe malnutrition (children)	Community/ Primary/ Secondary
		Deworming (children)	Community/ Primary/ Secondary
		Vitamin A supplementation in infants and children 6-59 months	Community/ Primary/ Secondary
TB		Isonized Preventive Therapy for children in contact with TB patients	Primary/ Secondary
		First line treatment for new TB Cases for adults	Primary/ Secondary
		First line treatment for retreatment TB Cases for adults	Primary/ Secondary
		First line treatment for new TB Cases for children	Community/ Primary/ Secondary
		First line treatment for retreatment TB Cases for children	Community/ Primary/ Secondary
		Case management of MDR cases	Primary/ Secondary
	TB Testing	LED test	Primary/ Secondary

		Xpert test	Primary/ Secondary
		MGIT test	Primary/ Secondary
		LJ test	Primary/ Secondary
		Treatment of Injuries	Primary/ Secondary
	Mental Health treatment	Basic psychosocial support, advice, and follow-up	Community/ Primary/ Secondary
		Anti-epileptic medication	Community/ Primary/ Secondary
NCDs		Treatment of depression (first line)	Community/ Primary/ Secondary
		Testing of pre-cancerous cells (vinegar)	Primary/ Secondary
	Diabetes treatment	Diabetes Type I	Primary/ Secondary
		Diabetes Type II	Primary/ Secondary
		Hypertension	Primary/ Secondary
Oral Health	Tooth pain treatment	Management of severe tooth pain, tooth extraction	Primary/ Secondary
		Management of mild tooth pain, tooth filling	Primary/ Secondary

Data on patient populations comes from a mid-term re-costing of the Health Sector Strategic Plan (2011-2016) undertaken by Clinton Health Access Initiative (CHAI) in 2014. For each intervention the target population (e.g. pregnant women, women in need of PMTCT, etc.) was identified. The cost of each intervention was calculated using a bottom-up ingredients based approach but only reflects drug and supply inputs rather than a cost per patient treated.