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Decision rules for allocation of finances to health systems strengthening

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ABSTRACT

A key dilemma in global health is how to allocate funds between disease-specific "vertical projects" on the one hand and "horizontal programmes" which aim to strengthen the entire health system on the other. While economic evaluation provides a way of approaching the prioritisation of vertical projects, it provides less guidance on how to prioritise between horizontal and vertical spending. We approach this problem by formulating a mathematical program which captures the complementary benefits of funding both vertical projects and horizontal programmes. We show that our solution to this math program has an appealing intuitive structure. We illustrate our model by computationally solving two specialised versions of this problem, with illustrations based on the problem of allocating funding for infectious diseases in sub-Saharan Africa. We conclude by reflecting on how such a model may be developed in the future and used to guide empirical data collection and theory development.

1. Introduction

The notion of health system strengthening (HSS) has become increasingly important in global health discourse in recent years, manifest for example in a declaration at the 2008 G8 Toyako Summit (Takemi and Reich, 2009). This focus of attention arises from a recognition that attempts to implement disease-specific vertical projects often founder in the face of weak health systems: for example, a donor might purchase malaria medications or insecticide treated bednets for a low-income country, but the Ministry of Health as the implementing in-country partner is unable to deliver the medications before they expire or the bednets to the at-risk population before the end of the rainy season. Thus, the reasoning goes, funding for such vertical projects has to be complemented with funding for "horizontal" programmes which aim at strengthening the health system as a whole.

As Ellner et al. (2011) remark, although the label *health systems strengthening* is relatively recent, the dialectic between proponents of vertical and horizontal approaches is a defining feature of global health debate through much of its history. The eradication of smallpox in the 1960s and 70s is an example of a "vertical project" (as were the earlier, failed, attempts to eliminate malaria). On the other hand, the Alma-Ata declaration (WHO, 1978), with its stress on the role of primary healthcare, presents a holistic vision of health services and is often taken as a statement of the philosophy and principles of the horizontal approach. Hafner and Shiffman (2013) describe how the focus on HSS marks a renewed interest and engagement in horizontal approaches on the part of key actors, including international organisations such as the WHO, World Bank, and other international agencies and donors.

Evidence of the importance of HSS is provided by the wide variations in health system performance amongst Low and Middle Income Countries (LMICs). Balabanova et al. (2013) highlight six countries and regions (Bangladesh, Ethiopia, Kyrgyzstan, Thailand, and the Indian state of Tamil Nadu) which have achieved good health at low cost and stress the vital role of systems-level elements in delivering success in what can be extremely challenging environments. The achievements of these countries cannot be explained by increased funding alone and can to some extent be attributed to the strength of the health systems. Chowdhury et al. (2013) describe how Bangladesh, for example, has higher life expectancy and lower infant,

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under-5 and maternal mortality than its South Asian neighbours, India, Pakistan and Nepal, despite lower per head expenditure.

In this paper, we discuss a problem faced by donors who have a primary mandate to deliver vertical projects targeted at particular diseases, but at the same time, recognise the importance of (and seek to fund) HSS. Statements on the websites of the Global Fund, Global Alliance for Vaccines and Immunizations (GAVI) and President's Emergency Plan for AIDS Relief (PEPFAR) indicate that many prominent donors meet this description. One problem such donors face is that of seeking an optimal balance of funding between disease specific programmes and HSS. Our paper attempts to address that question.

We organise our paper as follows. In Section 2, we provide an overview of the concept of HSS. In Section 3, we introduce our model through a motivating example. Section 4 presents our general model and shows how to efficiently solve a special case. In Section 5, we provide worked examples, based on the allocation of funds to infectious disease programmes in sub-Saharan Africa. Section 6 summarises our contributions and discusses implications for research and practice in this area.

2. Conceptual background

In this section to give the reader a clearer picture of what is captured in the concept of HSS, we present the WHO framework (WHO, 2007), which has played a key role in framing discussions of HSS. In this conception, the health system has six building blocks. These building blocks and the associated priorities are cited below.

1. Service delivery: packages; delivery models; infrastructure; management; safety and quality; demand for care;
2. Health workforce: national workforce policies and investment plans; advocacy; norms, standards and data;
3. Information: facility and population based information and surveillance systems; global standards, tools;
4. Medical products, vaccines, and technologies: norms, standards, policies; reliable procurement; equitable access; quality;
5. Financing: national health financing policies; tools and data on health expenditures; costing
6. Leadership and governance: health sector policies; harmonization and alignment; oversight and regulation (WHO, 2007).

