Samoa National NCD Cost Analysis Study

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This study was a joint effort of the Institute for Health Policy (IHP) in Sri Lanka and the Centre for Health Information, Policy and Systems Research (CHIPSR), Fiji National University in Fiji. The IHP team, consisting of Prasadini Perera, Sarasi Amarasinghe, Nishika Ranathunga, Nadeesha Thewarapperuma, Iresha Jayathunga and Nilmini Wijemanne, was led by Ravi Rannan-Eliya. The CHIPSR team was led by Wayne Irava, and also included Ronesh Prasad. Ravi Rannan-Eliya provided overall project direction for the study, and Rehana Thowfeek (IHP) rendered valuable support during the report writing stage.

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Figures

Tables

Abbreviations

APNHAN	Asia-Pacific NHA Network
CHIPSR	Centre for Health Information Policy and Systems Research
COPD	Chronic obstructive pulmonary disease
CVD	Cardiovascular disease
DDD	Defined daily dose
DSA	Disease-specific accounts
GBD	Global burden of disease
GHE	Global health estimates
GOPD	General outpatient department
GoS	Government of Samoa
HAPT	Health Accounts Production Tool
ICD	International Classification of Disease
IHD	Ischaemic heart disease
IHME	Institute for Health Metrics and Evaluation
IHP	Institute for Health Policy
IRP	International reference price
LOS	Length of stay
MOF	Ministry of Finance
MOH	Ministry of Health
MPR	Median price ratio
MSH	Management Sciences for Health
NCD	Non-communicable diseases
NHA	National health accounts
NHN	National health number
NHS	National Health Services

NKFS	National Kidney Foundation of Samoa
OTS	Overseas Medical Treatment Scheme
PATIS	Patient Information System
PIC	Pacific Island Country
SHA	System of Health Accounts
SOPD	Specialist outpatient department
TTMH	Tupua Tamasese Meaole Hospital
USD	U.S. Dollars
WB	World Bank
WDI	World Development Indicators
WHO	World Health Organization

Executive Summary

At the request of Samoa's Ministries of Health and Finance, and the World Bank, we examined the costs of non-communicable diseases (NCDs) in Samoa's health services. Samoa faces both a heavy burden of NCDs, of which diabetes is exceptionally high in prevalence, as well as a future trend of increasing cost pressures from these conditions. Policy makers are naturally concerned about the future burden these conditions will place on resources and the health services in general, and how Samoa can best use available resources to expand health services and improve health sector outcomes.

The scope of the study was modified twice to take into account (a) a request by the MOH to look at the impact of the policy on free medicines for NCD patients (March 2015), and (b) reduction in scope in October 2016 as the STEPS raw data was unavailable following protracted negotiations. Therefore, the analysis in this report does not include detailed modelling of the potential evolution of NCD costs in Samoa with future epidemiological trends, or of the potential impact on costs and mortality if NCD treatment protocols are optimized.

Building on the most recent national health accounts (NHA) study commissioned by the Ministry of Health (MOH), we were successful in using the data available in Samoa to estimate in some detail how current spending was allocated to different diseases and also across different demographic groups. Whilst our analysis could not examine spending in rural and community health services, the spending we did look at accounts for three quarters of the relevant spending by MOH.

Our study confirms that priority NCDs account for a large part of overall healthcare spending in Samoa, and essentially accounts for almost all spending in adult men and women, other than maternal care in women. The most costly is cardiovascular disease (12%), followed by diabetes (6%), and cancers (4%). Renal failure accounts for 0.5% of spending, but it is itself a consequence in many cases of advanced cardiovascular disease (CVD) or diabetes. These conditions alone account for 41% of total NCD spending, and 23% of all spending that could be linked to a disease. Spending also increases with age. Per capita spending in those aged 65 years and older was two to three times that in those aged 30–50 years.

This overall spending pattern resembles the burden of disease, but spending on CVD, diabetes, asthma and chronic obstructive pulmonary disease (COPD) in particular is proportionately less than the disease burden estimates. By itself, this does not suggest that spending is inadequate, but our other analyses provide strong evidence that Samoa may be under-investing in several key NCD interventions that are known to be cost-effective. In particular, we find that despite the existing burden of NCDs, the use of key cost-effective NCD medicines is exceptionally low in Samoa. For the medicines we examined, utilization was often half or one third of levels in other middle-income nations, and a tenth or less of levels in Australia. These findings indicate that Samoa could prevent over 400 deaths from CVD and diabetes in the next decade by scaling-up utilization of essential NCD medicines. In addition, whilst diabetes is often the focus of concern in Samoa, the heavy cost burden from CVD, which itself is closely linked with diabetes and impaired glucose tolerance, should be given more attention. Samoa may need to shift more attention to CVD (and also asthma) than it gives currently.

Whilst this analysis suggests the need for increases in overall health budgets, our findings also point to the need to look for potential savings from efficiency gains and from adopting more effective interventions. We find that the National Health Services (NHS) typically purchases medicines at two to four times the prices that the World Health Organization (WHO) recommends countries should achieve. Taken together, these results indicate that MOH needs to both increase its purchase and use of essential NCD medicines and substantially reduce the prices it pays for medicines. In combination, this might enable Samoa to do much better in managing the NCD burden and reducing future morbidity, whilst not substantially increasing the demand on the treasury. We also suggest that there may be potential benefits in reallocating some resources from the OTS to the purchase of essential NCD medicines, although we recognize that Samoan policy-makers are in the best position to make the necessary trade-offs.

Finally, we would recommend that Samoa makes better use of its STEPS survey data to find the most optimal and cost-effective way to expand screening and secondary prevention of NCDs to further reduce the future demand on services. Scaling-up access to essential NCD medicines can be expensive. Samoa would achieve the best value for money if it optimizes its future NCD screening and treatment protocols using its detailed STEPS data and applying the approaches used by developed countries such as Australia and UK to customize national guidelines. As mentioned above, we were not able to obtain access to Samoa's STEPS survey data, and so we were not able to undertake this type of analysis.

1. Introduction

Background and rationale of the study

Samoa faces an increasing epidemic and burden of non-communicable diseases (NCDs), which is placing an increasing burden on its health system, as well as impairing the productivity of its labour force and increasing the fiscal demands on government. This is linked to changing diets, increased use of tobacco and alcohol, and limited public understanding of associated health risks. The major NCDs affecting Samoa include diabetes, followed by ischaemic heart disease (IHD) and cardiovascular disease (CVD) generally, asthma, chronic obstructive pulmonary disease (COPD) and cancers. Both mortality and morbidity from these conditions have increased rapidly in recent decades in Samoa, and are likely to continue doing so in future. The prevalence of diabetes increased from 9.8% in 1987 to 23.0% in 2001, while obesity rates have grown from 25.5% in 1978 to 50.3% in 1991 and 67.5% in 2001, among the highest rates in the world. Whilst Samoa needs to do more to both prevent future NCDs and to treat Samoans with NCDs, resource constraints mean that increasing public spending is unlikely to be an option. The Samoa Health Financing Options Study 2013 studied identified improvements in efficiency and use of available resources key to improving future health outcomes in Samoa [1].

Following discussions between Ministry of Health (MOH) and World Bank (WB), WB agreed to organize a study to analyse the current and future costs of NCDs for the Samoa health sector, including the potential implications for employers and the economy of NCD-related illness in workers. In subsequent discussions, it was agreed by MOH and WB to scale down the scope of the proposed study to focus only on the current costs of NCDs for the health services, and analysis of the potential future costs if NCD screening and treatment was expanded as envisaged under current or alternative strategies. However, delays in making data available made it impossible to look at future and alternative costs.

Consequently, this study seeks to inform MOH and the Government of Samoa (GoS) about the current costs for the health system of the NCD epidemic. Future studies can build on this by looking at how these costs might evolve under current trends and also alternative healthcare and policy scenarios, including different options for the screening and treatment of key NCDs.

In undertaking this study, the authors built on and sought synergies with the parallel WHO-supported effort to update Samoa's national health accounts (NHA), which was coincidentally led by the CHIPSR members of our study team. The WHO-supported activity itself benefited from the analytical work that was done as part of this WB study, and this report extends the NHA work by providing more refined and detailed estimates of NCD expenditures in Samoa.

In this study, we examine direct medical costs in the healthcare system, using a top-down approach to identify which diseases and conditions expenditures were used for. The overall approach is anchored in the System of Health Accounts 2011 (SHA 2001) framework to ensure international comparability, as well as consistency with the Samoa NHA. This report presents the findings, further classifying spending by age and by gender, and provides a description of the methods used to generate these estimates. In addition, we report on an

analysis of the costs of medicines used for NCD treatment, which assesses the potential cost savings that might be obtained from more efficient medicines procurement.

Estimating healthcare spending on NCDs and all diseases in general is a relatively new field in Samoa and other Pacific Island countries (PICs). The hope is that these findings, which are amongst the first for any PIC, will be of interest both to policy-makers and health experts in Samoa and the Pacific more widely.

2. Approach

Context

Samoa achieves relatively good health outcomes for its level of economic development, but health spending in Samoa is also high for its level of economic development. Total expenditure on health in 2012 was 6.7% of GDP, compared with an average of 4.1% in all lower-middle income countries [2]. Part of the explanation for this high level of expenditure is that Samoa is a small island nation – health services generally cost more in such contexts, but the main reason is the high level of government spending on health. Total public financing accounts for 82% of overall health spending (2014/2015), and 18% of all government spending. This existing high level of government spending implies that further improvements in health sector outcomes are more likely to be feasible with improvements in the use of resources by the health system than by increased spending [1].

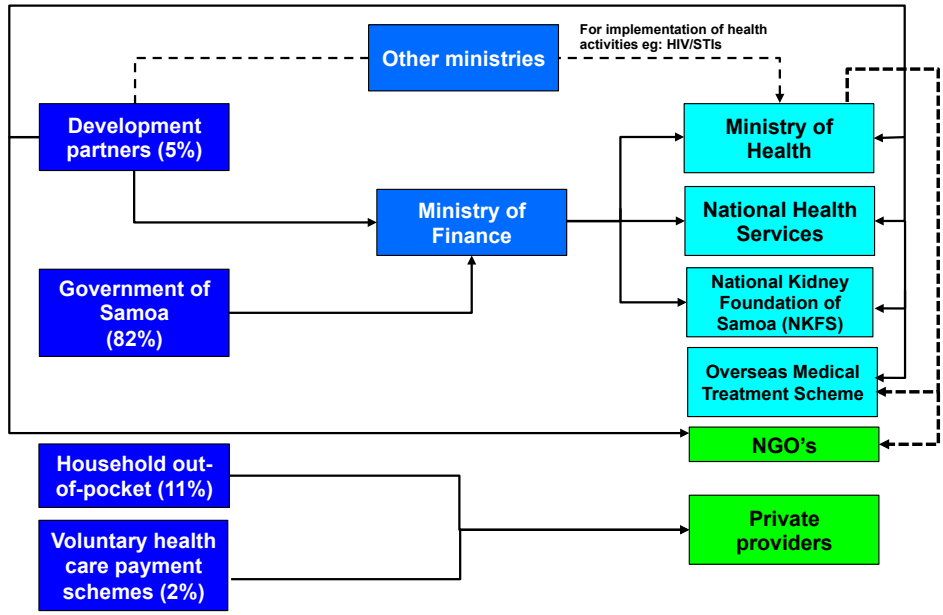

Figure 1: Flow of funds in Samoa's healthcare system

Government health funds are largely channelled through the Ministry of Health (MOH), which allocates most of its budget to the National Health Service (NHS), which is the primary publicly funded provider of preventive and clinical services (Figure 1). The NHS manages the national referral hospital in the capital, Apia, as well as seven district hospitals and several smaller clinics throughout the two main islands of the country. MOH also uses its budget to directly operate a range of non-hospital clinical services in rural areas, to run a number of public health programs reaching the whole population, and to finance a number of non-government providers, including the National Kidney Foundation of Samoa (NKFS). The Overseas Medical Treatment Scheme (OTS), which sends patients overseas for treatment, largely to New Zealand, accounts for a substantial amount of the government

health budget, being financed directly by the Ministry of Finance as well as by the Ministry of Health. This study focuses on spending by the NHS on TTMH hospital, as well as public spending on the NKFS, OTS and other preventive and public health activities.

General strategy

Our ultimate objective was to describe the allocation of relevant components of national health spending in Samoa to priority NCD conditions, by age and sex, and in a way consistent with existing national expenditure estimates and also comparable with other countries. To ensure consistency with national expenditure estimates, we took the recently published Samoa NHA estimates [3] of major spending items as being correct, plus other unpublished data generated by the NHA study team, who are also members of our team. To ensure international comparability, we followed to the extent possible the guidelines proposed in SHA 2011 [4].

We then adopted a disease accounts approach, similar to that used in Australia, The Netherlands, Bangladesh and Sri Lanka [5-7] to disaggregate selected items of spending across all diseases/conditions, and age and sex. The first step was to identify specific items of spending, or "cost buckets", for analysis; *e.g.*, inpatient ward spending at Tupua Tamasese Meaole Hospital (TTMH) or government spending on the OTS. We then used whatever data we could access to analyse each of these cost buckets, disaggregating spending at the most detailed or granular level possible. In the case of diseases, this meant analysis at the level of individual WHO International Classification of Disease (ICD) 10 codes in some instances, or much broader disease groupings in others, *e.g.*, infectious diseases or cancers. In the case of age, for the most part the data did not permit analysis at the level of individual years, and thus we grouped data according to five or ten year age categories. For some spending, we lacked data to accurately determine age and sex, and these are reported as "unknown", *e.g.*, spending on TTMH dental and oral health services.

Finally, we aggregated the different analytical results to produce overall estimates of spending by disease, age and sex. After which, we extracted spending on the priority NCD conditions of interest, using our disease classification framework to identify relevant spending.

In addition to the main costing analysis, we assessed and report on the relative prices of medicines purchased by the National Health Services (NHS) by comparing the actual prices paid with WHO reference data on prices paid by public procurement agencies following good practices. This analysis suggests that cost savings in procurement might help mitigate the future costs of treating NCDs, especially under the free medicine policy for NCD patients.

Categories of cost analysis

In the costing analysis, we simultaneously classified the analysed healthcare spending by demographic group and condition/disease.

Demographic classification

Spending was classified to both sexes, and to 19 age groups: 0, 1–4, 5–9 … 80–84, and 85+ years.

Disease or condition

SHA 2011 recommends that international comparisons of spending by disease use the WHO ICD-10 classification in analysis, and aggregate spending for reporting purposes using the Global Burden of Disease [8] classification of diseases. However, two practical issues complicate this recommendation. First, the specific GBD classification given in the SHA 2011 publication was only a WHO draft dating from 2008. This has since been superseded by the completely revised 2011 classification that WHO now uses for its Global Health Estimates (GHE) [9]. The second problem is that the GBD or GHE classification is concerned with identifiable diseases, but much healthcare activity and spending is not related to a specific disease or condition, or diseases in general, *e.g.*, general health check-ups and family planning. In addition, much patient-level spending is in cases where there is no definitive diagnosis made or possible, but only a patient-reported complaint or symptom. The latter is frequently the case in primary care. Although these non-illness reasons for healthcare provision can be coded using ICD-10 codes, neither the GBD or GHE classifications categorize these.

We used the WHO GHE 2011 classification as the basis for our classification and also mapping of ICD-10 codes to disease groupings, as this is the most current, published WHO classification. We note that the Institute for Health Metrics [10] publishes its own different fork of the GBD/GHE classification, which we do not use, as it is unlikely to be used in international comparisons of spending.

To address the second problem of ICD-coded conditions that are not mentioned in the WHO GHE classification, we drew on the work of a separate project led by the Asia-Pacific NHA Network (APNHAN), and funded by the Global Fund. In that project, involving IHP and CHIPSR, we reviewed ICD-10 codes that lack a mapping in the GHE classification, and developed an extended disease accounts classification to categorize these in these types of analysis. This extended "disease-specific accounts" or DSA classification adds categories for such non-disease spending as routine childbirth without complications and contact with health services for check-up. In this study, we used this extended DSA classification, as shown in Annex Table 2.

