# EFFICIENCIES IN DISTRICT HEALTH SERVICES

## Q2: Policy Brief

**Macro-Economic Analysis**

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## Introduction

Improving efficiency levels in public health services has become an important policy objective. The reasons are obvious. Across countries, public expenditures on health have been increasing and are forecasted to grow further both absolutely and relative to total government expenditures. Ensuring that such sizeable expenditures are utilised efficiently and effectively, particularly when government tax revenues are constrained is a key policy requiring greater accountability and good governance.

This report employs relatively simple benchmarking techniques to assess comparative efficiency levels in primary health care delivery, focusing on the country's (South Africa) district health system. The report will also provide some indications as to the likely sources of such inefficiencies. Based on these results some policy recommendations towards improving efficiency levels in the country's district health system will be suggested.

## Health Sector Reforms Since 1994

First a brief overview of the policy context shaping the country's public health sector is provided, highlighting the continued need for more efficient service delivery.

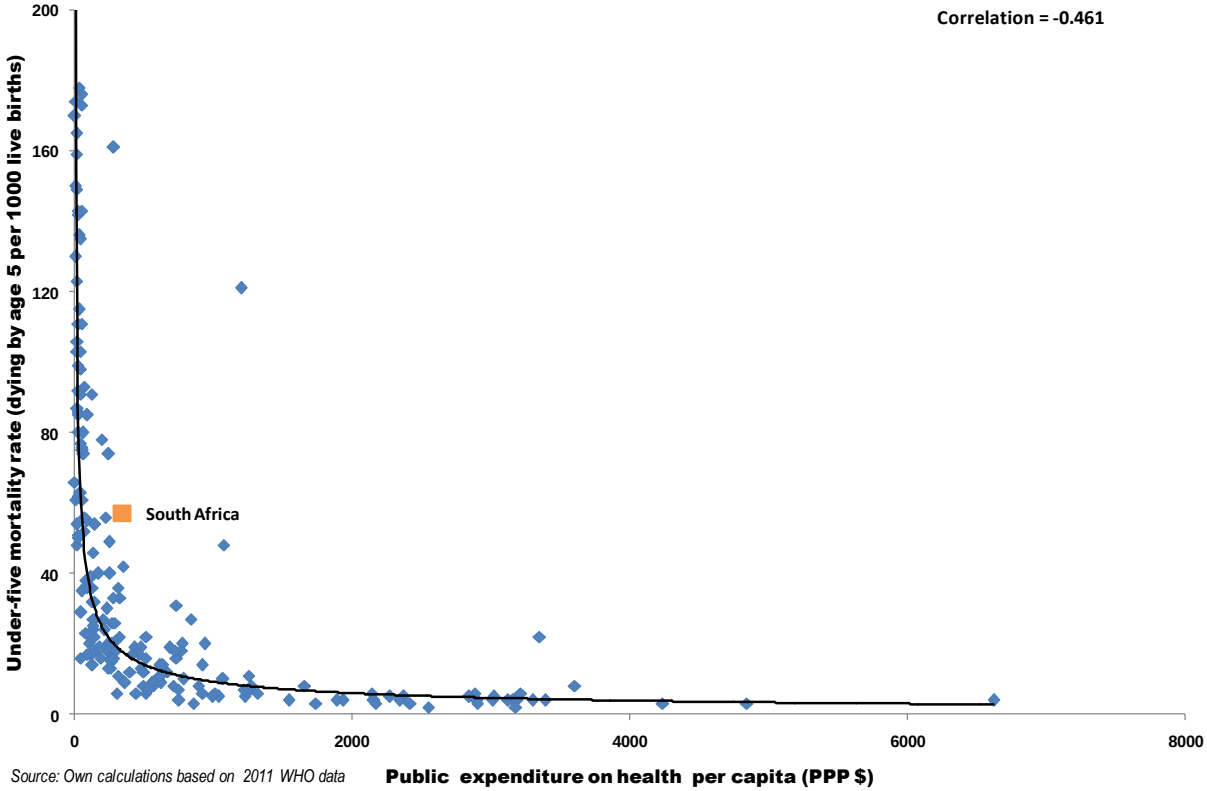
Improving health outcomes for all South Africans has consistently been a key policy priority of the South African government since 1994. This is evident from the various health sector policy reforms that have been adopted over the years leading to the realisation of the following key health policy milestones:

- The establishment of a district health system (1995)
- The introduction of free primary health care (1996)
- Introduction of the essential drugs programme (1996)
- The adoption of the National Health Act (2003)
- Increased rollout of ARV to HIV/AIDS patients (2009)
- The introduction of the National Health Insurance (2012)

Additional to these, interventions aimed at improving the general performance of the health system have been introduced. These have entailed establishing greater parity in district health expenditures; the introduction of the clinic expansion and improvement programme, the introduction of the hospital revitalisation programme, and the expansion of child immunisation services. Through these interventions the overall aim has been to create a health system capable of delivering the required health services efficiently and equitably.

However, despite the reforms, gaps have emerged and continue to widen between public health objectives and realised health outcomes. Measures of adult, child and maternal health have been declining since the mid-1990s and have been exacerbated by the HIV/Aids and TB pandemics. Substantial disparities between the public and private health sector have continued to persist resulting in significant discrepancies in quality of care (SAHR 2010); and more importantly, there have been increasing indications that for the resources that the country spends on the health the gains have been minimal (Figure 1). Particularly, when compared to countries with similar levels of expenditure on public health, South Africa has lagged behind in terms of health outcomes (child and adult health).

**FIGURE 1: PUBLIC HEALTH EXPENDITURES AND CHILD HEALTH ACROSS SELECTED COUNTRIES, 2010**




*Source: Own calculations based on 2011 WHO data*

## DISTRICT HEALTH DATA AND ESTIMATES OF HEALTH EFFICIENCY

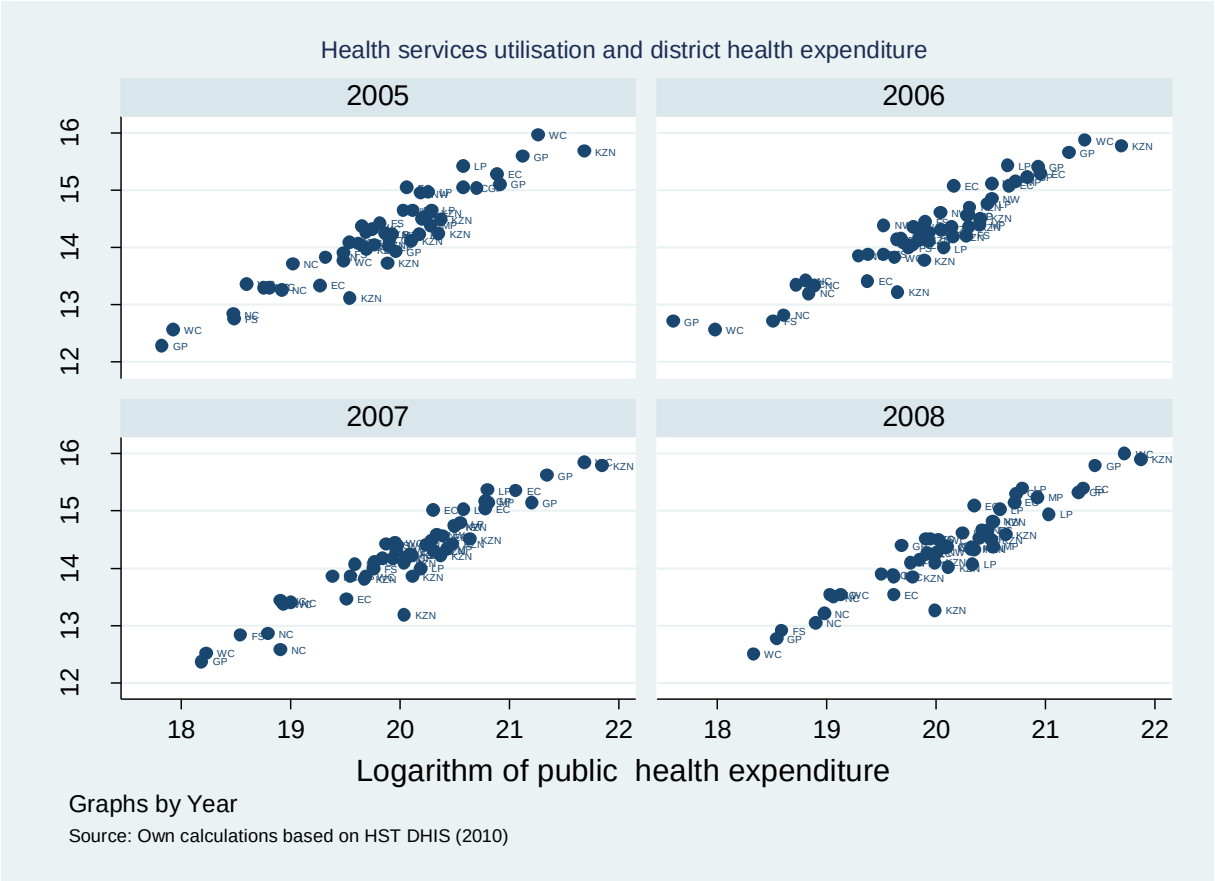
For purposes of this analysis public health services efficiency will be defined to mean the extent to which specific public health outputs/services are realized for given public expenditures.

