A Comparative Analysis of Cardiovascular Disease Health System Efficiency in Low and Middle Income Countries Using Data Envelopment Analysis

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1. Introduction

Noncommunicable diseases (NCDs) such as cancer, diabetes, cardiovascular disease and chronic respiratory disease are the leading causes of death worldwide. They are responsible for almost 2/3 of all deaths globally and nearly 80% of NCD deaths occur in low and middle income countries (WHO, 2011[a]). Ageing populations and increased exposure to risk factors associated with economic development have played part in producing these figures (Adeyi et al., 2007). Rapid epidemiologic transitions and urbanisation in developing countries have brought about a shift in trends from communicable diseases (e.g. HIV/AIDS & TB) to NCDs.

Many low and middle income countries (LMICs), as defined by the World Bank, are making efforts to tackle this issue, but NCD deaths show no signs of declining. By taking simple prevention measures, up to 80% of heart disease, stroke and type 2 diabetes alone could be averted (WHO, 2008).

Furthermore, cardiovascular disease (CVD) maintains its position as the largest cause of deaths worldwide (Mendis et al., 2011). Generally, CVDs are declining in high-income countries, but the opposite is true for LMICs. Despite this, not many countries have policies, strategies, or action plans specifically catered to CVDs (WHO, 2011[b]). Furthermore, CVD received the least amount of development assistance compared to other NCDs or its risk factors (Nugent and Feigl, 2010). In order for LMICs to cope with their changing epidemiological trends, the efficient management of health services towards CVD is essential.

2. Objective & Research Question

The main objective of this research is to analyse and evaluate the efficiency of CVD health systems in LMICs to better monitor and manage an impending CVD epidemic. In order to achieve this, the following research questions will be looked at:
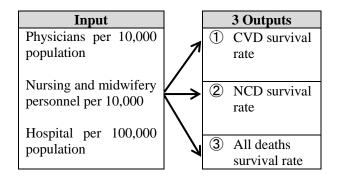
1. *How efficient are the CVD health systems in LMICs?*

2. *What implications (methodological and practical) for the health sector can be proposed from measuring the efficiency of CVD health systems?*

3. Methodology

This research uses data envelopment analysis (DEA) as the main tool for analysing the efficiency of existing CVD health systems in LMICs. DEA is a non-parametric, linear programming based technique for comparative efficiency assessments of organisational units.

(1) To reveal the efficiency levels of each LMICs' health systems with a particular emphasis on CVDs, a standard input-oriented value-based DEA model was first performed on 41 LMICs. The following input and output variables were selected to reflect an efficient CVD health system across 41 LMICs:

Table 1. Input and Output Variables

Input	3 Outputs
Physicians per 10,000 population	① CVD survival rate
Nursing and midwifery personnel per 10,000	② NCD survival rate
Hospital per 100,000 population	③ All deaths survival rate

(2) Using the same 41 LMICs and the variables above, an analysis using the Banker and Morey model which incorporates non-discretionary input variables into the basic input-oriented DEA model was also conducted. The non-discretionary input variables were: (a) Daily tobacco smoking (b) Consumption of alcohol (c) Prevalence of obesity (d) Prevalence of physical inactivity.

(3) The results obtained from these two analyses were compared, and only those LMICs still deemed inefficient were further analysed (i.e. Inefficiency does not stem from the CVD-related environmental factors but from the health system itself). This narrowed the final number of LMIC to 16.

(4) To determine that the inefficiency is an issue specific to CVD health systems, and not for NCD or all deaths, countries where efficiency using output ① (see table 1) was the worst were looked into further.

4. Results

Out of 16 LMICs, four countries (Jamaica, Bosnia & Herzegovina, Turkey and Lebanon) showed that efficiency obtained using output ① was worse than ② and ③. Therefore, CVD < NCD ≤ All deaths. Those countries were deemed to have a particularly inefficient CVD health system. The table below shows the efficiency for the CVD health system amongst 16 LMICs.

Table 2. CVD Health System Efficiency Scores

	Country	CVD Efficiency (%)
1	Jamaica	75.43
2	Cameroon	44.23
3	Gambia	37.74
4	Côte d'Ivoire	31.07
5	Micronesia	27.47
6	Botswana	26.75
7	Swaziland	25
8	Bosnia & Herzegovina	20.53
9	Hungary	20
10	Turkey	12.5
11	Romania	11.76
12	Lebanon	11.62
13	Namibia	10.95
14	Samoa	10.6
15	Tonga	8.48
16	Kazakhstan	5.56

5. Methodological Implications

When the results for the four countries highlighted above (Table 2) were compared to a study by the WHO (Evans et al., 2001), which ranked 191 countries based on the comparative efficiency of their respective national health systems, trend similarities could be detected for all but Turkey.

Similarity results with the WHO supports the authenticity of the methodology implemented here, while the inconsistency in the efficiency levels for Turkey illustrates the benefits of focusing specifically on CVD health systems and using CVD-specific non-discretionary variables. It was possible to identify an inefficient country (Turkey) which otherwise would not have been identified if the whole health system was analysed with methodologies utilised in a major study by the WHO.

Furthermore, with the current method, an efficiency analysis goes beyond the simple acknowledgement of the existence of CVD policies/ programmes/action plans, and can better define the "quality" of such policies/programmes/action plans. For example, Lebanon has an established CVD programme, but its efficiency score was the lowest of the four countries in this study. This example makes it very clear how it is not the *existence* of such programmes, but their *performance* that must be uncovered when analysing health systems. These interpretive findings justify the need for a method such as the one introduced in this study to identify dysfunctional, or overburdening policy/programme/action plan in regards to CVD health systems.

6. Practical Implications

Through further qualitative analysis of these countries, CVD policy implications for the health care sector can be suggested. Turkey's government authorities responsible for the healthcare system need to catch up with the CVD epidemic. Cardiology specialists, decision-makers and managers in the health sector must become more open and update their knowledge on new developments and ideas towards CVDs. Increasing the number of cardiologists may be necessary. These are prerequisites for the coordination and promotion of specialised centres for CVD rehabilitation and prevention, which in turn can initiate programmes/ self-help groups for patients. As for the least efficient out of the four countries highlighted, Lebanon could reassess the accessibility to health care, and also make efforts to reduce their dependency on NGOs. More control from the Ministry of Public Health over the management and coordination of the whole health sector may help reduce the oversupply of health resources. A system to standardize and improve the overall standard of cardiologists may also contribute to increasing the efficiency level.

7. Conclusion

This study demonstrates how the use of DEA with disease-specific non-discretionary variables to measure the efficiency level of CVD health systems is a useful technique which can offer insights into how an impending CVD epidemic can be monitored and managed in LMICs.

8. References

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