Identification of priority NCDs

Since the ultimate concern of this study was spending on NCDs, we had to identify a shortlist of priority NCDs. These are major NCDs that we determined to be of policy relevance to Samoa; that is those NCDs that account for the largest burden in the healthcare system, where costs for government are likely to be growing the fastest, and for which policy can play a role in mitigating future burdens. Following discussions with MOH counterparts and initial assessment of the situation and data sources, the following priority NCD conditions were identified for specific focus in the analysis (corresponding DSA codes from Annex Table 2 given in parentheses):

(i) Asthma (2I02)

(ii) Cancers (2A)

(iii) Cardiovascular disease (2H)

(iv) Chronic kidney failure (2K07)

(v) Chronic obstructive pulmonary disease (2I01)

(vi) Diabetes mellitus (2C)

Whilst the focus of this study is on these selected conditions, the approach we used to estimate costs actually analyses the full distribution of spending by disease. That means in addition to reporting spending on the above priority NCDs, we can also report estimates of spending across other major condition groups, although these were not the primary objective of our analysis.

Choice of cost buckets in the cost analysis

We reviewed the various expenditure flows that were captured by the Samoa NHA Study, and identified specific aggregates that were likely to contain NCD spending, and for which data and methods could be identified that would enable us to apportion spending by disease/condition, age and sex. These "cost buckets" are what are referred to as "areas of health expenditure" in comparable Australian work [5]. The main cost buckets that we used in the analysis were:

(i) Inpatient ward spending (TTMH)

(ii) Operating theatre costs (TTMH)

(iii) Outpatient clinic costs (TTMH)

(iv) Laboratory services (TTMH)

(v) Imaging services (TTMH)

(vi) Medicines dispending (TTMH pharmacy)

(vii) Dental and oral health services (TTMH)

(viii) NKFS services

(ix) Overseas Medical Treatment Scheme

(x) Preventive and public health activities, including disease surveillance, etc.

For each of these cost buckets, we developed distribution keys that used available and relevant data to apportion spending by disease, age and sex. These distribution keys were used to disaggregate the relevant spending in each cost bucket, and then the resulting

estimates for each cost bucket were collated to obtain the distribution of overall spending by disease, as illustrated schematically in Figure 2.

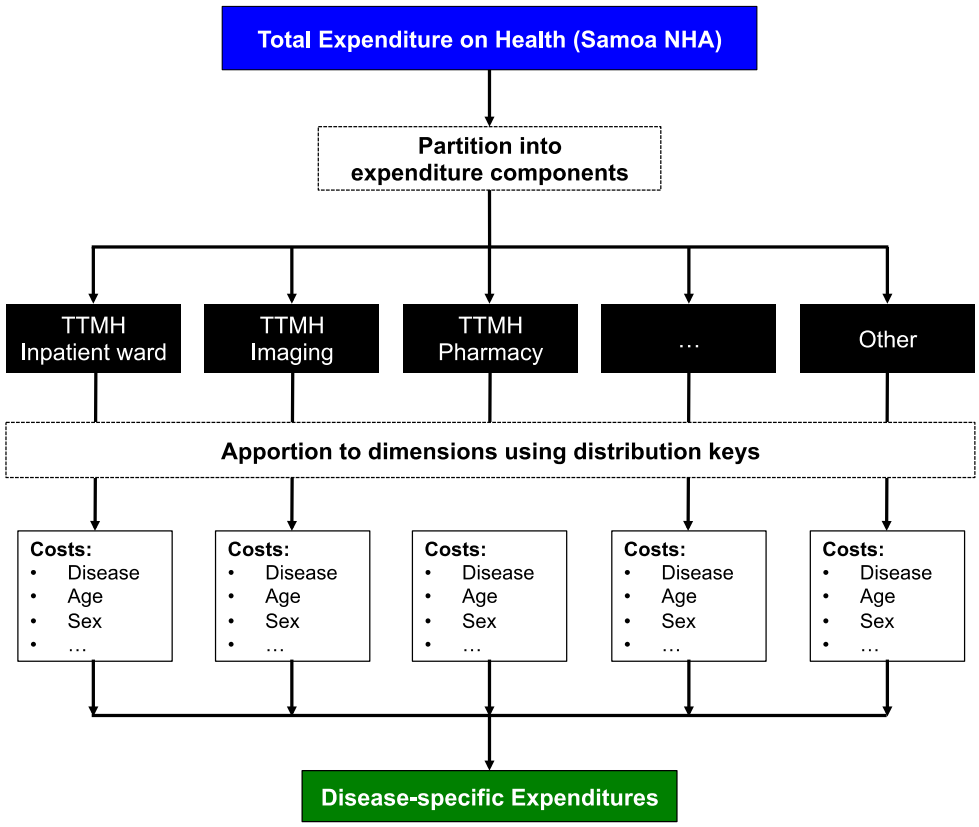

Figure 2: Overview of analytic approach to estimating spending on NCDs

Differences with recent Samoa NHA cost of disease estimates

Although the recently published Samoa NHA report [3] provided estimates of spending by disease, including a single NCD category, the analysis presented here differs in several key respects.

First, this study undertakes a more intensive analysis of the available data, so it is able to generate more detailed and also more robust estimates than earlier published. Consequently, there are some differences in the overall spending shares that we report, but the ones reported here should be regarded as more definitive.

Second, the Samoa NHA study used the WHO Health Accounts Production Tool (HAPT) software for collating its results, including its disease breakdowns. Although the HAPT software generally follows the SHA 2011 framework [4] that is recommended by WHO, it does not comply with the recommendation in SHA 2011 that presentations of spending by disease should be organized by GBD categories, having mapped spending using ICD codes.

It instead adopts its own classification of conditions for which no ICD code listing is provided. In our study, we follow the SHA 2011 recommendation more closely, specifically to use the full GBD/GHE classification combined with specific ICD-10 coding when categorizing spending by disease. In addition, it should be noted that the HAPT software recognizes only one neoplasm category, whilst the WHO GBD work and also our DSA classification distinguishes between benign and malignant neoplasms. The "cancers" category in this report's priority NCD listing refers to malignant neoplasms, excluding benign neoplasms.

Data sources and analysis

We used a number of data sources that were made available to the study team by MOH, NHS and other agencies in Samoa. These included data collected by the National Health Accounts (NHA) study in 2016, the NHS Patient Information System (PATIS), the NHS Pharmacy LOTS database, laboratory and operating theatre registers maintained at TTMH, and the National Kidney Foundation of Samoa (NKFS) patient register.

The NHA study provided the main expenditure totals that we analysed by disease in this study. The various NHS databases were used to estimate how specific items of spending within the NHS were distributed by disease, age and sex, whilst the NKFS patient register was used to do the same with NKFS spending. We often found it necessary to link records from separate NHS databases, and we generally used the National Health Number (NHN) for this purpose. The LOTS database was used in two ways. First, it was used to identify what medicines were used by the NHS, which in turn we estimated their use by disease. Second, in a separate analysis, we used the LOTS data on procurement prices to analyse the efficiency of medicines procurement. This efficiency analysis was done using the methodology recommended by WHO, which looks at the ratio of a medicine price to its median price in a basket of medicines procured by agencies using best practices.

Further details of these various data sources, how they were processed, and analytical methods are given in the Technical Appendix.

Data limitations

We were not able to obtain data to analyse spending by the dental and oral health services, by age and sex of their patients. In addition, resources did not permit us to conduct an analysis of spending in the rural and community-based services outside TTMH. Nevertheless, our analyses do cover the bulk of all relevant MOH spending and also all health spending in Samoa.

Although Samoa does have relatively sophisticated electronic information systems at TTMH and NHS, data gaps and lack of standardization of data entry were significant challenges. This limited our analyses in places, as well as their overall accuracy.

We had hoped to model also the potential evolution of the costs in Samoa with future epidemiological trends, and also model the potential impact on costs and mortality if NCD treatment protocols were revised. However, we were not able to obtain access to Samoa's STEPS survey data, and so this analysis was dropped.

Scope of analysis

We were only able to analyse a subset of total spending by the public sector, specifically spending at TTMH, which accounts for over 90% of total hospital spending, and spending by NKFS, the Overseas Medical Treatment Scheme and various government-funded preventive and public activities. This analysed spending of WST 66.3 million represents 73% of total government spending on health, and 60% of total national current spending on health (inclusive of private expenditures). The government spending we do not cover includes national level spending of WST 7.9 million by MOH on policy and administrative services and other general activities that cannot be meaningfully associated with specific diseases, plus WST 16.2 million spent on other medical services provided through smaller hospitals and rural and community health services. Consequently, our final analysis covers 80% of all public spending that might potentially be attributed to specific diseases, excluding only the spending at smaller hospitals and rural and community health services.

This 80% of spending that we do analyse can be considered reasonably representative of the overall pattern of government spending by disease and on NCD interventions. First, spending at the second hospital is unlikely to have a substantially different pattern to that at TTMH. Second, the rural and community health services account for only a small proportion of overall patient services in Samoa. Only 25% of outpatient contacts occur at this level, and 13% of inpatient admissions (Table 1Table 1). Furthermore, in most rural clinics doctors are not available every day, and so staff refer many NCD cases that require treatment to TTMH and Malietoa Tanumafili II Hospital (MTII).

Table 1: Distribution of patient activity and spending by health service levels in Samoa public delivery system (%)

Level of care	TTMH	MTII	District hospitals, health centres, rural services
Inpatient admissions (%)	71	16	13
Outpatient contacts	55	21	25
Drug expenditure	75	Included in TTMH	25

Source: NHS annual reports 2014–2015.

3. Findings

Overall expenditures on priority NCDs

The distribution of analysed spending in fiscal year 2014/2015 by major items is shown in Table 2. As noted earlier, our analysis refers to 80% of all government spending that can be reasonably attributed to any condition.

Table 2: Composition of expenditure by type of spending analysed in study

Type of care	Cost (WST millions)	Percentage (%)
TTMH (inpatient)	21.3	32.2
Overseas Medical Treatment Scheme	11.6	17.5
TTMH (outpatient)	10.4	15.7
NKFS (dialysis)	5.7	8.6
TTMH medicines (outpatient)	3.9	5.9
Preventive and public health activities	3.9	5.8
TTMH medicines (inpatient)	2.7	4.1
TTMH Dental	2.4	3.7
TTMH laboratory (outpatient)	2.0	3.0
TTMH laboratory (inpatient)	1.3	1.9
TTMH radiology (outpatient)	0.9	1.3
TTMH radiology (inpatient)	0.2	0.3
Total	**66.3**	**100.0**

Table 3: Expenditure by priority NCDs and other conditions

Condition	Cost (WST millions)	Percentage (%)
Cardiovascular diseases	7.8	11.8
Communicable diseases	7.1	10.7
Other NCDs	6.2	9.4
Genitourinary diseases	5.0	7.5
Diabetes Mellitus	4.0	6.1
Injuries	4.0	6.0
Other (laboratory expenses not on priority NCDs)	2.7	4.1
Cancer	2.6	3.9
Digestive diseases	2.6	3.9
Musculoskeletal disease	2.6	3.9
Oral conditions	2.6	3.9
Skin diseases	1.9	2.8
Neurological conditions	1.6	2.4
Asthma	0.4	0.6
Chronic renal failure	0.3	0.5
Chronic obstructive pulmonary disease	0.3	0.4
Other contacts with health services	10.9	16.4
Signs and symptoms without a diagnosed condition	3.7	5.5
Total	**66.3**	**100.0**

Note: Other NCDs include all NCDs excluding asthma, cancer, cardiovascular disease, kidney disease, chronic obstructive pulmonary disease, and diabetes mellitus.

Table 3 shows the overall distribution of this spending by priority NCDs and other conditions. More detailed breakdowns of spending across other conditions are available from the study team, and are summarized in the next section.

The selected priority NCDs account for 23% of all spending that can be allocated to a condition, and 41% of overall NCD spending. Overall, CVD is the most expensive major NCD, followed by cancers. However, the importance of these NCDs varies by type of care. Dialysis services at NKFS are dominated by chronic renal failure (much of which is caused by diabetes) and diabetes diagnoses (Table 4). In the case of medicines, overall pharmacy spending is dominated by NCDs, and cardiovascular disease followed by diabetes account for a larger share each of medicine spending on the priority NCDs (Table 5).

Table 4: Spending of the Overseas Medical Treatment Scheme by priority NCDs and other conditions, 2014-15

Condition	Cost (WST millions)	Percentage (%)
Cardiovascular diseases	2.13	18.3
Cancer	1.64	14.1
Other neoplasms	0.75	6.4
Other NCDs	0.72	6.2
Back and neck pain	0.48	4.1
Other congenital anomalies	0.45	3.9
Urolithiasis	0.41	3.5
Other respiratory diseases	0.36	3.1
Other neurological conditions	0.34	2.9
Other musculoskeletal disorders	0.29	2.5
Gynecological diseases	0.24	2.1
Kidney diseases (exc. chronic disease)	0.23	2.0
Injuries	0.17	1.5
Communicable diseases	0.09	0.8
Diabetes mellitus	0.08	0.7
Cataracts	0.03	0.3
Signs and symptoms without a diagnosed condition	1.75	15.0
Other contacts with health services	1.46	12.5
Total	**11.6**	**100.0**

Notes:
(i) Other NCDs include all NCDs excluding asthma, cancer, cardiovascular disease, kidney disease, chronic obstructive pulmonary disease, and diabetes mellitus.

Table 6 compares the distribution of spending with recent estimates of the burden of disease in Samoa. Although disease burden is not an adequate guide to how money should be allocated – a decision that needs to take into account other factors, such as the cost-effectiveness of available interventions, the needs for risk protection, etc. – this provides some useful context for considering these results. They indicate that the general pattern of spending does resemble the disease burden, but that spending on both cardiovascular disease and diabetes might be less than their share in the overall disease burden. Overall, the priority conditions account for 38% of the disease burden, but only 23% of the spending. Confirmation of this would need to take into account spending by district hospitals and clinics, as well as private spending, both of which we could not analyse. Nevertheless, they suggest that if anything the increasing burden of diabetes and cardiovascular disease is not

reflected in a commensurate share of spending. This may be because an increased share is not appropriate or because there is actual under-spending. If the latter is the case, then the potential for increases in NCD spending will be greater. However, based on comparison with unpublished data from other countries that we are working in, we think it likely that overall allocation of spending to diabetes and cardiovascular disease is less than in comparable countries, and even less if consideration is given to the very high levels of diabetes and other related NCDs in Samoa. The most likely area where spending is less would be medicines, suggesting that there may be a need to increase spending on medicines for priority NCDs in Samoa in order to improve the overall response.

Table 5: Hospital pharmacy spending by priority NCDs and other conditions (%)

Condition	Inpatient	Outpatient	Total
Communicable diseases	27.8	21.4	24.0
Cardiovascular diseases	13.3	14.7	14.2
Diabetes Mellitus	8.5	13.6	11.5
Epilepsy	8.0	9.8	9.1
Other NCDs	15.5	4.2	8.8
Other contacts with health services	2.6	7.0	5.2
Signs and symptoms without a diagnosed condition	3.4	6.1	5.0
Skin diseases	4.0	5.1	4.6
Other digestive diseases	6.1	3.1	4.3
Injuries	3.7	3.0	3.3
Asthma	0.3	4.8	2.9
Other musculoskeletal disorders	1.7	3.6	2.8
Parkinson disease	1.0	3.0	2.2
Chronic obstructive pulmonary disease	2.0	0.8	1.3
Cancer	2.1	0.0	0.8
Total	**100.0**	**100.0**	**100.0**

Notes:
(i) Other NCDs include all NCDs excluding asthma, cancer, cardiovascular disease, kidney disease, chronic obstructive pulmonary disease, and diabetes mellitus.

Table 6: Comparison of the distribution of spending on priority NCDs and the overall disease burden

Condition	Spending (%)	Disease burden (DALYS, %)
Asthma	0.6	2.1
Cancers	3.9	6.4
Cardiovascular Diseases	11.8	18.4
Chronic renal failure	0.4	4[ii]
Chronic Obstructive Pulmonary Disease	0.5	2.1
Diabetes Mellitus	6.1	8.6
All other conditions	76.7	62.4
Total	**100.0**	**100.0**

Notes:
(i) DALYS = Disability adjusted life years.
(ii) DALY estimate is for "chronic kidney disease" as defined by IHME.
(iii) Disease burden estimates are for 2015 and sourced from IHME [10].

Spending across all conditions

The previous section focused on spending on the priority NCDs. However, the study also generated analysis of spending across all disease conditions (as classified in Annex Table 2), age groups and sexes. These results are summarized in this section.

Spending by disease

The overall distribution of spending by disease and age group is profiled in Figure 3, with the priority NCDs highlighted in Figure 4. As can be seen, in ages 20–39 years, spending is dominated by maternal conditions, which is a fairly typical pattern in most countries.