A full decomposition of all the sources of inefficiencies in health service delivery, although preferable, is not feasible due to limited data. The focus will therefore be limited on broad measures on health service delivery at a district municipal level.

Currently the country has 52 health districts, all responsible for providing primary health services within their designated geographic boundaries. At the minimum each health district consists of a network of district hospitals, clinics and community health centres (CHCs), and managed by administrative and medical professionals.

Figure 2 provides a summary of health services delivery and levels of district health expenditure between the years 2005 - 2008.

**FIGURE 2: HEALTH EXPENDITURE AND HEALTH SERVICES UTILIZATION ACROSS DISTRICTS, 2005 - 2008**

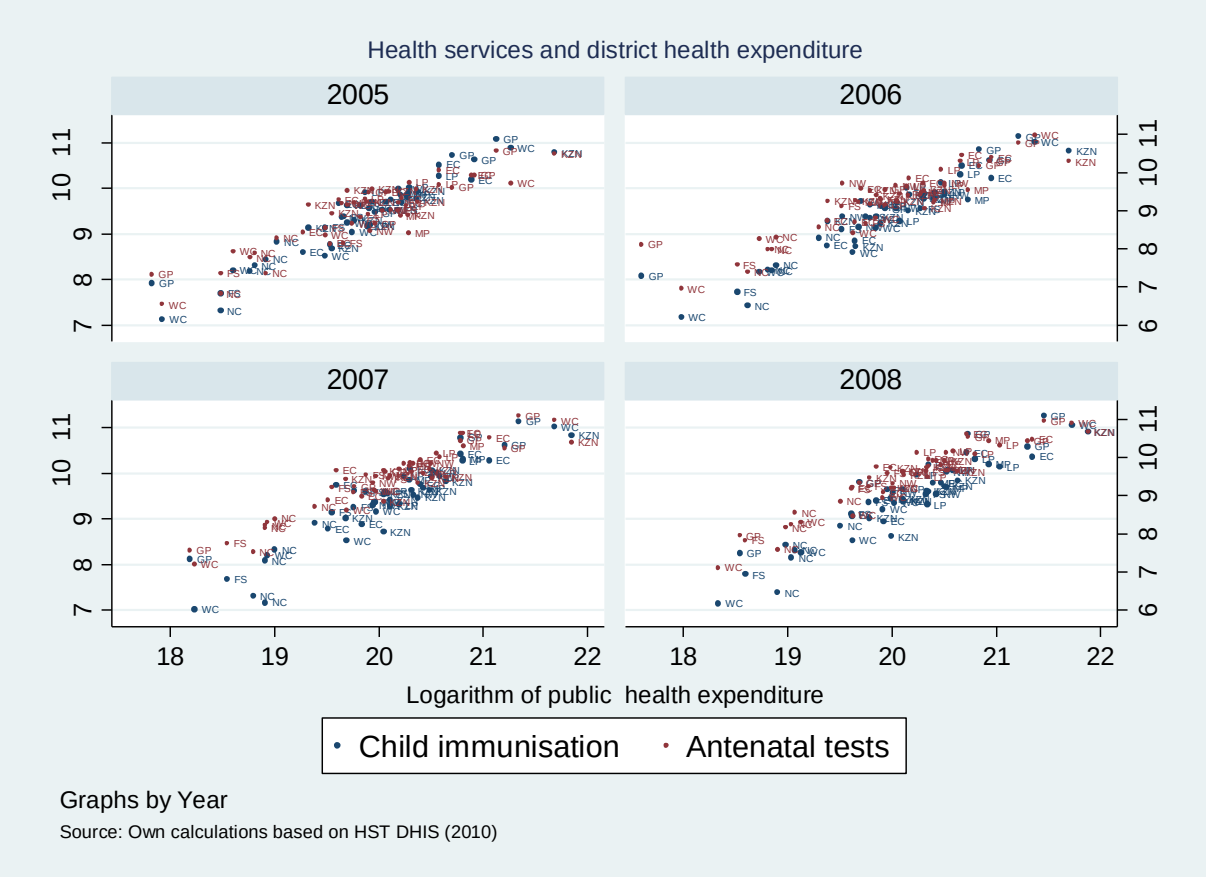



**SOURCE: OWN CALCULATIONS BASED ON HST, DHIS (2010)**

As to be expected more expenditure on public health generally delivers more health services. Viewed as an input/output production relationship Figure 2 also illustrates how some health districts within provinces seem to be relatively more efficient than others in health services delivery. Particularly all districts represented by points constituting the left most outer boundary of the scatter dominate all those within, since they are able to deliver quantitatively more at equal or lower costs.