This framework has been used by Warren et al. (2013) to track Global Fund expenditures, and similar frameworks have been suggested and used for expenditure tracking by Shakarishvili et al. (2011) and Goeman et al. (2010). Such expenditure tracking is clearly informative but limited. For example, it is impossible to infer whether funds are or are not optimally allocated across the building blocks without further information about cost-effectiveness. Note that a focus on HSS recognizes the importance of economies of scope that exist within any health system. In particular, resources such as service delivery platforms and information systems are shared by many interventions, and their nature and effectiveness will therefore be important determinants of cost structures within the system.

Investing in HSS presents a significant philosophical challenge from the point of view of economic appraisal. Of course, the difficulties of performing a sound economic analysis of the costs and benefits of a vertical project – delivering a course of TB treatment, or rolling out rotavirus vaccination – should not be underestimated. Obtaining reliable and useable empirical studies and transferring findings to a new setting with a different population, disease pattern, and service infrastructure requires considerable analytic capacity.

Nevertheless, appraisal of vertical projects falls squarely within the standard paradigm of economic analysis as it has developed over the last several years, and so can take place in a well developed theoretic framework according to clear standards (Drummond et al., 2005; Gold et al., 1996; Tan-Torres Edejer et al., 2003). In particular, because health benefits – whether measured in reduced number of infections, avoided mortality or gains in QALYs or decreases in DALYs – can be ascribed to a specific project, it is possible to assess their cost-effectiveness. The well-established decision rule of cost-effectiveness is to rank interventions in decreasing order of their benefit to cost ratios and proceed down the list from most to least cost-effective until the budget is exhausted (Weinstein and Zeckhauser, 1973; Weinstein, 2012).

Investments in HSS cannot be easily accommodated within this framework. Unlike funding vertical projects, funding HSS interventions such as policy development or information systems does not contribute to health directly, but is instead complementary to existing delivery systems. To take a concrete example, according to WHO (2007), in over 60 countries, less than a quarter of deaths are recorded by vital registration systems. Of course, vital registration by itself does not save lives. However, in such countries, if a system of vital registration existed, the ability of planners to target such medical resources as do exist on those in most needs may be massively improved. Yet such qualitative considerations do not help a decision maker with a mandate focused on (say) malaria control and elimination in deciding how much to invest in upgrading the system of vital registration.

Frenk (2010) has called for a "diagonal" approach to thinking about health systems, which recognises the complementarity between horizontal and vertical programmes. In this paper, we respond to that challenge. The way we think about this is as follows. We conceptualise the effect of a weak health system in terms of the gap between efficacy and effectiveness. In principle, one could estimate the effect which a treatment will have on a population by taking efficacy data from a laboratory study and multiplying up at the population level. In practice, of course, in all health systems, effectiveness in the field never attains the level of efficacy in the laboratory. In actual clinical practice, many of the population in need may not be able to secure access to medical care; they may be diagnosed wrongly or treated inappropriately; or they may refuse care, fail to comply with the treatment regime or terminate the course before completion – all of which may be consequences of a weak or failing health system. In other words, we conceptualise the impact that a weak health system has on the delivery of a vertical project as one of dilution of the health benefits.

3. Motivating example

In this section, we present a motivating example of a decision problem for a donor looking to allocate resources between different HIV prevention projects (with data based on Hutton et al., 2003). In Table 1 we present data for nine vertical projects on the total cost of full implementation, the number of infections averted and incremental cost-effectiveness ratios, ranked in descending order of cost-effectiveness.

Assuming the projects are independent, the standard cost effectiveness rule for approaching this problem is to proceed down the table funding interventions until the budget b is exhausted. For example, if the donor has $\$2m$, the optimal solution is to implement interventions 1–4 completely and then intervention 5 fractionally. This rule is the optimal solution to an implied mathematical program, the linear knapsack problem, (*LK*).

$$\begin{aligned} \max \quad & \sum_{i \in I} v_i x_i \\ \text{s.t.} \quad & \sum_{i \in I} c_i x_i \le b \quad (LK) \end{aligned}$$

In (*LK*), I is the index set of projects (typical member denoted i); the c_i terms are the monetary costs, the v_i terms are the health benefits, i.e. the number of infections averted and the x_i are the decision variables, indicating the proportion of project i implemented. We assume that projects are ordered in decreasing value for money order, i.e. the larger i, the smaller v_i/c_i.