Nevertheless, the dominance and central importance of NCDs in the cost of health services in Samoa is readily apparent. Cardiovascular disease spending becomes substantial from the age of 30, and is the leading cause of spending from the age of 50 years, largely due to ischaemic heart disease. Spending on diabetes is substantial, but trails CVD spending overall, whilst genitourinary disease is larger. The peak in spending in those aged 60–64 years is also driven by these three conditions.

It is worth noting that after the age of 15 years, spending on infectious disease and respiratory conditions and injuries is small, and spending is almost wholly due to NCDs, with the exception of maternal conditions in the 20–49 year age range. Indeed, above the age of 45 years, NCDs account for most of healthcare spending of which priority NCDs account for more than half (Figure 5).

Spending by demographic groups

Although aggregate spending is not substantially greater in the older age groups than the younger ones (Figure 3), spending on a per capita basis increases substantially with age (Figure 6). Spending per capita on those aged 60–80 years is three times that in those aged 30–50 years.

The difference between the two charts arises from the shape of Samoa's age pyramid with fewer people currently in older age groups. This increase in per capita spending by age in adults is consistent with other countries, but it does mean that as the population in Samoa continues to age, spending pressure will also increase in the absence of other interventions. As noted earlier, spending in these older age groups is dominated by spending on the priority NCDs.

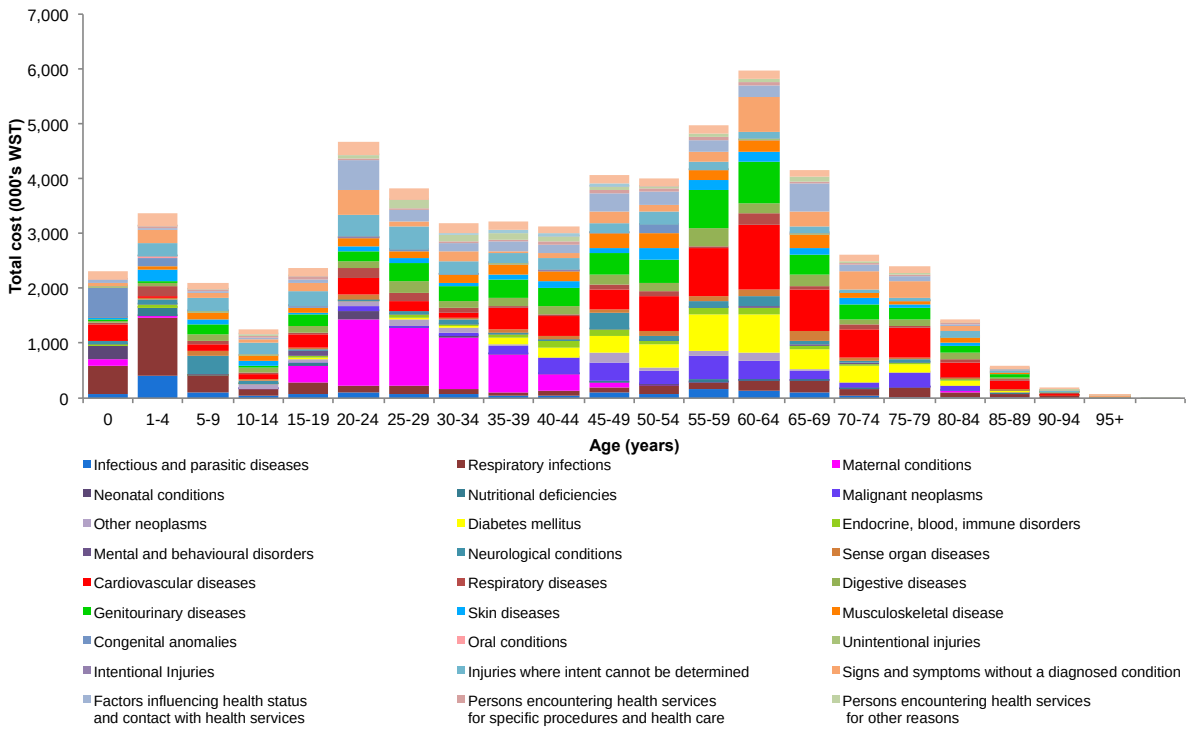

Figure 3: Spending by disease and age group analysed in study, 2014-2015 (WST thousand)

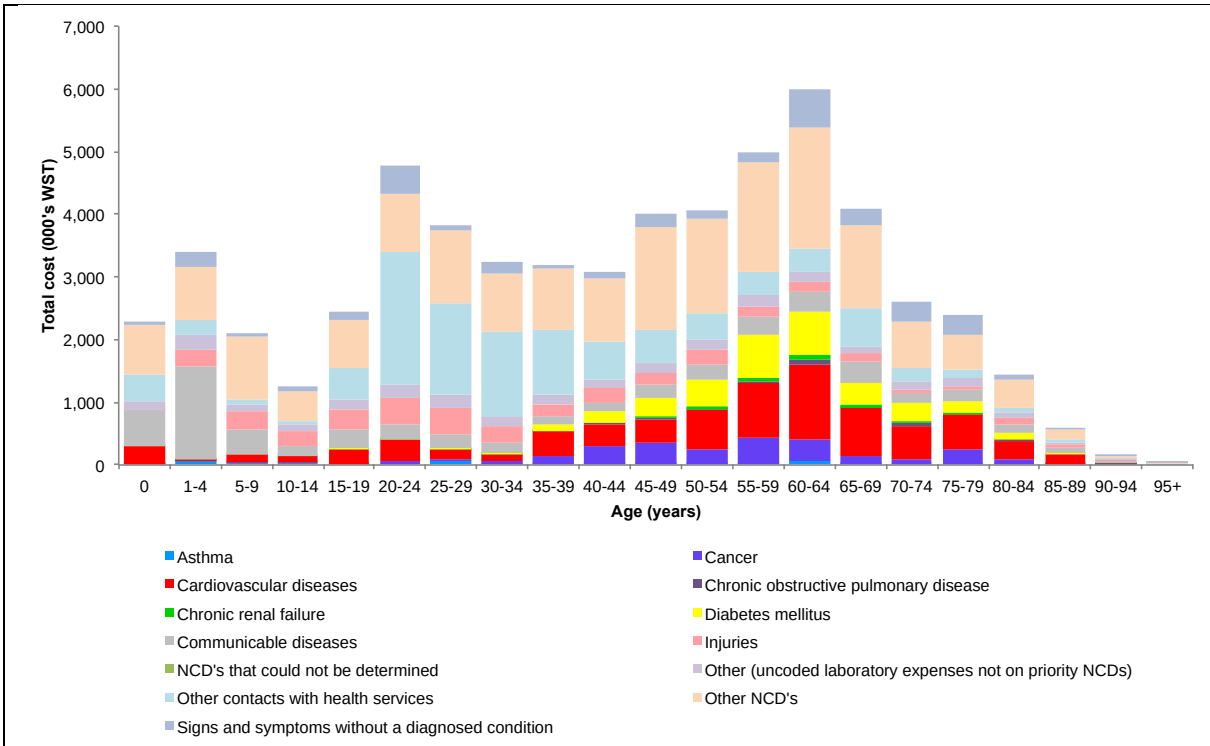

Figure 4: Spending by major disease and age group analysed in study, 2014-15 (WST millions)

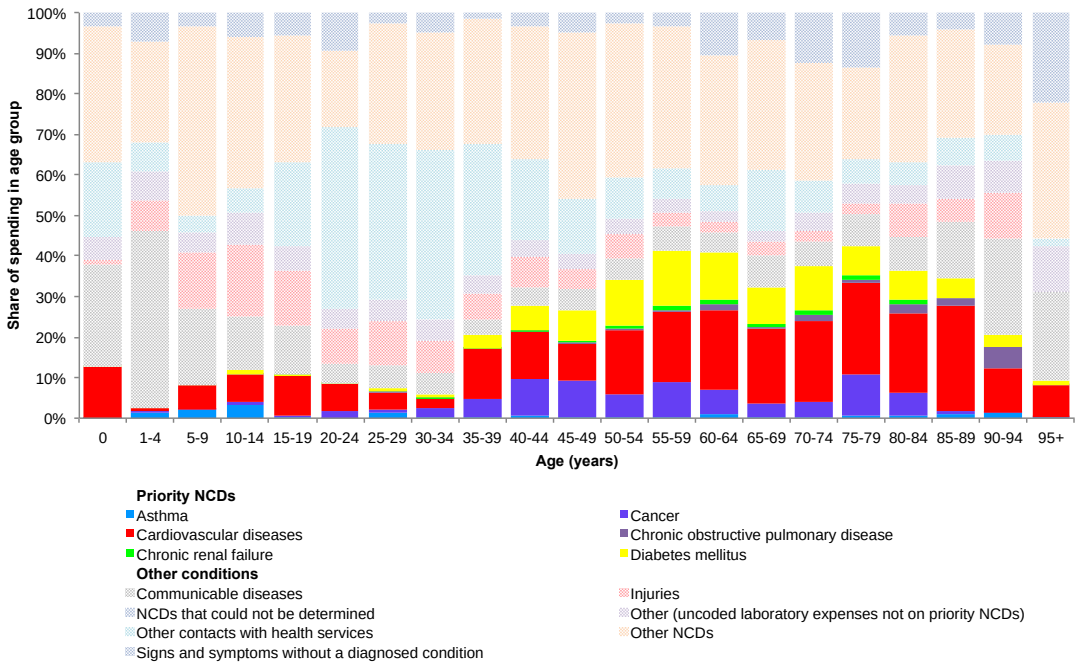

Figure 5: Distribution of spending by major disease and age group (years) analysed in study, 2014-15 (%)

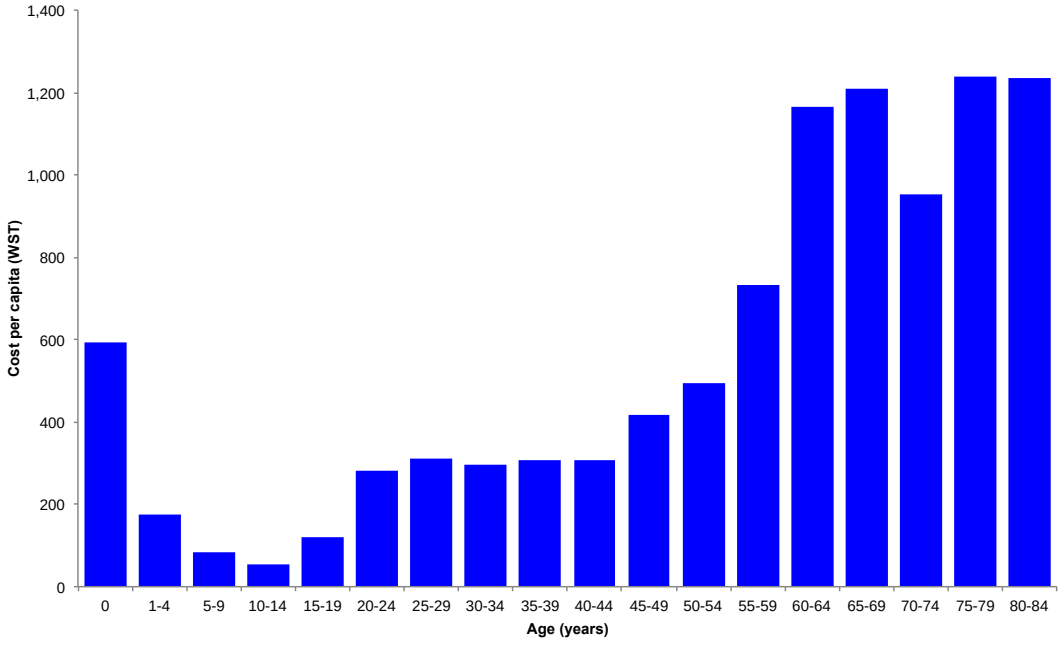

Figure 6: Per capita spending by age group, as analysed in study, 2014-15 (WST)

Note: There is a decrease in per capita spending with age in the older age groups. This is observed in other countries too and is not that surprising, although the reasons are not fully understood. Estimates for those aged 85+ years is not shown as they are subject to large error owing to small sample sizes in the data.

Medicines prices

MPR levels and trends

We assessed NHS medicine procurement prices by calculating the ratio of the price paid for each medicine to the WHO benchmark price or "median price ratio" (MPR). Further details of the methodology are given in the Technical Appendix. MPRs could be calculated for a total of 198, 198, and 67 medicines in 2012, 2013, and 2014, respectively (Annex Table 3). Of these, 59 medicines were purchased in all three years and 179 medicines were purchased only in 2012 and 2013. For the full listing of medicines with MPRs in any year, the overall cost-weighted MPR fell from 6.4 in 2012 to 4.5 in 2013 and 2.6 in 2014. These results do not significantly change if the analysis is restricted only to those medicines for which MPRs could be computed for all years or just 2012 and 2013. Overall, Samoa is purchasing medicines on average for three to five times the prices obtained by the procurement agencies contributing data to the MSH database, including some purchasing on behalf of small microstates in the Caribbean.

Table 7: Cost of pharmaceuticals recorded in LOTS database, 2012–2014

Condition	2012	2013	2014
Total cost of recorded pharmaceuticals (WST)	4,253,103	2,069,106	39,198
Cost of items for which MPRs were computed (WST)	1,097,462	1,012,456	27,835
Cost of items for which MPR were computed (% of total cost)	25.8%	48.9%	71.0%
Cost of core list of medicines in WHO-PEN protocol for NCD interventions (WST)	842,210	590,812	23,103
Cost of core list of medicines in WHO-PEN protocol for NCD interventions (% of total cost)	19.8%	28.6%	58.9%
Cost of core list of medicines in WHO-PEN protocol for NCD interventions for which MPRs were computed (WST)	729,817	538,120	16,162
Cost of core list of medicines in WHO-PEN protocol for NCD interventions for which MPRs were computed (% of total cost)	17.2%	26.0%	41.2%

Table 8: Cost-weighted average MPR, 2012–2014

	All medicines with an MPR in any year	Medicines with MPRs in all three years	Medicines with MPRs in both 2012 and 2013
All medicines			
		(N=59)	(N=179)
2012	6.36	6.75	6.38
2013	4.48	5.21	4.52
2014	2.58	2.58	
Core list of medicines in WHO-PEN protocol			
		(N=53)	(N=24)
2012	6.88	7.46	6.88
2013	5.36	6.20	5.38
2014	2.24	2.25	

In a proposed set of indicators to monitor access to essential medicine WHO advises that MPRs should be less than 3.0 for selected medicine [11]. In addition, some developing countries are able to purchase medicines at MPRs consistently below 1, *e.g.*, Sri Lanka's MOH has consistently achieved an average MPR of less than or around 1.0 from 2005 to 2012 [12]. So prices paid by the NHS appear to be relatively high. We also compared the MPRs paid by Samoa with the MPRs paid by some other Asia-Pacific countries with electronic procurement data participating in a separate GFATM-funded project of the Asia-Pacific NHA Network (APNHAN). The results of this comparison can be included in the report if requested by MOH and with agreement of GFATM and relevant collaborators.

These results suggest that there may be considerable space for cost savings if Samoa NHS improves its procurement processes. This would allow MOH to either reduce its medicines costs, or increase the amount of medicines purchased with the current budget.

We also examined the distribution of MPRs across the basket of medicines. Of the total cost of medicines where an MPR is calculable and for the basket of medicines for 2012-2013, in 2012, only 24% of costs were for medicines purchased at twice the IRP level or less (Figure 7), the large proportion purchased at more than twice the IRP level drove the overall cost-weighted MPR to more than six times the IRP (Figure 7). In comparison, in 2013, 37% was purchased at less than twice the IRP and the shift in the cumulative percentage cost curve for 2013 to the left of 2012 contributed to the decrease in the cost-weighted MPR to around four times the IRP in 2013. A similar pattern is seen for the limited basket of 59 medicines for which MPRs are available in all years during 2012-2014 (Figure 8). These results suggest that although NHS can and does obtain good prices for many of its medicines, high prices are paid for more than 60% of total procurements, which substantially inflates overall costs. However, on a positive note, the overall average MPR does show a decrease from 2012 to 2014.

These findings should be assessed with caution, particularly owing to the incomplete information resulting from technical issues experienced during data collection. For some of the medicine formulations MPRs are not calculable due to incomplete information on medicine formulations and their influence on the overall MPR cannot be assessed. Also, the observed decrease in MPR is for a limited number of medicines (59 medicine formulations in 2012–2014) and excludes many of the medicine formulations with high MPRs observed in 2012 and 2013. A more comprehensive assessment would be desirable, but would require obtaining additional information to fill some of the data gaps in the LOTS database.