Similar patterns of positive associations between health services delivery and health expenditures emerge even when other indicators of health services delivery are utilised, albeit with some variation in the districts constituting the efficient boundary (Figure 3).

**FIGURE 3: DISTRICT HEALTH EXPENDITURE, CHILD IMMUNIZATION AND ANTENATAL TESTS**




Source: Own calculations based on HST DHIS (2010)

Selecting child immunisation and antenatal tests as health services indicators, districts within Gauteng appear to dominate (Figure 3), painting a different picture to the case of services utilisation headcounts , in which districts within the Western Cape were among the most efficient.

The ambiguity in precisely identifying the most efficient districts is a common feature in most output based efficiency test, particularly when the organisational units being compared produce multiple services/outputs. A more satisfactory approach that avoids direct comparisons of multiple services/ outputs entails the estimation of boundary "cost" functions, also commonly known as stochastic cost frontiers.

Given cross-section data on regional health output indicators with corresponding levels of expenditure, the Stochastic Frontier Analysis (SFA) approach estimates the following regression cost equation: (1.1)

$$ln\,(C_i) = \alpha + \sum_{z}^{M} \gamma_z ln\,(Y_z) + \sum_{j}^{N} \beta_j\, ln(x_j) + \varepsilon_i$$

With the following properties:

$\boldsymbol{C_i}$ represents some measure of total expenditure in district/region $\boldsymbol{i}$ for delivering a list of primary health services, represented by $\boldsymbol{Y_z}$, $z = 1, 2 \ldots M$.

