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What do we want and when do we want it? Mathematical programming for optimal allocation of health care resources

A commonly used decision rule is to implement healthcare treatments which have the highest incremental cost-effectiveness ratio (ICER) below a pre-determined threshold. However, this approach does not quantify the true opportunity cost of the decision and relies on several assumptions which are not easily made explicit.

This paper extends the work of other authors (for example, Stinnett and Paltiel 1996) by developing a mathematical programming framework and applying it to a stylised but relevant policy problem, using data taken from recent NICE appraisals. This approach allows us to incorporate a number of important features of the decision into our analysis. Firstly, we are able to take account of both the total cost of treatments and the profile of those costs over time when choosing the optimum treatments. Secondly, the mathematical programming framework allows us to evaluate the shadow price of different budget constraints and the opportunity cost of applying alternative budgetary rules. Thirdly, we introduce equity considerations as constraints. The basic problem allows the implementation of some treatments to be mixed, that is, only a proportion of the population are given that treatment. Horizontal equity concerns are incorporated as indivisibility constraints by restricting the decision variables to be 0-1 integer values. We find that the opportunity cost of these constraints, measured as the loss in total population health, is different for different treatments and patient populations.

The framework provides a robust and transparent process for social decision making. Further work will extend the method by introducing uncertainty, and incorporating non-linearity where fixed costs or other non-constant returns to scale are identified.