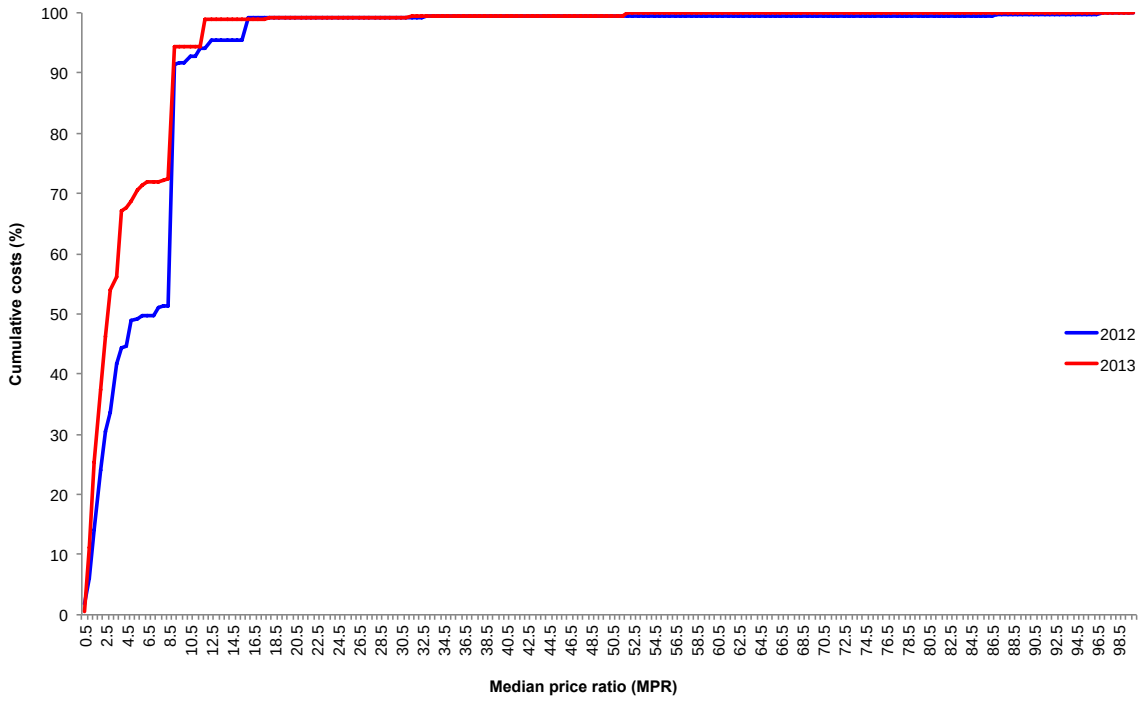

Figure 7: Percentage cumulative frequency of medicine expenditures by median price ratio (MPR) for basket of medicines (N=179), 2012–13

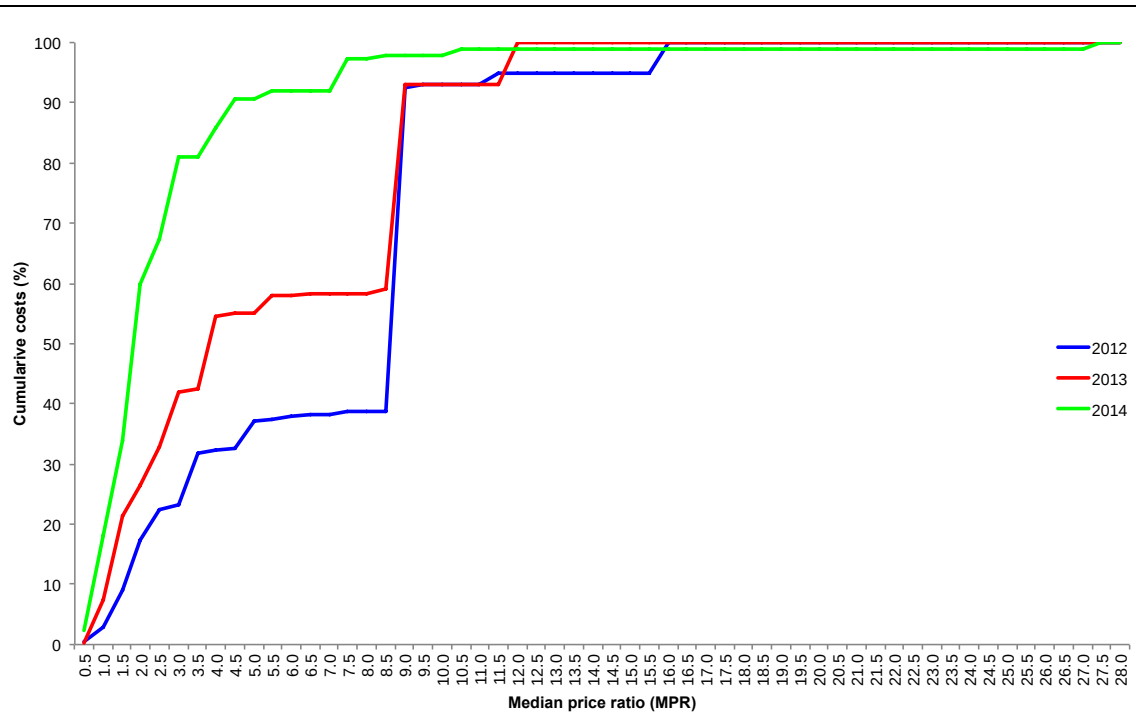

Figure 8: Percentage cumulative frequency of medicine expenditures by median price ratio (MPR) for basket of medicines (N=59), 2012-14

Nevertheless, on the reasonable assumption that the NCD medicines requirement would only increase two to three times at most in the medium term as a result of epidemiological trends and ageing, this suggests that efficiency gains in procurement alone would allow MOH to accommodate the increased costs of medicines for NCD patients. However, the greatest gains might only arise from pooling purchasing with other neighbouring PICs, since the WHO-MSH data reflects prices obtained by such regional pooling arrangements by the English-speaking Caribbean island nations.

Medicines utilization

Our other results suggest that spending on priority NCDs may be currently too low, notwithstanding relatively high prices paid for medicines. One way of examining this further is to consider how much treatment is actually provided to the population in relation to underlying needs. Comprehensive analysis of this is beyond the scope of this study, but the dispensing data does allow some assessment.

We reviewed both the LOTS purchasing data and the dispensing data to assess whether we could estimate overall consumption levels of key medicines used in NCD treatment. Although MOH is not the sole supplier of medicines in Samoa, private retailers account for a relatively small share of the market in Samoa, and so the MOH data can be considered a good proxy for overall medicine utilization levels. This is even more so for NCD medications, since the pattern in most countries is that the public sector is more likely to dominate provision of these medicines if it chooses to supply them.

We found that the analysis was not feasible for many types of medicine, owing to (a) inadequate data recorded in the databases to allow estimation of quantities of medicines in non-tablet form, and (b) the substantial gaps in the overall coverage of the LOTS database. Nevertheless, we were able to estimate quantities in defined daily dosages (DDDs) for several medications that are used in CVD and also are recommended in most countries for routine use in diabetics. DDDs are a WHO-defined unit of comparison that WHO recommends for comparing utilization levels of medicines across countries. Data limitations prevented us from deriving estimates for medicines used in asthma and COPD, and also for insulins.

The results indicate that utilization in Samoa of all the key NCD medications examined is very low, both in comparison with other middle-income and also developed countries, as well as in relation to likely need. Figure 9 compares utilization levels of four key classes of NCD medicine in Samoa with a number of representative OECD and other developing nations. These other countries tend to have a mix of either greater or lesser prevalence from key NCDs, as illustrated in Figure 10, so are comparable in terms of underlying need with Samoa.

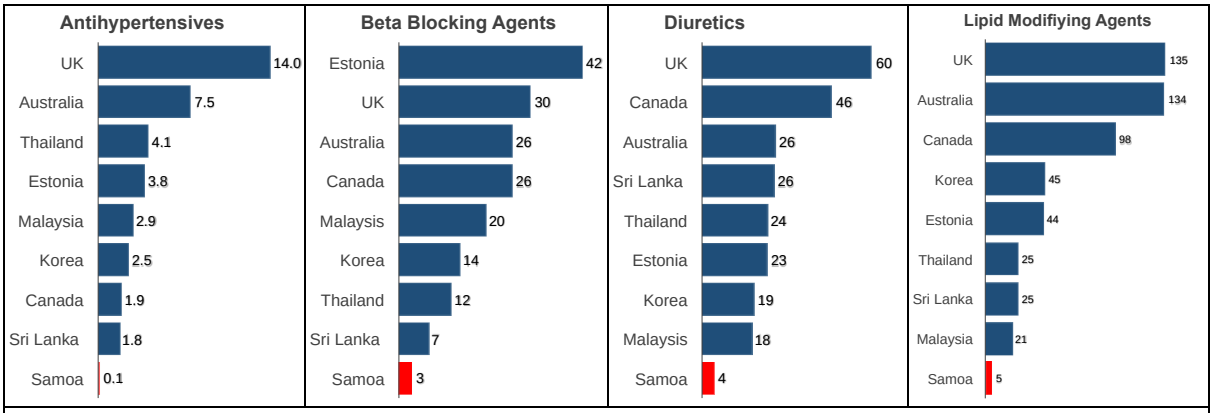

Figure 9: Utilization of key NCD medicines in Samoa and selected other countries (DDD/1,000 population/day), 2013

Note: The statistics refer to the following WHO ATC categories: antihypertensives – C02, beta blocking agents – C07, diuretics – C03, and lipid modifying agents – C10.

Source: Authors' analysis for Samoa; authors' analysis for Sri Lanka and Thailand from GFATM funded study (grant no. 799); OECD Statistics on Medicine Consumption (2016) for OECD countries; MOH Malaysia published data for Malaysia.

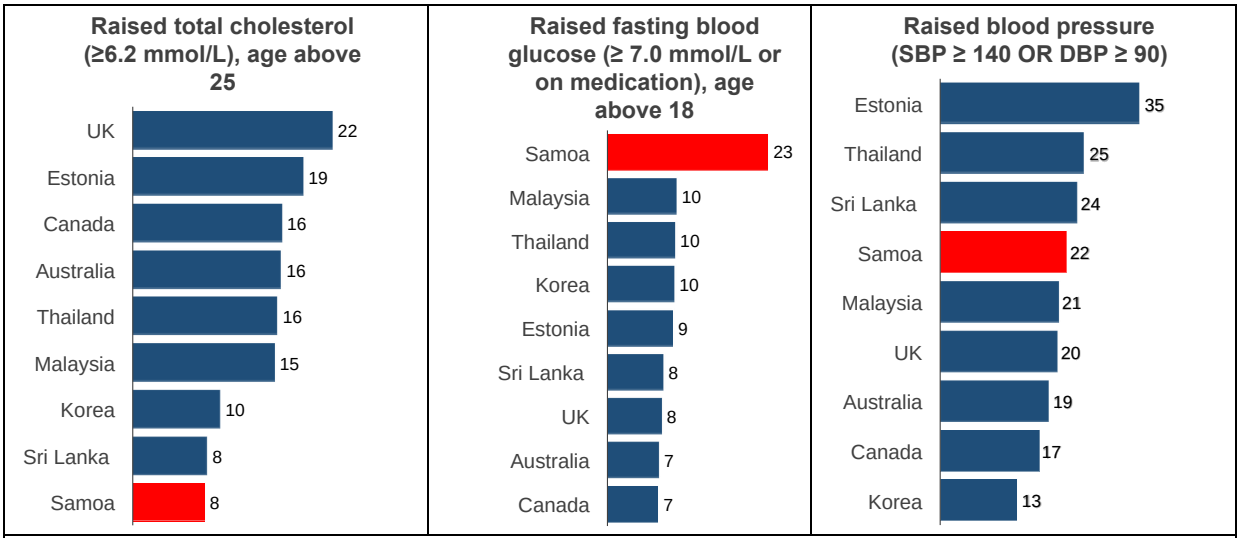

Figure 10: Prevalence of key NCD risk factors in Samoa and selected countries, 2008–2015

Source: WHO Global Observatory data repository: http://apps.who.int/gho/data, downloaded 30 December 2016

Prevalence of hypertension in Samoa is middle of the range in the countries shown in Figure 10, but use of antihypertensives, beta-blockers and diuretics – all key medicines for lowering blood pressure – are less than one-tenth-to-one quarter of use in the other countries shown Figure 9.

In the case of diabetes, we estimate that use of oral hypoglycaemics in Samoa is around 10–11 DDDs/1,000 population/day in the data we examined from the hospital sector, and overall use taking into account distribution from lower level services and the private sector is unlikely to more than 20 DDDs/1,000 population/day. We do not have OECD data for use of

this sub-class of medicines, but these utilization rates in Samoa are one third to one quarter of the levels of use of these medicines in Malaysia, Sri Lanka and Thailand, all of which have much lower diabetes prevalence, and would be a similar proportion of OECD use if we assume that most anti-diabetic medication in OECD countries consists of oral hypoglycaemics. When we turn to statins comparative utilization is also low: we find that utilization in Samoa is less than one half the levels in other middle-income countries, and less than one tenth that in Australia. As is evident, even allowing for additional provision of these medicines by the private sector in Samoa and by MOH rural services, utilization of these key medications lags other countries with comparable disease burden.

Of course these comparisons are only relative and do not necessarily demonstrate that utilization in Samoa is low – it could just be that utilization in other countries is too high. However, we can make an approximate estimation of how much a minimal level of utilization of selected key NCD medicines might be. Using the published STEPS report [13] and other information from IHME [8], our calculations indicate that based on reported NCD prevalence rates in Samoa and WHO PEN recommendations, use of oral hypoglycaemics should be at least 430, statins 230 and antihypertensives 190 DDDs/1000 population/day. This confirms the conclusions from the earlier comparative analysis of NCD medicines use and reinforces the finding that use of essential NCD medicines in Samoa is far too low.

Such increased levels of use of oral hypoglycaemics, statins and antihypertensives would translate into a minimum reduction of 486 deaths from CVD over 10 years in Samoa, or around 32% of the projected deaths from these conditions if no change is made. Actual reductions might be much greater than this if treatment protocols were refined using actual STEPS data, something which we were not able to do. Such an increase in medication use would cost the NHS an additional WST 7 million a year if Samoa purchased these medicines at current WHO MRP prices.

As these medications, particularly statins (included in lipid modifying agents) have a key role in reducing NCD morbidity and mortality, it is likely that Samoa could substantially improve its performance in NCD management by substantially increasing access to and use of these medications. Coupled with the findings that Samoa NHS pays relatively high prices for its medicines, this suggests there is both room and also need to substantially improve access to medicines in Samoa as part of its overall NCD strategy.

This raises the critical question as to why utilization of effective NCD medications is so low despite the prioritization by government of access to such medicines. Our analysis cannot answer this question, and further analysis should be a high priority for government. However, possible reasons include some or all of a combination of inadequate population coverage by current NCD screening services, known limitations in the accuracy of the PEN screening guidelines in quantifying individual risks, barriers that prevent or discourage either screened or other individuals accessing clinical services for further investigation and treatment, gaps in the availability of laboratory services, shortfalls in the clinical practices and protocols for managing NCDs in the NHS including failures of compliance by both clinicians and patients, and possibly shortfalls in the availability and supply of key medicines at all levels in the health services.

4. Conclusions

Our study confirms that NCDs account for a large part of overall healthcare spending in Samoa. The most costly is CVD (12%), followed by diabetes (6%), and cancers (4%). Renal failure account for 0.5%, but it is itself a consequence in many cases of advanced CVD or diabetes. These conditions alone account for 41% of total NCD spending, and 23% of all spending that could be linked to a disease.

This overall spending pattern resembles the burden of disease, but spending on CVD, diabetes, asthma and COPD in particular is proportionately less than the disease burden estimates. By itself, this does not suggest that spending is inadequate, but our other analyses provide compelling evidence that Samoa is under-investing in several key NCD interventions that are known to be cost-effective. In addition, whilst diabetes is often the focus of concern in Samoa, the heavy cost burden from CVD, which itself is closely linked with diabetes and impaired glucose tolerance, should be given more attention. Samoa may need to shift more attention to CVD than it gives currently.

The importance of NCDs in the overall pattern of spending increases with age, and is the main driver of the age-related increase in spending in Samoa Figure 5. This coupled with the current trends of increasing prevalence rates in many NCDs and associated risk factors in Samoa, and the general trend of population ageing, indicates that a growing burden of NCDs will substantially increase cost pressures on the health budget.