$\boldsymbol{x_j}$ contains all the exogenous factors that are thought to influence district costs in service delivery.

$\boldsymbol{\varepsilon_i}$ is a composite error term that incorporates both measurement error, $\boldsymbol{v_i}$, and some measure of district cost inefficiency, $\boldsymbol{u_i}$.

Moreover, for estimation purposes the $\boldsymbol{\varepsilon_i}$ components are specified to have the following statistical properties:

$\boldsymbol{\varepsilon_i = u_i + v_i}$, with $\boldsymbol{u_i \sim N^+(0, \sigma_u^2)}$ and $\boldsymbol{v_i \sim N(0, \sigma_v^2)}$, i.e. half-normal and normal distributed, respectively. Then equation (1.1) can be modified to:

$$\boldsymbol{ln\,(C_i) = \alpha + \sum_{z}^{M} \gamma_z ln\,(Y_z) + \sum_{j}^{N} \beta_j\, ln(x_j) + u_i + v_i}$$

In conventional regression analysis interest mainly lies in the estimation of the regression parameters, $\boldsymbol{\beta_j, \gamma_z}$ in the above equations, but for purposes of cost frontier analysis, it is $\boldsymbol{u_i}$, the measure of cost inefficiency, which assumes greater significance.

Given the above model determining the relative measure of inefficiency for each district becomes relatively straightforward and can be estimated by the mean value of $\boldsymbol{u_i}$, conditioned upon the composite error term, $\boldsymbol{\varepsilon_i}$, as in

$$\boldsymbol{E\,[u_i|\varepsilon_i] = \frac{\sigma\lambda}{(1 + \lambda^2)} \left[ \frac{\phi(\varepsilon_i\,\lambda/\sigma)}{\Phi\,(-\varepsilon_i \frac{\lambda}{\sigma})} - \frac{\varepsilon_i\,\lambda}{\sigma} \right]}$$

With the following definitions for parameters:

$$\boldsymbol{\lambda \equiv \frac{\sigma_u}{\sigma_v}}$$

and

$$\boldsymbol{\sigma^2 \equiv \sigma_v^2 + \sigma_u^2}$$

$\boldsymbol{\phi}$ and $\Phi$ being the normal density and cumulative distributions, respectively.

## ESTIMATION RESULTS

**FIGURE 4: STOCHASTIC FRONTIER ESTIMATION OF DISTRICT HEALTH EXPENDITURE, HEALTH SERVICES AND DISTRICT HOSPITALS**

| Dependent - log (district total exp) | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| log (services utilisation headcount) | 0.93 | 0.03 | 31.66 | 0.00 | 0.87 | 0.99 |
| log (district hosp) | 0.07 | 0.03 | 2.27 | 0.02 | 0.01 | 0.14 |
| constant | 6.37 | 0.42 | 15.18 | 0.00 | 5.55 | 7.19 |
| log(sig2v) | -4.40 | 0.67 | -6.60 | 0.00 | -5.71 | -3.10 |
| log(sig2u) | -1.92 | 0.28 | -6.92 | 0.00 | -2.47 | -1.38 |
| sigma_v | 0.11 | 0.04 | | | 0.06 | 0.21 |
| sigma_u | 0.38 | 0.05 | | | 0.29 | 0.50 |
| sigma2 | 0.16 | 0.04 | | | 0.09 | 0.23 |
| lambda | 3.46 | 0.08 | | | 3.29 | 3.62 |

Likelihood-ratio test of sigma_u=0: chibar2(01) = 10.00 Prob>=chibar2 = 0.001

Figure 4 illustrates the estimation results of a cost frontier with health utilisation headcount and the number of district hospitals the only determinants of district health costs. Evidently the headcount variable is highly significant with a 1 per cent increase in health utilisation increasing regional/district health costs by 0.93 per cent. The number of district hospitals is also highly significant. The likelihood ratio test rejects the null of no systematic variations in efficiency across districts at 0.1 per cent level.