Whilst one response to this challenge would be to increase the health budget, this is not a realistic option, as concluded in the earlier Samoa Health Financing Study 2013 [1]. The reality of little leeway in the budget points to the need to look for potential savings from efficiency gains and from reallocating resources from less to more effective interventions. Here, our report identifies four areas where Samoa may be able to achieve substantial efficiency gains, and in effect do more with less or do more with its current budget.

1. Improve efficiency of NHS medicines procurement

This is potentially an easy win, since it does not require any changes to the overall package of services that the NHS offers Samoans. Nobody has to be a loser except foreign pharmaceutical suppliers. Simply reducing procurement prices would allow the NHS to buy more of what it currently does with no increase in the budget.

Medicines are a large component of both overall spending and spending specifically on NCDs. The PEN strategy for NCD screening and treatment which has been initiated in Samoa also depends heavily on improving access to medicines. It should be of concern that the NHS is paying two to three times or more the WHO MPR levels for its medicines. Although Samoa can never expect to achieve as low prices as countries which have much larger drug budgets and which are located much closer to the major producing countries, it can certainly do a lot better. Reducing the average price paid in procurement for medicines to the levels achieved by countries with good procurement practices would enable Samoa to purchase two to four times as many medicines as now without increasing spending. Alternatively, the NHS could have reduced its medicines budget by WST 2 million each year without reducing the quantities it was purchasing, if it had achieved the prices that other

countries obtain. It is beyond the scope of this study to recommend how improvements should be made, but we can make several suggestions. One is to more systematically benchmark in future all medicines procurements against WHO reference prices so as to identify when high prices are being paid, and to allow financial managers to monitor efforts to improve procurement efficiency. Improvements in the tendering procedures might also help, but this may require some investment in increasing management capacity at TTHM Pharmacy. Finally, pooling purchasing with other Pacific island countries for some or all medicines might enable Samoa to achieve further cost savings – countries in the Caribbean who have collaborated in this way have been able to achieve significant cost savings. This of course does require engagement and negotiations with other Pacific countries, and so is probably a longer-term option.

2. Ramp up supply and use of essential NCD medicines

Our results show that the use of key NCD medications in Samoa is very low, confirming the general direction of PEN. Despite high levels of NCDs, access to key NCD medicines in Samoa is a fraction not only of developed nations but also comparable middle-income developing nations. Many of these NCD medicines are amongst the most cost-effective health interventions available. Provisional analysis indicates that the NHS could prevent at least 486 deaths each year from CVD by ramping up use of NCD medicines in high-risk individuals.

The Government of Samoa has made important steps towards this goal already through its policy of free NCD medicines, and by its adoption of the WHO PEN strategy. However, to realize the full benefits of these actions, the NHS will need to do much more.

We recommend that MOH and NHS carefully review what barriers exist in the health delivery system that prevent uptake of these medicines, such as inadequate levels of NCD screening, lack of accessible diagnostic services, constraints that might prevent healthcare workers from prescribing and dispensing these medicines appropriately, and lack of awareness by Samoans of the availability of effective interventions to reduce their future risk of NCD morbidity and mortality. It is unclear which of these potential factors drive the low uptake of NCD medicines, and their relative importance. A broader analysis is desirable to assess the bottlenecks at each level and identify potential areas for improvement, before prioritizing specific gaps for action.

3. Optimize national guidelines and protocols for screening and treating individuals with NCDs or at high risk of NCDs

Purchasing NCD medicines can be expensive, even for developed countries. The key to realizing the full benefits and for making NCD medicines cost-effective is to identify the optimal protocols for screening individuals for high risk and for treatment or primary prevention. Experience of other countries, including Australia and New Zealand, is that the best and most cost-effective screening and treatment protocols are based on the specifics of how NCD risks are distributed across individuals in the population. Samoa needs to better understand the interaction between risk factors and demand on healthcare services in Samoa and to make better use of the country's data to identify the most cost effective prevention and

treatment strategies. In this respect, we recommend that Samoa obtains technical support to use its STEPS survey data to model the impact and cost of alternative PEN screening and treatment protocols to identify the most cost-effective guidelines for use in Samoa. This will require going beyond simply the tabulations in the published report. Experience in other countries is that doing so can identify options that are two to three times more cost-effective than the generic guidelines provided by WHO PEN. Such modelling could also help assess how future epidemiological trends might impact the disease burden as well as future demands on healthcare services.

4. Reallocate resources from the OTS to essential NCD medicines

The Overseas Medical Treatment Scheme (OTS) costs Samoa more than WST 11 million a year, much of which is to treat Samoans suffering from the complications of NCDs. This compares with WST 7 million that we estimate it would cost to provide all relevant Samoans with some of the most cost-effective NCD medicines. We recognize that the OTS does provide financing for care that might not be available in Samoa, and for cases that policy-makers judge to be of high priority on broader social grounds. Nevertheless, reallocation of a small fraction of the OTS budget might enable Samoa to prevent a far greater burden of disease and in the long-term reduce the need for expensive tertiary care.

Whilst the overall study does confirm that Samoa does face a significant cost burden from NCDs, it also suggests the situation is more complicated. First, costs may actually be less than they should be because of inadequate investment in key interventions. Second, although costs will increase with ageing and general epidemiological trends, there is much room to mitigate the cost pressures through a focus on improving efficiency and effectiveness. In doing that, we would strongly advise MOH to look more closely at how its NCD screening and treatment strategies can be optimized and expanded, and how it cane make efficiency savings in the use of the health budget.

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Technical Appendix on Data Sources and Methods

We used a number of data sources that were made available to the study team by MOH, NHS and other health agencies. In this appendix, we provide details and the methods used to process each of these.

National Health Accounts (NHA) Study

The 2016 update of the Samoa NHA was undertaken by the CHIPSR team in collaboration with the MOH in a separate project funded by WHO [3]. From this work, overall aggregates for spending in different programs, and also cost centres within TTMH were obtained directly for fiscal year 2014/2015. Expenditures by the two TTMH CSU (clinical service unit) divisions were treated as overhead spending, and allocated on a pro-rata basis to all the TTMH cost centres.

Patient Information System (PATIS)

Patient Information System (PATIS) is a modular, electronic database maintained by the NHS that records data on patients and patient treatments. It is designed to record data on all inpatient and outpatient visits, as well as details of all radiology investigations, with separate modules recording data in each domain, such as radiology tests, outpatient visits, etc. However, owing to problems such as the system being inoperable, not all data are entered, and there are often significant gaps in the data for specific time periods, in addition to other gaps resulting from errors or omissions in data entry.

The NHS uses a unique ID, the National Health Number (NHN), to identify individual patients, and there is provision in PATIS to record this for each patient encounter and radiology investigation. The NHN is valuable as it allows linkage of data across the different PATIS modules. Although the NHN was usually entered in the PATIS data, this is not consistently the case in other NHS databases, and so it is not possible to always link data in PATIS with the person-level records in the other databases.

In the following section, we detail the specific PATIS modules accessed and how the data were processed.

Inpatient admissions

The PATIS inpatient database records details of all inpatient admissions at TTMH, but almost all the data examined related to TTMH admissions. For each admission, PATIS records the NHN of the patient, the dates of admission and discharge, the patient date of birth and sex, the diagnoses coded using ICD-10, discharge outcome and ward. The data provided to the team consisted of 74,287 records covering the period from January 2012 to December 2015, but as noted it is likely that there were data gaps within this.

Following data cleaning, the patient age and length of stay (LOS) were computed from the available information. When LOS was missing, it was imputed as the average of the same ward-age-sex-diagnosis group. Small percentages of cases lacked valid age and sex

information, and these cases were redistributed over other records sharing the same diagnosis/ward information. The records were then mapped to our disease classification using mapping tables and algorithms.

The final imputed data file was used as the distribution key to allocate spending at TTMH inpatient wards across disease, age and sex, using LOS as the cost weight. In the case of admissions with zero LOS, i.e., same day discharges, the LOS value was changed to 0.5, since some costs would still have been involved. Where admissions were associated with multiple diagnoses, the cost of the admission was apportioned equally to each diagnosis. Separate cost allocations were computed for Medical, Surgical, Obstetric and Gynaecology, Paediatric and Intensive Care Unit wards.

Outpatient visits

The PATIS outpatient database records details of all outpatient visits at TTMH, but almost all the data examined related to TTMH encounters. For each visit, PATIS records the NHN of the patient, the date of encounter, the patient date of birth and sex, the diagnoses coded using ICD-10, and clinic. The data provided to the team consisted of 540,331 records covering the period from January 2012 to December 2015, but as noted it is likely that there were data gaps within this.

Following data cleaning, the patient age was computed from the available information. Small percentages of cases lacked valid age and sex information, and these cases were redistributed over other records sharing the same age/sex/clinic characteristics. The records were then mapped to our disease classification using mapping tables and algorithms.

The final imputed data file was used as the distribution key to allocate spending at TTMH clinics across disease, age and sex, treating each visit as having the same relative cost. Separate cost allocations were computed for A&E, general outpatients (GOPD) and specialist outpatients (SOPD), since these were separately available from the NHA analysis.

Radiology and imaging investigations

Table 9: Relative cost weights used when apportioning imaging costs

Investigation type	Cost weight
General X-ray	1.0
CT-scan	5.0
Ultrasound	2.0
Mammogram	1.0
Special X-rays	3.0

Note: Special X-rays include investigations such as barium enema, barium swallow, barium meal, intravenous pyelogram, retrograde urethrogram, sinogram, tomogram and urethrogram. Cost weights are based on review of cost studies from Malaysia and Sri Lanka, in the absence of specific cost data from Samoa.

The radiology PATIS database records details of X-ray and other radiology and ultrasound investigations provided at TTMH. For each investigation, the database records the type of investigation, the date, the NHN of the patient, the patient date of birth and sex, and the ward

or clinic unit that referred the patient. The data provided to the team consisted of 54,126 records covering the period from January 2012 to December 2015, but as noted it is likely that there were data gaps within this. The patient age was computed from the patient date of birth and date of investigation. The PATIS imaging data does not report the disease of the patients. This information was obtained by linking with the PATIS inpatient and outpatient databases using the NHN and date of investigation to find corresponding patient encounters. However, only 27% of the records could be matched in this way (55% of inpatient investigations, 23% of outpatient investigations). For the remaining ones the disease distribution was imputed assuming that the distributions within each ward/clinic and sex-age category were similar across linked and unlinked records. The final imputed data file was used as the distribution key to allocate spending at TTMH radiology department across disease, age and sex, having applied relative cost weights to the different types of investigation as given in Table 9.

Pharmacy LOTS databases

Data coverage

We obtained data from two pharmacy databases – the LOTS database of medicine procurements, and the linked LOTS dispensing database maintained at TTMH. The first database was used primarily for analysis of medicine procurement prices, and the second for analysis of how medicines were spent by disease.

LOTS dispensing database

The LOTS dispending database records details of medicines dispensed at TTMH. For each item dispensed, the database records the date, the patient NHN, the patient type and category, the type of medicine and its formulation, the quantity and the pharmacy inventory cost. The data provided to the team consisted of 1.6 million dispensed items covering the period from January 2012 to February 2016, but as with the other PATIS data, this contained many apparent data gaps. Additionally, we found that for a number of records the dispensing quantity was not correctly entered. This was particularly the case for medicines dispensed in non-tablet form. Where possible these errors were identified and corrected during data processing. This required time consuming effort.

The dispensing database does not report information on patient disease, age or sex. To incorporate these, we attempted to link each item to a patient inpatient or outpatient encounter recorded in the relevant PATIS database. We could only link 3.8% of the records in this way (4.5% of the inpatient items, N=4,559; 3.7% of the outpatient items, N=56,043). Of the records that we could link, we noted that in many cases a non-disease-specific ICD10 code was entered, even though the underlying disease was self-evident. For example, there were 3,210 matched records relating to drugs used in diabetes (WHO ATC code A10), but in only 598 records (18.6%) was the diagnosis recorded as diabetes. In many of the rest (1,284; 40%), the disease code used was a generic one relating to "persons encountering health services in other circumstances". For a number of medicines where the purpose is self-evident, such as medicines used in diabetes, anti-epileptics, lipid-lowering agents, etc., we accordingly recoded the disease code to the most relevant disease category. For the remaining unlinked records the disease, age and sex distributions were imputed assuming that the

distributions within each patient category and year were similar across linked and unlinked records. Owing to the small number of linked records, the inpatient medicines apportionment was based on the pooled linked records for the full time period. The final imputed data file was used as the distribution key to allocate spending by the pharmacy across disease, age and sex.

The method just described has its limitations. The main one is that it may over-estimate the allocation of spending to the diseases that benefit from the recoded spending. In fact this appears to be the case, as we found that if we did not recode any medicines at all, the share of spending that went to NCDs declined substantially. This is illustrated in Figure 11. Unfortunately there is no way to know which result is better without better data. However, as a validity check, we exploited a different estimation method that is under development in a separate project led by the Asia-Pacific NHA Network (APNHAN), and funded by the Global Fund. This other study, in which both IHP and CHIPSR are involved in, makes use of outpatient prescribing data from multiple countries to identify the most likely pattern of use of medicines when no prescribing data are available. We used this method to estimate how the medicines dispensed in TTMH might have been used, without reference to the Samoan prescribing data that we did have. This produced a third set of estimates, as shown in Figure 11, which lies in between the two other estimates. We suspect that this alternative method is the least biased of the three and probably the most accurate (especially if the injury component is adjusted to match the Samoan data), but as it does not use Samoan prescribing data at all we do not use it in the final analysis.

This third estimation, using the APNHAN-GFATM developed estimator, produces results which lie clearly in between the first two estimates, especially if the injury component is additionally adjusted to match the lower proportions seen in the Samoa data. This provides strong independent corroboration of our presumptions about the relative biases of the two first methods. Taking this into account, to obtain our final results, we averaged the estimates for the outpatient medicines category from the two methods of estimation; where one estimate was obtained by recoding the medicines (A) and the other where such recoding was not carried out (B).

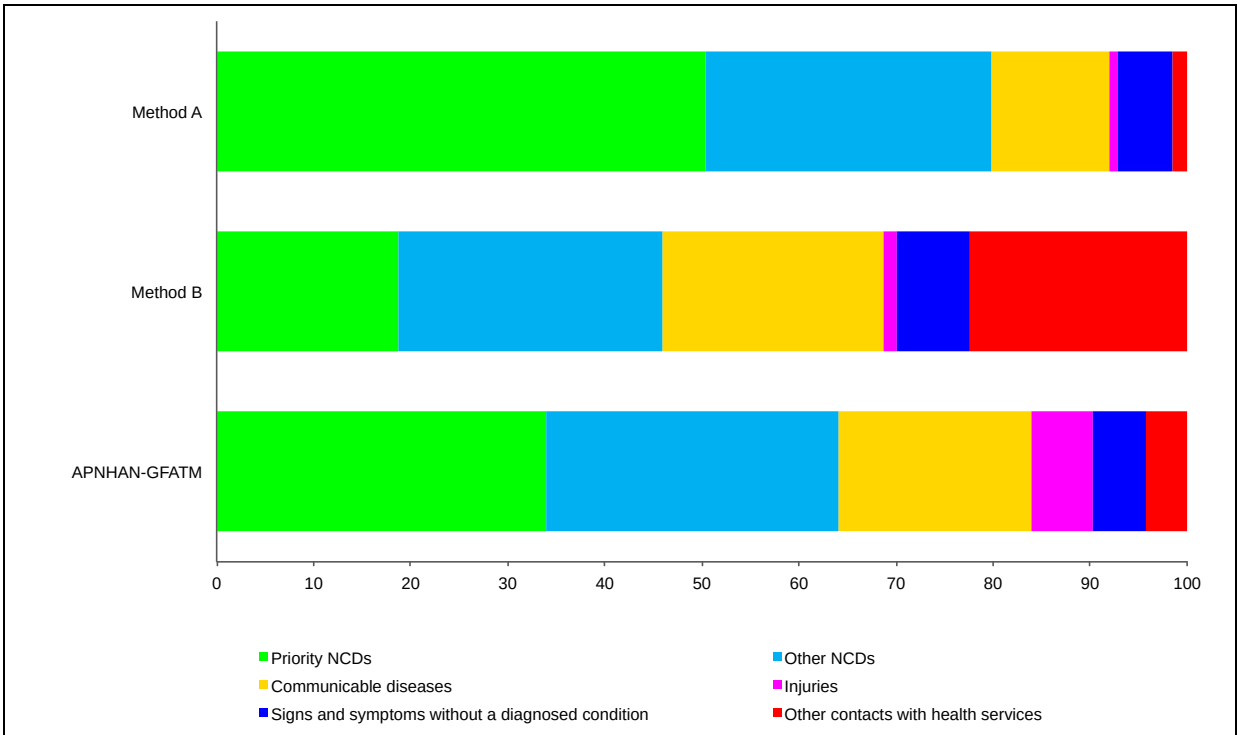

Figure 11: Estimates of pharmacy dispensing to outpatients by disease category using alternative methods (%)

Notes:

(i) Method A refers to the estimates developed using the first method described in the text, which reassigns spending on selected medicines to specific diseases. Method B refers to the estimates obtained when this recoding is not done, and assignation of medicines to disease is based purely on the matching records. APNHAN-GFATM refers to the third method that uses mapping algorithms developed by the ongoing GFATM-funded APNHAN project.

(ii) Priority NCDs are diabetes, cardiovascular disease, asthma, chronic obstructive pulmonary disease, chronic renal failure, and cancers

LOTS procurement database

The TTMH Pharmacy records all NHS medicines procurements using the LOTS database. The LOTS database records for each medicine purchased the purchase date, the type of medicine and its formulation, the quantity and the price paid. The TTMH Pharmacy provided the data covering calendar years 2012 to 2014, although significant periods within this data were not recorded owing to system outages. Consequently, the value of the medicines purchased each year in LOTs does not correspond well with the value of the medicines reported in the dispensing database: the latter was usually significantly higher.

The total cost of pharmaceuticals available in the LOTS data varied substantially across the three years, as did the proportion for which MPRs could be calculated (Table 7). This is likely because the LOTS database that was made available for the study is incomplete due to technical difficulties and other errors at the time of data entry. In a few instances, although an IRP is available, MPRs could not be calculated because of incomplete information on medicine formulation in the recorded in the database. For example, for many of the oral

liquid formulations, LOTS did not report the volume and as a result the price per millilitre could not be calculated.

The LOTS data were used for the analysis of medicine procurement prices. Where possible, all medicines in the LOTS database were matched by generic name, strength, formulation, and route of administration to the Management Sciences for Health [14]/WHO International Reference Prices for the relevant year.

For those medicines in the LOTS database that had a match with the MSH/WHO reference prices, the unit procurement price of each item was calculated according to the unit used in the MSH/WHO data. For example for tablet or suppositories unit prices are reported per tablet/capsule or per suppository, for parenteral formulations units prices are reported per vial/ampule/syringe or per millilitre, for oral and other liquid preparations unit prices are reported per millilitre, and for creams unit prices are reported in grams.

The per unit procurement prices were then converted to USD using the official exchange rates for each year as reported by the World Bank World Development Indicators (WDI) online database [15]. Following standard methods for comparing with the international reference price (IRP) [16], the median price ratio (MPR) was calculated at the level of the medicine formulation by using the following formula:

$$Median\ Price\ Ratio\ (MPR)\ = \frac{Procurement\ price\ per\ unit}{Median\ IRP}$$

For medicines where more than one procurement unit price was reported in a given year in LOTs, the cost weighted average MPR was computed.

Management Sciences for Health Drug Price Indicator Guide

The Management Sciences for Health [14] Drug Price Indicator Guide [16] provides comparative information on public procurement prices paid for medicines by a range of public sector medicine procurement agencies. Produced in collaboration with the WHO, WHO recommends its use for comparative assessment of medicines procurement prices [16].

Medicines included in the Management Sciences for Health [14] Drug Price Indicator Guide are those included in WHO's essential medicines (both core and complimentary) list and other therapeutic alternatives, and medicines used in the treatment or prevention of tuberculosis, malaria, and HIV/AIDS. In addition, the MSH Price Guide also includes prices for vaccines, immunologic agents, disinfectants, fluids and electrolytes, and some diagnostic tests and agents. The majority of the products in the list have generic equivalents. Annual updates to the price guide increasingly incorporate drugs used in the treatment of cancer and chronic disease care.

The MSH Drug Price Indicator Guide contains both supplier and buyer prices. Supplier prices in the Guide represent the prices offered by for-profit and not-for-profit suppliers to developing countries for generic equivalents. Buyer prices are actual prices paid by

government agencies and development organizations for medicines purchased through international competitive bidding, or tenders. Countries that provide information for buyer prices are predominantly from Latin America, the Caribbean and Africa. Most of these countries are upper-middle and lower-middle-income countries with a few low-income countries. In some instances, the information is reported not from individual countries, but from regional organizations such as the Central American Integration System and the Organization of the Eastern Caribbean States Pharmaceutical Procurement Service, which is a regional initiative to pool medicines purchasing by many small Caribbean island nations [16]. We used the buyer prices in our analysis of Samoa procurement prices.

The Guide reports multiple prices for most single medicine formulation, as buyer prices are available from a number of sources. In these cases, following WHO guidelines [16], we used the median price for price comparisons (*i.e.*, the median IRP).

The MSH Drug Price Indicator Guide is published online [16]. MSH obtains its prices in local currency, and it converts these to U.S. dollars at the exchange rate for each year. We used the data for 2014, which was the latest year available.

TTMH Operating Theatre Register

PATIS does not store details of operations conducted at TTMH, but details are recorded manually in paper registers maintained by the TTMH Operating Theatre. A sample of 2,386 records was obtained by taking photographs of a systematic sample of pages in the register covering the period from July 2014 to June 2015. A team of pre-internship medical graduates at IHP reviewed these records and transcribed the relevant information into a database. The final database contained information on the operating date, patient NHN, age and sex, the ICD-9 procedure code, ICD-10 diagnosis, and the start and end time of each operation.

Following data cleaning, the data file was used as the distribution key to allocate spending at TTMH Operating Theatre across disease, age and sex, using the time spent in the operating theatre as the cost weight.

TTMH Laboratory Information System

The TTMH Laboratory records details of laboratory tests performed in Excel spreadsheet files. Extracts of these covering the period 2014–2016 were provided to the study team, of which the study processed the information for July 2014 to June 2015 comprising information on 58,643 test orders. For each test order, the spreadsheet files reported the date, whether specific types of test had been conducted, and the clinical department or external entity that had ordered the test.

The NHN was also recorded as free text entries, but in practice was available only for 21% of test orders. It proved difficult to use this to match orders to specific patient encounters in the PATIS database. A team of pre-internship medical graduates at IHP reviewed the Excel spreadsheet files and reassembled the data into a standardized database structure. The diagnosis was entered in the original database in a text field, and was not coded or standardized. Given the limited time, only the priority NCDs for the study were identified by manual review and coded to ICD-10. Other records were left uncoded and are reported in the

final results as "Other (not priority NCD)": these can include both non-priority NCDs and other non-NCDs and conditions. As most laboratory tests were not definitively coded to a diagnosis, the possibility remains that we missed some laboratory tests that were treatment of the selected priority NCDs, and so our estimates may underestimate this spending.

Following data cleaning, the data were used as the distribution key to allocate spending at TTMH laboratory cost centre across the different clinical departments and activities, and disease, age and sex. It was assumed in the absence of better data that all laboratory tests cost the same in terms of resources.

NKFS Patient Register

The National Kidney Foundation of Samoa (NKFS) provides dialysis and other services to registered patients with chronic renal failure. It does not have a database that lists dialysis sessions with linked data on diagnosis, age and sex. In the absence of such, the list of newly registered patients during the period 2005 to 2016 was obtained. This contained information on the initial diagnosis, sex and age at time of registration.

The diagnosis was transcribed to ICD-10 codes by the study team, and the data incorporated in a single data file. This age, sex and disease distribution was then used to apportion spending by NKFS to disease, age and sex.

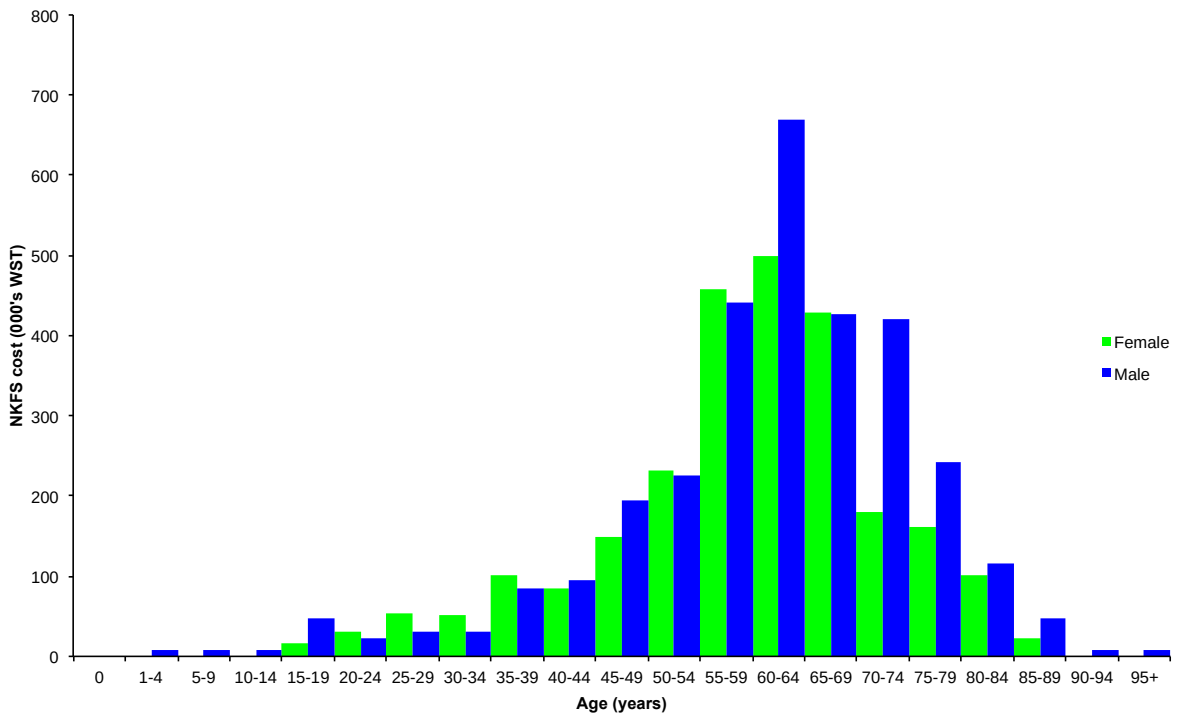

Figure 12: NKFS spending by age group and sex, 2014-15 (WST thousand)

Table 10: Spending by the NKFS by priority NCDs and other conditions, 2014-15 (%)

Condition	Cost (WST millions)	Percentage (%)
Cardiovascular diseases	1.8	32.0
Diabetes mellitus	1.1	19.7
Kidney diseases (exc. chronic disease)		
Non-inflammatory disorders of ovary, fallopian tube	*0.5*	*9.3*
Unspecified kidney failure	*0.2*	*3.1*
Other kidney diseases (exc. chronic disease)	*0.3*	*4.5*
Chronic renal failure	0.3	5.7
Other NCDs	0.3	5.3
Gout	0.3	5.1
Endocrine, blood, immune disorders	0.2	3.8
Chronic kidney disease - Other	0.3	5.0
Injuries	0.1	1.4
Communicable diseases	0.0	0.5
Cancer	0.0	0.4
Asthma	0.0	0.2
Chronic obstructive pulmonary disease	0.0	0.0
Signs and symptoms without a diagnosed condition	0.1	1.4
Other contacts with health services	0.2	2.7
Total	**5.7**	**100.0**

Preventive and public health activities

MOH spent a total of WST 3.9 million on a number of preventive and public health programmes, as well as subventions to local organizations involved in disease-related work, such as the Diabetes Association and Samoa AIDS Foundation. The exact amount spent on each activity or as a subvention was obtained from the MOH budgetary reports, and then apportioned to specific disease conditions based on assessment of programme documentation and information provided by key informants. Table 11 gives a listing of the relevant items of expenditure, and Table 12 and Table 13 gives the final estimated distribution of spending by all these programmes by major condition/disease category.

Table 11: Budgetary line items for preventive and public health activities separately apportioned to disease, 2014-15

Budget line	Expenditure (WST millions)
Health protection & enforcement division	1.93
National health surveillance & international health regulation	0.31
Drinking water quality & sanitation monitoring & awareness	0.12
Special expenditure (WHO Grant)	1.04
Diabetes association clinic	0.01
Diabetes association services	0.39
Samoa AIDS foundation	0.03
Samoa cancer society	0.04

Note: Apportionment of spending in above items to disease consistent with estimates of NHA 2016 study.

Table 12: Estimated spending by preventive and public health activities by priority NCDs, 2014-15 (%)

Condition	Cost (WST millions)	Percentage (%)
Communicable diseases	1.3	34
Diabetes mellitus	0.6	15
Cardiovascular diseases	0.4	10
Other contacts with health services	0.2	5
Injuries	0.1	3
Cancer	0.1	2
Other NCDs	0.1	4
NCDs that could not be determined	1.0	26
Total	**3.9**	**100**

Table 13: Estimated spending by preventive and public health activities by priority NCDs and other conditions, 2014-15 (%)

Condition	Cost (WST millions)	Percentage (%)
Diabetes mellitus	0.6	15.3
Diarrheal diseases	0.2	5.2
Hypertensive heart disease	0.2	5.0
Other cardiovascular diseases	0.2	5.0
Maternal conditions	0.2	4.7
HIV/AIDS	0.1	3.6
Injuries	0.1	3.5
Tuberculosis	0.1	3.2
Respiratory infections	0.1	2.5
Sexually transmitted diseases (STDs) excluding HIV	0.1	2.3
Malignant neoplasms	0.1	2.0
Respiratory diseases	0.0	1.3
Oral conditions	0.0	1.3
Mental and behavioral disorders	0.0	1.3
Infectious and parasitic diseases that could not be determined	0.7	17.6
NCDs that could not be determined	1.0	26.3
Total	**3.9**	**100.0**

Overseas Medical Treatment Scheme

The Overseas Medical Treatment Scheme (OTS) accounts for a substantial amount of government spending on health, of the order of 10–15% in recent years [1] The study team obtained data from the NHS on what patients were funded by this programme and their associated costs. We used this information to allocate the costs of this programme to disease, age and sex. Table 4 summarizes the estimated distribution of spending by priority NCDs and other diseases and conditions, and Figure 13 illustrates the distribution of spending by disease and age.