**FIGURE 5: DISTRICT EFFICIENCY MEASURES**

| | | |
|---|---|---|
| EC | Cacadu | .12747981 |
| EC | Amathole | .42305859 |
| EC | Chris Hani | .23998294 |
| EC | Ukhahlamba | .45708922 |
| EC | O.R. Tambo | .11520462 |
| EC | Alfred Nzo | .19778823 |
| EC | Nelson Mandela Bay Metro | .06470816 |
| FS | Xhariep | .1302428 |
| FS | Motheo | .46726944 |
| FS | Lejweleputswa | .16994063 |
| FS | Thabo Mofutsanyane | .06285634 |
| FS | Fezile Dabi | .20729622 |
| GP | Sedibeng | .27419454 |
| GP | Metsweding | . |
| GP | West Rand | .06300349 |
| GP | Ekurhuleni | .13549947 |
| GP | City of Johannesburg | .31593993 |
| GP | City of Tshwane | .49956365 |
| KZN | Ugu | .46780329 |
| KZN | uMgungundlovu | .30393383 |
| KZN | Uthukela | .41117373 |
| KZN | Umzinyathi | .55018663 |
| KZN | Amajuba | .49305014 |
| KZN | Zululand | .48756353 |
| KZN | Umkhanyakude | .48149195 |
| KZN | Uthungulu | .51165154 |
| KZN | iLembe | .25550289 |
| KZN | Sisonke | 1.0778863 |
| KZN | eThekwini | .55109446 |
| LP | Mopani | .12180262 |
| LP | Vhembe | .07214383 |
| LP | Capricorn | .56112 |
| LP | Waterberg | .66631919 |
| LP | Greater Sekhukhune | .15724986 |
| MP | Gert Sibande | .56374841 |
| MP | Nkangala | .33858116 |
| MP | Ehlanzeni | .20856628 |
| NC | John Taolo Gaetsewe (Kgalagadi) | .24114864 |
| NC | Namakwa | .25930502 |
| NC | Pixley ka Seme | .06814064 |
| NC | Siyanda | .10819327 |
| NC | Frances Baard | .12884724 |
| NW | Bojanala Platinum | .23920099 |
| NW | Ngaka Modiri Molema (Central) | .26113803 |
| NW | Dr Ruth Segomotsi Mompati (Bophirima) | .21676059 |
| NW | Dr Kenneth Kaunda (Southern) | .24997774 |
| WC | City of Cape Town | .29292575 |
| WC | West Coast | .20793392 |
| WC | Cape Winelands | .10645931 |
| WC | Overberg | .10568239 |
| WC | Eden | .05887772 |
| WC | Central Karoo | .21614118 |

In fact the average inefficiency across the sample is estimated at 30 per cent, with substantial variations across districts. That is, on average districts costs are 30 per cent or higher than the required minimum to deliver those services, Figure 5.

The question of what accounts for the variations in may be of interest for health policy. Figure 6 attempts to answer such a question, first by extracting individual district inefficiency and then regressing these on selected variables that are known to be major drivers of health

costs and service delivery levels, i.e. *district population numbers*, *number of district clinics, district community health centres*, *and district nurses.*

**FIGURE 6: ACCOUNTING FOR SOURCES OF DISTRICT INEFFICIENCY**

| Dependent - log (district inefficiency measure) | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| log(district population) | 0.12 | 0.04 | 2.67 | 0.01 | 0.03 | 0.21 |
| log(number district clinics) | -0.09 | 0.06 | -1.60 | 0.11 | -0.21 | 0.02 |
| log (number district community health centres) | -0.06 | 0.02 | -2.59 | 0.01 | -0.10 | -0.01 |
| log (number district nurses) | -0.32 | 0.07 | -4.43 | 0.00 | -0.46 | -0.17 |
| constant | 0.12 | 0.44 | 0.28 | 0.78 | -0.76 | 1.01 |

From Figure 6 it is clear that the number of district clinics, community health centres and nurses tend to improve district health service efficiency. Districts with more clinics, community health centres and adequate number of nurses tends to be relatively more efficient. Particularly, the number of nurses in a district seems to be the most important factor in improving efficiency. Perhaps these results should not be that surprising, after all, given the accepted view of what constituents an efficient and effective primary health delivery system (WHO 2010).