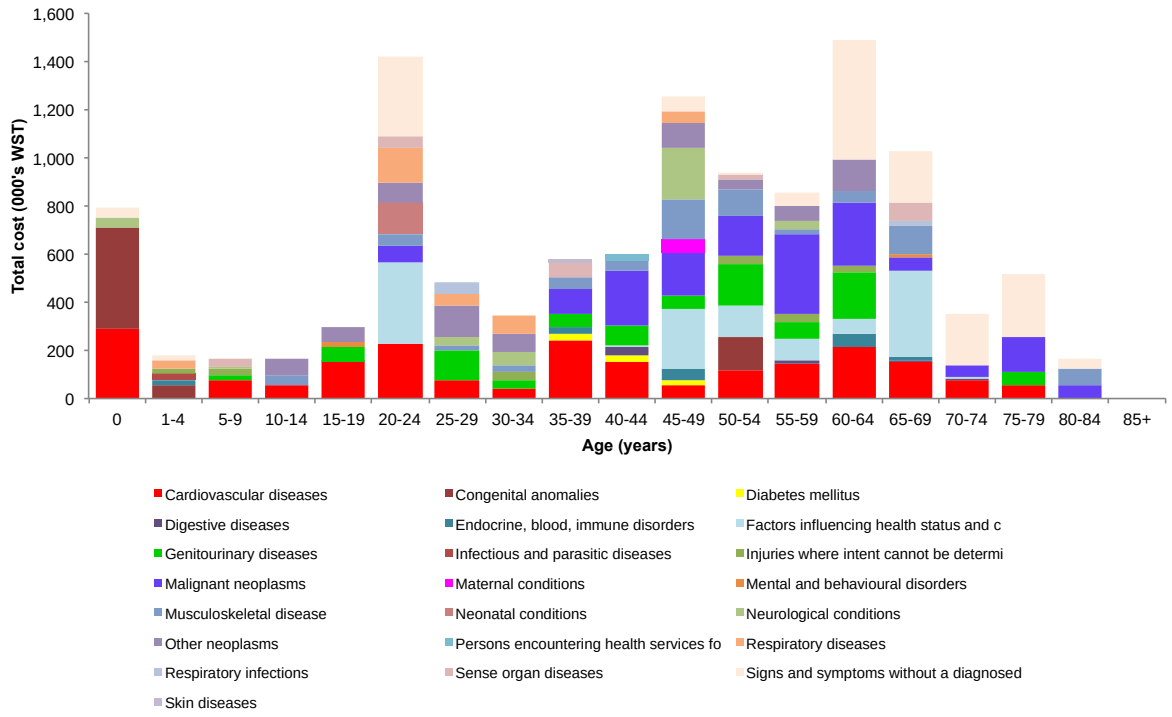

Figure 13: OTS spending by disease and age group, 2014-2015 (WST thousand)

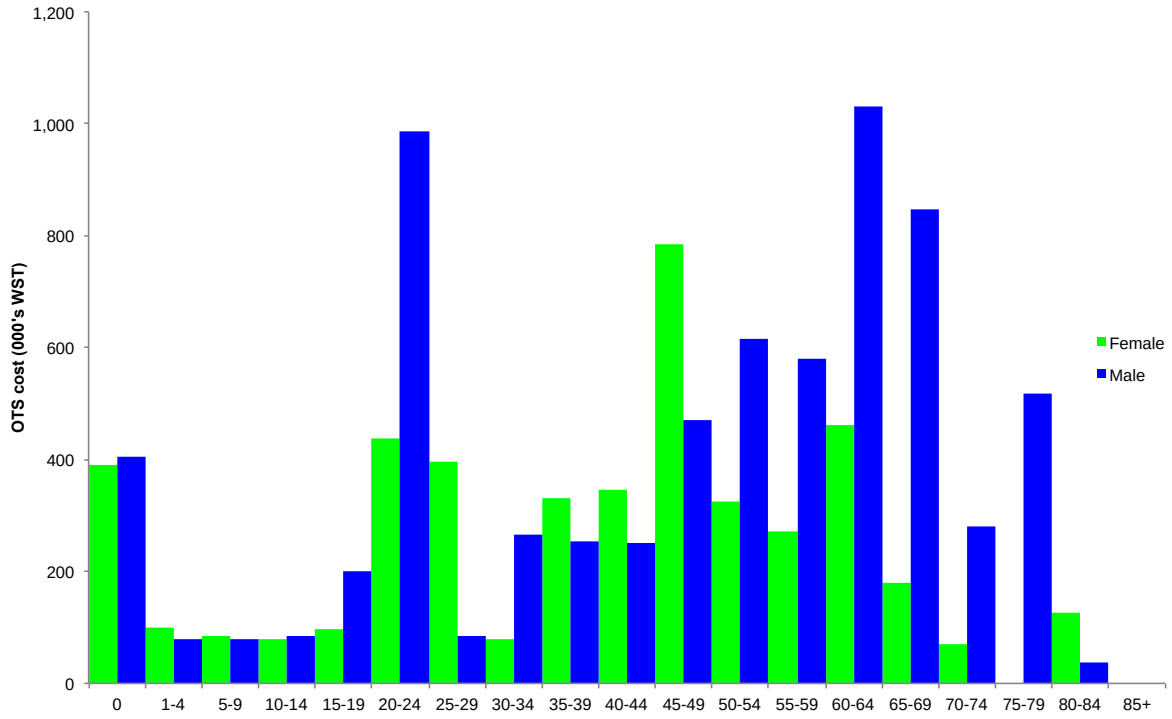

Figure 14: OTS spending by age group and sex, 2014-2015 (WST thousand)

Annex Tables

Annex Table 1: Official exchange rate, WST per US$, 2012-15

Year	WST per US$
2012	2.29
2013	2.31
2014	2.33
2015	2.56

Source: World Bank Development Indicators, official exchange rate (LCU per US$, period average), accessed 22nd March 2017.

Annex Table 2: Classification of disease/condition used in analysis and corresponding ICD-10 codes

DSA Code	Cause/condition	ICD-10 code
1	**Communicable, maternal, perinatal and nutritional conditions**	
1A	Infectious and parasitic diseases	
1A01	Tuberculosis	A15-A19, B90, E350, H488, K230, K673, K930, M011, M490, N740, N741
1A02	Sexually transmitted diseases (STDs) excluding HIV	
1A02a	Syphilis	A50-A53, G22, H480, H940, K672, L998, M031, N742
1A02b	Chlamydia	A55-A56, N744
1A02c	Gonorrhoea	A54, K671, N743
1A02d	Trichomoniasis	A59
1A02e	Other STDS	A57-A58, A60-A64, N70-N73
1A03	HIV/AIDS	B20-B24
1A04	Diarrhoeal diseases	A00,A01, A03, A04, A06-A09, M076
1A05	Childhood-cluster diseases	
1A05a	Whooping cough	A37
1A05b	Diphtheria	A36, I430
1A05c	Measles	B05
1A05d	Tetanus	A33-A35
1A06	Meningitis	A39, G00, G03, I520, M010, M030
1A07	Encephalitis	A83-A86, B94.1, G04
1A08	Hepatitis B	B16-B19 (except B17.1, B18.2)
1A09	Hepatitis C	B17.1, B18.2
1A10	Parasitic and vector diseases	
1A10a	Malaria	B50-B54, P37.3, P37.4
1A10b	Trypanosomiasis	B56
1A10c	Chagas disease	B57, K231, K931
1A10d	Schistosomiasis	B65
1A10e	Leishmaniasis	B55
1A10f	Lymphatic filariasis	B740-B742
1A10g	Onchocerciasis	B73, H428
1A10h	Leprosy	A30
1A10i	Dengue	A90-A91, A97
1A10j	Trachoma	A71
1A10k	Rabies	A82
1A11	Intestinal nematode infections	
1A11a	Ascariasis	B77
1A11b	Trichuriasis	B79
1A11c	Hookworm disease	B76
1A12	Other infectious diseases	A02, A05, A20-A28, A31, A32, A38, A40-A49, A65-A70, A74-A79, A80-A81, A87-A89, A92-A99 (except A97), B00-B04, B06-B15, B25-B49, B58-B60, B64, B66-B72, B74.3-B74.9, B75, B80-B89, B78, B91-B99 (except B94.1), H620, K670, M012, M014, M015, M016, M491, H621, M032
1B	Respiratory infections	
1B01	Lower respiratory infections	J09-J22, P23, U04

DSA Code	Cause/condition	ICD-10 code
1B02	Upper respiratory infections	J00-J06
1B03	Otitis media	H65-H68
1C	Maternal conditions	
1C01	Maternal haemorrhage	O44-O46, O67, O72
1C02	Maternal sepsis	O85-O86
1C03	Hypertensive disorders of pregnancy	O10-O16
1C04	Obstructed labour	O64-O66
1C05	Abortion	O00-O07, O08-O089
1C06	Other maternal conditions	O20-O43, O47-O63, O68-O71, O73-O75, O87-O99, O76
1C07	Pregnancy, delivery, post-natal care	O80-O84
1C08	Antenatal screening and other supervision of pregnancy	Z34-Z36, O09
1C09	Liveborn infants according to place of birth	Z38
1C10	Postpartum care and examination	Z39
1D	Neonatal conditions	
1D01	Preterm birth complications	P05, P07, P22, P27-P28
1D02	Birth asphyxia and birth trauma	P03, P10-P15, P20-P21, P24-P26, P29, P19
1D03	Neonatal sepsis and infections	P35-P39 (except P37.3, P37.4)
1D04	Other neonatal conditions	P00-P02, P04, P08, P50-P96, P09
1E	Nutritional deficiencies	
1E01	Protein-energy malnutrition	E40-E46
1E02	Iodine deficiency	E00-E02
1E03	Vitamin A deficiency	E50
1E04	Iron-deficiency anaemia	D50, D64.9
1E05	Other nutritional disorders	D51-D53, E51-E64, I432
2	**Non-communicable diseases**	
2A	Malignant neoplasms	
2A01	Mouth and oropharynx cancers	C00-C14
2A02	Oesophagus cancer	C15
2A03	Stomach cancer	C16
2A04	Colon and rectum cancers	C18-C21
2A05	Liver cancer	C22
2A06	Pancreas cancer	C25
2A07	Trachea, bronchus and lung cancers	C33-C34
2A08	Melanoma and other skin cancers	C43-C44
2A09	Breast cancer	C50
2A10	Cervix uteri cancer	C53
2A11	Corpus uteri cancer	C54-C55
2A12	Ovary cancer	C56
2A13	Prostate cancer	C61
2A14	Bladder cancer	C67
2A15	Lymphomas and multiple myeloma	C81-C90, C96
2A16	Leukaemia	C91-C95
2A17	Other malignant neoplasms	C17, C23, C24, C26-C32, C37-C41, C45-C49, C51, C52, C57-C60, C62-C66, C68-C80, C97, M495

DSA Code	Cause/condition	ICD-10 code
2B	Other neoplasms	D00-D48, D49
2C	Diabetes mellitus	E10-E14, E08, E09
2D	Endocrine, blood, immune disorders	D55-D64 (except D64.9), D65-D89, E03-E07, E15-E34, E65-E88, M143, M144, H420
2E	Mental and behavioural disorders	
2E01	Unipolar depressive disorders	F32-F33, F34.1
2E02	Bipolar affective disorder	F30-F31
2E03	Schizophrenia	F20-F29
2E04	Alcohol use disorders	F10, X45
2E05	Drug use disorders	F11-F16, F18-F19, X41-X42
2E06	Anxiety disorders	F40-F44
2E07	Eating disorders	F50
2E08	Pervasive developmental disorders	F84
2E09	Childhood behavioural disorders	F90-F92
2E10	Idiopathic intellectual disability	F70-F79
2E11	Other mental and behavioural disorders	F04-F09, F17, F34-F39 (except F34.1), F45-F48, F51-F69, F80-F83, F88-F89, F93-F99, N53
2F	Neurological conditions	
2F01	Alzheimer's disease and other dementias	F01-F03, G30-G31, F00
2F02	Parkinson disease	G20-G21
2F03	Epilepsy	G40-G41
2F04	Multiple sclerosis	G35
2F05	Migraine	G43
2F06	Non-migraine headache	G44
2F07	Other neurological conditions	G06-G12, G23-G25, G36-G37, G45-G98, H282
2F08	Neurological conditions - Other	G138, G14, G26, G32
2G	Sense organ diseases	
2G01	Glaucoma	H40
2G02	Cataracts	H25-H26
2G03	Refractive errors	H49-H52
2G04	Macular degeneration	H35.3
2G05	Other vision loss	H30-H35 (except H35.3), H53-H54
2G06	Other hearing loss	H90-H91
2G07	Other sense organ disorders	H00-H21, H27, H43-H47, H55-H61, H69-H83, H92-H93
2H	Cardiovascular diseases	
2H01	Rheumatic heart disease	I01-I09
2H02	Hypertensive heart disease	I10-I15
2H03	Ischaemic heart disease	I20-I25
2H04	Stroke	I60-I69
2H05	Cardiomyopathy, myocarditis, endocarditis	I30-I33, I38, I40, I42, M036
2H06	Other cardiovascular diseases	I00, I26-I28, I34-I37, I44-I51, I70-I99 (remove I84)
2I	Respiratory diseases	
2I01	Chronic obstructive pulmonary disease	J40-J44
2I02	Asthma	J45-J46
2I03	Other respiratory diseases	J30-J39, J47-J98
2J	Digestive diseases	

DSA Code	Cause/condition	ICD-10 code
2J01	Peptic ulcer disease	K25-K27
2J02	Cirrhosis of the liver	K70, K74
2J03	Appendicitis	K35-K37
2J04	Other digestive diseases	K20-K22, K28-K31, K38-K66, K71-K73, K75-K92, I84, K68, K94
2K	Genitourinary diseases	
2K01	Kidney diseases (exc. chronic disease)	N00-N19, (remove N180 - N185, N189)
2K02	Hyperplasia of prostate	N40
2K03	Urolithiasis	N20-N23
2K04	Other genitourinary disorders	N25-N39, N41-N45, N47-N51, N52
2K05	Infertility	N46, N97
2K06	Gynaecological diseases	N60-N64, N75-N76, N80-N96, N98, N65
2K07	Chronic kidney disease	
2K07a	Chronic renal failure	N185, G998,
2K07b	Chronic kidney disease - Other	N180-N184, N189,
2L	Skin diseases	L00-L98, H624, M070, M071, M072, M073, M090,
2M	Musculoskeletal disease	
2M01	Rheumatoid arthritis	M05-M06, I528, J990
2M02	Osteoarthritis	M15-M19
2M03	Gout	M10, G991, H628
2M04	Back and neck pain	M45-M48, M50-M54
2M05	Other musculoskeletal disorders	M00, M02, M08, M11-M13, M20-M43, M60-M99, G058, J991, N778
2M06	Musculoskeletal diseases - Other	M098
2N	Congenital anomalies	
2N01	Neural tube defects	Q00, Q05
2N02	Cleft lip and cleft palate	Q35-Q37
2N03	Down syndrome	Q90
2N04	Congenital heart anomalies	Q20-Q28
2N05	Other chromosomal anomalies	Q91-Q99
2N06	Other congenital anomalies	Q01-Q04, Q06-Q18, Q30-Q34, Q38-Q89
2O	Oral conditions	
2O01	Dental caries	K00-K04, K06-K14, M26, M27
2O02	Periodental disease	K05
2O03	Edentulism	
3	**Injuries**	
3A	Unintentional injuries	
3A01	Road injury	V01-V04, V06, V09-V80, V87, V89, V99
3A02	Poisonings	X40, X43-X44, X46-X49
3A03	Falls	W00-W19
3A04	Fire, heat and hot substances	X00-X19
3A05	Drownings	W65-W74
3A06	Exposure to forces of nature	X30-X39
3A07	Other unintentional injuries	V00, V05, V07-V08, V81-V86, V88, V90-V98, W20-W64, W75-W99, X20-X29, X50-X59, Y40-Y86, Y88, Y89
3B	Intentional Injuries	

DSA Code	Cause/condition	ICD-10 code
3B01	Self harm	X60-X84, Y870
3B02	Interpersonal violence	X85-Y09, Y871
3B03	Collective violence and legal intervention	Y35-Y36
3C	Injuries where intent cannot be determined	
3C01	Traumatic injuries	S00-T19, T79, T90-T94, T980, T982
3C02	Burns and corrosive injuries	T20-T32
3C03	Poisoning and toxic effects	T36-T65, T96, T97
3C04	Other injuries	T33-T35, T66-T78, T80-T88, T981, T983
7	**Signs and symptoms without a diagnosed condition**	**R00-R99, G89, R37, R97, I96**
8	**Other Contacts with Health Services**	
8A	Factors influencing health status and contact with health services	
8A01	Persons encountering health services for examination and investigation	Z00-Z13
8A02	Asymptomatic human immunodeficiency virus [HIV] infection status	Z21
8A03	Other persons with potential health hazards related to communicable disease	Z20, Z22-Z29
8B	Persons encountering health services for specific procedures and health care	Z40-Z54
8C	Persons encountering health services for other reasons	Z31-Z33, Z37, Z55-Z99
8D	Post procedural complications	E89, H95, N99, T89, E36, D78
8E	Family planning	Z30
8F	Other	E90, U06-U85, U88-U89, Y33-Y34, Y872, Y90-Y98, Z14, Z15, Z16, Z17, Z18, Z68, Z69, Z77, Z78, Z79

Note: All other ICD-10 codes not mentioned are remapped to categories listed above according to specific algorithms and mapping rules.

Annex Table 3: Median price ratio for medicine formulations in LOTS data, 2012-2014

Medicine/formulation	2012	2013	2014	PEN category
Acetazolamide 250 mg Tab-cap	7.37	5.32		
Acetylsalicylic Acid 300 mg Tab-cap	1.28	0.38	0.32	Aspirin
Acetylsalicylic Acid 100 mg Tab-cap	4.96	4.42	2.9	Aspirin
Aciclovir 400 mg Tab-cap	1.44	0.59		
Aciclovir (Powder) 250 mg Vial	0.36			
Adenosine 3 mg/ml Ampoule	3.51	3.61		
Allopurinol 100 mg Tab-cap	1.71	1.6		
Allopurinol 300 mg Tab-cap	1.1	1.04		
Aminophylline 25 mg/ml Ampoule	2.9	1.59		
Amiodarone 50 mg/ml Vial	0.96	2.16		
Amitriptyline 25 mg Tab-cap	1.19	0.64		
Amoxicillin 500 mg Tab-cap	1.14	1.14	1.07	Amoxicillin
Amoxicillin 250 mg/5 ml Suspen	2.46	2.22	2.61	Amoxicillin
Amoxicillin 125 mg/5 ml Suspen	3.29	2.32	1.69	Amoxicillin
Amoxicillin 250 mg Tab-cap	2.55	2.36		Amoxicillin
Amoxicillin+Clavulanic Acid 500mg+125mg Tab-cap	1.2	1.48	1.23	
Amoxicillin+Clavulanic Acid 125 + 31.25 mg/5ml Suspen		0.85		
Amoxicillin+Clavulanic Acid 250 + 62.5 mg/5ml Suspen	1.03	1.04	1.63	
Amoxicillin+Clavulanic Acid 1000+200 mg Vial	0.52			
Ampicillin 1 g Vial	0.33	0.7		
Atenolol 100 mg Tab-cap	1.28	1.11		Beta-blocker
Atenolol 50 mg Tab-cap	2.42	1.97		Beta-blocker
Atorvastatin 10 mg Tab-cap	5.86		3.06	Statin
Atorvastatin 20 mg Tab-cap	0.37	0.71	0.68	Statin
Atorvastatin 40 mg Tab-cap		0.33		Statin
Atracurium 10 mg/ml Ampoule	0.66	0.65		
Atropine Sulfate 1 mg/ml Ampoule	1.6	1.31		
Azathioprine 50 mg Tab-cap	2.51	2.75		
Beclometasone 100 Mcg/Dose 100 mcg/dose Inhaler	0.65	0.61	1	Beclometasone
Bendroflumethiazide 2.5 mg Tab-cap	13.63	2.49	3.02	Thiazide
Benzatropine Mesilate 1 mg/ml Ampoule	12.09	3.08		
Betamethasone (Opht/Otic) 0.1% Opht drop	0.78			
Betamethasone Valerate 0.1% Cream	1.37	1.19	0.79	
Bisacodyl 5 mg Tab-cap	0.78	0.44	0.44	
Bisacodyl 10 mg Suppos	1.75	1.16		
Bupivacaine Hcl 0.5% Ampoule	11.45	8.91	27.38	
Calamine -9 Lotion	2.36	2.35		
Calcium Chloride 10% Vial	32.91	31.29		
Calcium Gluconate 100 mg/ml Ampoule	1.81	3.06		

Medicine/formulation	2012	2013	2014	PEN category
Captopril 50 mg Tab-cap	5.26	1.65	0.34	ACE Inhibitor
Carbamazepine 100 mg/5 ml Suspen	0.01			
Carbamazepine 200 mg Tab-cap	0.88	0.93		
Carbimazole 5 mg Tab-cap	1.84	2.14	2.49	
Cefalexin 250 mg Tab-cap	1.57	1.28	1.46	
Ceftazidime 1 g Vial	2.96			
Ceftriaxone 1 g Vial	0.85	1.07		
Cefuroxime 750 mg Vial	0.51	0.88		
Cetrimide+Chlorhexidine Gluconate 15%+1.5% Solution	0.86	0.82		
Chloramphenicol 125 mg/5 ml Suspen	2.28	1.09		
Chloramphenicol 250 mg Tab-cap	1.2	0.79		
Chloramphenicol (Base) 1 g Vial	1.99	1.99		
Chlorphenamine Maleate 4 mg Tab-cap	5.74	5.28		
Chlorpromazine Hcl 25 mg/ml Ampoule	2.57	2.44		
Chlorpromazine Hcl 100 mg Tab-cap	2.27	1.56		
Ciprofloxacin 500 mg Tab-cap	4.07	3.64	3.62	
Ciprofloxacin 250 mg Tab-cap	0.74	0.84	0.76	
Clindamycin (Base) 150 mg Tab-cap	5.04			
Clomifene 50 mg Tab-cap	0.46			
Clotrimazole 1% Cream	7.6	7.3		
Codeine [13] 30 mg Tab-cap	0.44	0.77		Codeine
Colchicine 0.5-0.6 mg Tab-cap	1.87	1.83	3.57	
Dexamethasone 5 mg/ml Ampoule		2.55		
Dexamethasone 4 mg/ml Ampoule	1.57	1.04		
Dextrose 5% In Water -9 Solution	1.51	1.49		Dextrose infusion
Dextrose In Water 10% Solution	1.18	0.97		Dextrose infusion
Dextrose In Water (Hypertonic) 50% Solution	3.77	2.98		Glucose injectable solution
Diazepam [13] 5 mg/ml Ampoule	2.59	2.21		Diazepam
Diazepam [13] 5 mg Tab-cap	11.26	8.05		Diazepam
Diazepam [13] 2 mg Tab-cap		10.98		Diazepam
Diclofenac 12.5 mg Suppos		0.27		
Diclofenac Sodium 50 mg Tab-cap	9.35	3.93	4.06	
Diclofenac Sodium 25 mg/ml Ampoule	10.41	5.79		
Digoxin 0.25 mg Tab-cap	0.68	0.82	0.27	
Digoxin 0.25 mg/ml Ampoule	0.29	0.48		
Dobutamine 12.5 mg/ml Vial	2.03	2.04		
Dopamine Hcl 40 mg/ml Ampoule	1.24	1.27		
Doxycycline 100 mg Tab-cap	1.26	1.18		
Enalapril 5 mg Tab-cap	0.74	0.87	0.9	ACE Inhibitor
Enalapril 20 mg Tab-cap	5.74	3.28	4.42	ACE Inhibitor

Medicine/formulation	2012	2013	2014	PEN category
Enoxaparin 60 mg Syringe		2.36		
Ephedrine 30 mg/ml Vial	1.26	1.31		
Epinephrine (Adrenaline) 1 mg/ml Ampoule	7.44	3.41		Epinephrine
Erythromycin (Base) 125 mg/5 ml Suspen	1.16	0.86		Erythromycin
Erythromycin (Base) 250 mg Tab-cap	1.32	1.21		Erythromycin
Estrogens, Conjugated 0.625 mg Tab-cap		2.3		
Fentanyl Citrate [13] 50 mcg/ml Vial	2.81	2.66		
Ferrous Salt (Iron=60-65 Mg) 200 mg Tab-cap	1.45	0.52		
Ferrous Salt+Folic Acid (Iron=60 Mg) 200+0.25 mg Tab-cap	7.15	8.32	8.25	
Flucloxacillin 250 mg Tab-cap	2.34	1.43	1.86	
Flumazenil 0.1 mg/ml Vial	1.86			
Fluoxetine 20 mg Tab-cap	2.62	2.39		
Fluphenazine Decanoate 25 mg/ml Ampoule	0.14	0.43		
Folic Acid 5 mg Tab-cap	9.48			
Furosemide 40 mg Tab-cap	1.3	0.87	1.03	Furosemide
Furosemide 10 mg/ml Ampoule	2.44	2.11		Furosemide
Gentamicin Sulfate 40 mg/ml Ampoule	3.78	1.09		
Glibenclamide 5 mg Tab-cap	15.66	11.65	7.23	Glibenclamide
Gliclazide 80 mg Tab-cap	1.67			
Glutaraldehyde 2% Solution		1.12		
Griseofulvin 500 mg Tab-cap	1.59	1.28		
Haloperidol 5 mg Tab-cap	0.77			
Haloperidol 5 mg/ml Ampoule	1.97	1.51		
Heparin 5000 iu/ml Ampoule	1.04	0.99		Heparin
Hydralazine 20 mg Ampoule	4.06	1.25		
Hydrocortisone 1% Cream	3.97	2.74		
Hydrocortisone (Sodium Succinate) 100 mg Vial	0.67	0.68		Hydrocortisone
Hydrogen Peroxide 6% Solution	16.32	6.22	13.37	
Hyoscine Butylbromide 10 mg Tab-cap	1.35	1.19	1.25	
Hyoscine Butylbromide 20 mg/ml Ampoule	1.27	1.3	14.72	
Ibuprofen 100 mg/5 ml Suspen	0.01	0.01		Ibuprofen
Ibuprofen 400 mg Tab-cap	1.73	1.6	1.45	Ibuprofen
Indometacin 25 mg Tab-cap	2.05	1.99		
Insulin, Isophane (Nph) 100 iu/ml Vial	8.59	11.98		Insulin
Insulin, Neut. Sol/Isophane 30/70 (Human, Mixtard) 100 iu/ml Vial	1.22	1.41		Insulin
Insulin, Neutral Soluble (Regular) 100 iu/ml Vial	7.5	8.52		Insulin
Isoflurane -9 Liquid	3.84	3.98		
Ketamine 50 mg/ml Vial	14.15	17.64		
Lactulose 3.35 g/5 ml Solution	0	0	0	
Levodopa+Carbidopa 100+25 mg Tab-cap	3.34	3.26		

Medicine/formulation	2012	2013	2014	PEN category
Levothyroxine 50 mcg Tab-cap	4.21	4.22		
Levothyroxine 100 mcg Tab-cap	3.89	3.74		
Lidocaine Hcl 2% Vial	2.16	2.64	1.07	
Lidocaine Hcl 1% Vial	1.21	1.01		
Lidocaine+Epinephrine 1%+1:100000 Vial		12.98		
Loperamide Hcl 2 mg Tab-cap		2.62	1.56	
Loratadine 10 mg Tab-cap	2.99	3.14		
Losartan 50 mg Tab-cap	0.71	0.98	0.64	
Magnesium Sulfate 50% Vial	2.48	2.4		Magnesium sulphate
Mannitol 20% Solution	1.02	0.76		
Mebendazole 100 mg Tab-cap	86.89	63.21		
Medroxyprogesterone 10 mg Tab-cap			0.86	
Medroxyprogesterone 5 mg Tab-cap	1.02	1.13		
Metformin Hcl 500 mg Tab-cap	1.95	3.75	1.8	Metformin
Methyldopa 250 mg Tab-cap	0.87	0.64		
Metoclopramide Hcl 10 mg Tab-cap	6.46	6.41	3.94	
Metoclopramide Hcl 5 mg/ml Ampoule	0.81	1.14		
Metronidazole 400-500 mg Tab-cap	2.83	2.58	2.52	
Midazolam [13] 1 mg/ml Ampoule	4.85	6.26		
Misoprostol 200 mcg Tab-cap	1.88	4.54		
Morphine Sulfate [13] 10 mg/ml Ampoule	1.93	1.85		Morphine
Naloxone Hcl 0.4 mg/ml Ampoule	4.91	3.61		
Naloxone Hcl 0.02 mg/ml Vial		4.53		
Naproxen 250 mg Tab-cap	2.41	1.62	1	
Neostigmine Methylsulfate 2.5 mg/ml Ampoule	2.63	2.61		
Nifedipine 10 mg Tab-cap	18.6	20.62		
Nifedipine (Sustained-Release) 30 mg Tab-cap	3.52	1.29	2.73	CCB - (long-acting)
Nifedipine (Sustained-Release) 20 mg Tab-cap		4.08		CCB - (long-acting)
Nitrofurantoin 100 mg Tab-cap	2.1	1.28		
Norepinephrine 1 mg/ml Vial		5.32		
Norethisterone 5 mg Tab-cap	0.48	0.84		
Nystatin 100000 iu/ml Suspen	2.22	1.9	2.78	
Omeprazole 20 mg Tab-cap	1.97	1.74		
Oral Rehydration Salts [13] 1 pkt/1 l Powder	0.8	0.79	1.72	
Oxytocin 10 iu Ampoule	1.49	1.19		
Paracetamol 500 mg Tab-cap	0.77	0.72	0.84	Paracetamol
Paracetamol 250 mg Suppos	1.54	1.34		Paracetamol
Paracetamol 500 mg Suppos	0.12	0.12		Paracetamol
Paracetamol 120 mg/5 ml Suspen	1.01	0.68	0.61	Paracetamol
Paracetamol 125 mg Suppos	2.05	2.06		Paracetamol
Paraffin, Liquid (Mineral Oil) -9 Liquid	0.44			

Medicine/formulation	2012	2013	2014	PEN category
Penicillin, Benzyl (600 Mg, Pen. G) 1m iu Powder	0.16	0.39		Penicillin
Penicillin, Phenoxymethyl (Pen. V) 250 mg Tab-cap	1	0.79	1.07	
Penicillin, Phenoxymethyl (Pen. V) 125 mg/5 ml Suspen		2.41		
Penicillin, Phenoxymethyl (Pen. V) 250 mg/5 ml Syrup	2.19	2.17		
Penicillin, Procaine Benzyl (2.4 G Of Pen. G) 4m iu Powder	5.07	4.49		
Permethrin 5% Cream		0.94	0.78	
Pethidine Hcl [13] 50 mg/ml Ampoule	4.53	3.96		
Phenobarbital [13] 30 mg Tab-cap			2.17	
Phenytoin 100 mg Tab-cap	0.97	1.23	1.08	
Phenytoin 50 mg/ml Ampoule	3.89	4.99		
Potassium Chloride 600 mg Tab-cap		0.73		
Potassium Chloride 15% Vial	7.76	7.69		
Povidone Iodine 10% Solution	3.39	2.76	2.22	
Prednisolone 5 mg Tab-cap	2.59	2.36	1.64	Prednisolone
Prochlorperazine 5 mg Tab-cap	9.85	5.51		
Promethazine Hcl 25 mg Tab-cap	0.22	2.6		Promethazine
Promethazine Hcl 5 mg/5 ml Suspen	7.25	4.95		Promethazine
Promethazine Hcl 25 mg/ml Ampoule	0.28	0.23	0.31	Promethazine
Propofol 10 mg/ml Vial	1.16	1.29		
Propranolol Hcl 40 mg Tab-cap	1.13	0.82		Beta-blocker
Protamine Sulfate 10 mg/ml Ampoule	0.89	0.89		
Ranitidine 25 mg/ml Ampoule	0.95	0.94		
Ranitidine 150 mg Tab-cap	2.94	2.57	2.52	
Risperidone 2 mg Tab-cap	5.05	6.97		
Salbutamol 100 Mcg/Dose 100 mcg/dose Inhaler	1.86	1.69	2.3	Salbutamol
Salbutamol 2 Mg/5 Ml 2 mg/5 ml Syrup	8.72	8.65	10.01	Salbutamol
Salbutamol 4 Mg 4 mg Tab-cap	1.45	0.68		Salbutamol
Sevoflurane -9 Solution	1.97	1.56		
Silver Sulfadiazine 1% Cream	1.68	1.79	1.43	
Sodium Bicarbonate 8.4% Solution	96.86	51.99		
Sodium Chloride In Water (Normal Saline) 0.9% Solution	3.11	2.5	1.4	Sodium chloride infusion
Sodium Lactate Compound (Ringer'S/Hartmann'S Sol.) -9 Solution	3.24	3.85		
Sodium Valproate 200 mg Tab-cap	1.21	1.2		
Spironolactone 25 mg Tab-cap		1.68	1.22	Spironolactone
Streptokinase (Powder) 1,500,000 iu Vial	7.5	3.47		
Sulfamethoxazole+Trimethoprim (Co-Trimoxazole) 200+40mg/5ml Suspen	5.98	5.44	5.39	
Sulfamethoxazole+Trimethoprim (Co-Trimoxazole) 400 mg+80 mg Tab-cap	0.54	0.55	0.68	
Suxamethonium Cl (Succinylcholine) 50 mg/ml Ampoule	3.4	3.17		

Medicine/formulation	2012	2013	2014	PEN category
Tetanus Antitoxin 1500 iu Ampoule	1.8	1.78		
Thiopental Sodium 500 mg Vial	10.45	12.55		
Triamcinolone Acetonide 10 mg/ml Ampoule	3.02	2.87		
Trihexyphenidyl (Benzhexol) 2 mg Tab-cap	1.65	2.94		
Vancomycin 500 mg Vial	3.21	1.46		
Vecuronium 4 mg Vial	2.55	2.55		
Verapamil Hcl 2.5 mg/ml Vial	2.64	1.24		
Vitamin B Complex -9 Tab-cap	3.54			
Vitamin C (Ascorbic Acid) 100 mg Tab-cap	6.36			
Vitamin D (Alfacalcidol) 0.25 mcg Tab-cap	0.34			
Vitamin K1 (Phytomenadione) 10 mg/ml Ampoule	0.76	0.58		
Warfarin Sodium 3 mg Tab-cap	3	2.09	2.94	
Warfarin Sodium 1 mg Tab-cap		1.58	1.82	
Warfarin Sodium 5 mg Tab-cap	2.43	2.51	2.65	
Water For Injection 10 ml Ampoule	4.6	3.99	4.26	
Zinc Sulfate 20 mg Tab-cap	4.36			