Interestingly high district population numbers tend to have the opposite (negative) impact on efficiency of district health services. The only plausible reason we can give for this is that primary health delivery may be susceptible to some form of capacity constraints and bottlenecks in regions where there are inadequate primary health facilities. In fact if one estimates a similar equation as Figure 6 but controls for the number of health the population variable becomes statistically insignificant.

## CONCLUSION

Substantial variations in efficiency in health services do exist across districts. Assuming that health costs are likely to continue increasing for the foreseeable future understanding what accounts for these variations is an important health policy concern. The analysis above has revealed and confirmed the accepted view that adequate numbers of clinics, community health centres and nurses are an important ingredient of any well-functioning and efficient primary health delivery system.

## APPENDIX A: FRAMEWORK FOR EFFICIENCY ANALYSIS IN PUBLIC HEALTH SERVICES

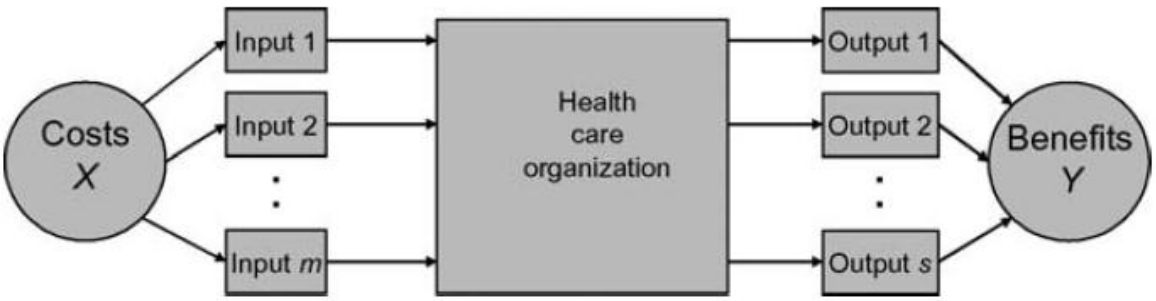
As indicated earlier the focus is on district health services and this constitutes the unit level of analysis.

The approach adopted for benchmarking efficiency is a combination of two frameworks: The Framework for Managing and Evaluating Programme Performance (Office of the Presidency and National Treasury, 2007), which provides the basis for classifying programme performance information into inputs, activities, outputs, outcomes and impacts, and the other entails Stochastic Frontier Analysis (SFA) of costs of services.

There are numerous conceptual and practical issues that need to be clarified when seeking to undertake such an exercise. First, the measure of efficiency adopted needs to be precisely defined. For purposes of this exercise efficiency will simply refer to the comparison of health outputs (however measured) to the value of resources (inputs) consumed to provide those services. Note, depending on the purpose of the study, health outputs could be defined as public health activities, outputs and outcomes. Defining health outputs as such is particularly useful when the units being analysed can naturally be grouped to form higher levels or hierarchies of health system organisation (i.e. from clinics, hospitals to local/ district health systems and all higher up to national public health systems).

Figure A1 depicts the schematic framework for analysing efficiency in health care organisations.

**FIGURE 1A: RELATING COSTS TO HEALTH SERVICE**




For this framework a single health organisation/system consumes a series of resources (call them public health expenditures) which are valued in total at X. Some transformation process takes place converting those inputs into S public health outputs, which are valued in aggregate as Y.

In this framework efficiency can simply be viewed as the ratio Y/X, which represents a value for money measure, or cost-effectiveness.

## REFERENCES

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