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Resource allocation, health mobility and adaptation to illness

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Abstract

The increased availability of panel data has made it possible to estimate and measure health mobility for population subgroups who may have systematically different levels of mobility. The objective of this paper is to stimulate discussion on what estimated differences across subgroups may mean for resource allocation. We use a straightforward hypothetical example to investigate the implications of different levels of health mobility on health outcomes, considering in addition the effects of adaptation to illness over time. We also discuss some of the ethical and political implications of health mobility.

Keywords: health mobility, panel data, health outcome measurement, adaptation, response shift

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Introduction

Every health system aspires to implement health policies which can achieve the best possible health and wellbeing for the population. This requires decisions on how to allocate scarce resources among competing subgroups. Such decisions are complicated by the fact that the health of populations and the relative disadvantage of certain subgroups change over time (Cutler and Richardson, 1998). For example, analysis of mental health in the UK shows that low income groups and minority ethnic groups experience similar levels of mental illness at a point in time in terms of prevalence (Hauck and Rice, 2004). However, when investigated over time, these two disadvantaged groups are not similar: Individuals with low incomes tend to experience mental health problems of a long-lasting nature, whereas individuals from minority ethnic groups experience great fluctuations in their mental health, and thus in 'health mobility'. To take this a stage further, suppose a policy maker wants to implement a mental health program, targeted at these two subgroups, shown to be at risk of mental illness. How should resources be allocated between the two groups? Are they both equally badly off, as suggested by analysis undertaken at a point in time? This would imply that, other things such as costs being the same, they should attract an equal share of resources. Or, is one group comparatively worse off than the other? If so, which one is worse off, and how can efficient and equitable resource allocation decisions be made?

The increased availability of panel data has made it possible to estimate and measure health mobility for different subgroups who may have systematically different levels of health mobility. The objective of this paper is to stimulate discussion concerning potential differences in health mobility between subgroups, and what they may mean, for individuals, for society and for policy makers. We use a straightforward hypothetical example and simulated data to investigate the implications of different levels of health mobility on resource allocation, considering in addition the effects of adaptation to illness over time. We find that different scenarios on the level of health mobility and type of adaptation lead to very different implications for resource allocation across different sub-populations. The hypothetical example we give suggests a framework for future analysis in this area taking account of health mobility and adaptation.

Health Mobility

Cross sectional studies on population health are often used to determine prevalence rates and to explain differences in these across subgroups, at a certain point in time. For example, a study on the mental health of young Australians finds that 27% of 18-24 year olds suffer from a mental health disorder (ABS, 1997). This might be due to (a) each individual having a 27% chance of suffering ill health, in any given year, or (b) 27% suffering from ill health all the time (and 73% never) or (c) something in between, so that of the 27%, (say) 10% will experience ill health in repeated time periods, and the rest (17%) are ill for one time period only. Case (a) has high health mobility[1]; (b) has no health mobility; and (c) intermediate health mobility. Panel data can be used to test the extent of such health mobility, tracking individuals over time (Jones and Lopez, 2004; Jones et al 2006; Hauck and Rice 2004, Hernández-Quevedo 2006; Lecluyse and Cleemput 2006).

Assume a situation where people can be either healthy or ill (and there are no births or deaths). As with incidence and prevalence, health mobility is determined by the proportion of healthy individuals becoming sick. As with prevalence, but unlike incidence, health mobility is determined by the proportion of sick individuals who become healthy. Unlike both incidence and prevalence, health mobility reflects the number of consecutive periods individuals remain in one health state or the other. In addition, unlike both incidence and prevalence, health mobility can be used with categorical (with three or more levels of health) or continuous health measures to reflect the magnitude of change in health states (Lecluyse and Cleemput 2006). If changes are large (small), health mobility is

[1] Some may term this *dynamics*, we use the term *health mobility* to avoid confusion with the habit formation literature, and dynamics and lags. We are not referring to functional mobility, but mobility between health states.

consequently high (low). A measure of mobility collapses these factors into a single summary measure, which allows comparison of mobility across different subgroups.

Jones et al. (2006) identify the factors which may influence the extent of health mobility. Low health mobility can reflect the nature of prevalent health problems: some illnesses are inherently chronic, and therefore associated with lower mobility. Individuals may have characteristics which are persistent over time and predispose them to worse health, contributing towards lower mobility. These characteristics can be observed socioeconomic characteristics, or unobserved factors such as genetic predisposition or risk attitude. However, even observationally identical individuals may still experience different health states. This can be explained by state dependence, which describes a phenomenon whereby a cumulative history of a range of health problems may directly affect current health. Given all of these factors, we hypothesise that not accounting for health mobility may mean policy makers do not have full information on the effects of illness on sub populations, which may lead to the misallocation of resources in certain circumstances.

Health mobility: A hypothetical example

We use valuations of health or health related quality of life (HRQOL) on a scale with 1 for full health and 0 for dead. We consider a sample of 180 persons over 9 time periods. In each period, 20 are sick and 160 are healthy. For simplicity, we assume HRQOL are the same for each sick individual within a subgroup. We also assume the levels of HRQOL are comparable and can be aggregated across individuals, and over time. We initially calculate aggregate QALYs for three hypothetical subgroups with *no*, *intermediate* and *high health mobility*, respectively. With *high mobility*, each person in the sample is sick for one time period only, so that those sick (n=20) change after each period. With *no mobility* the same 20 are sick in each time period, and the other 160 are healthy throughout. For *intermediate mobility*, we assume that 10 are sick for the whole time period, and 10 persons are sick for one time period only.

In order to make our example more realistic, we also consider the possibility that patients may adapt to illness. Measured at a point in time, HRQOL is usually lower the worse the patient's health state. The answer on what happens to HRQOL if an illness lasts over several time periods is less straightforward. As documented in the quality of life literature, patients' own valuation of their health states can improve over time, even if the underlying illness and the state of health experienced stay the same, a phenomenon called positive adaptation or response shift (Howard et al., 1979; Schwartz and Sprangers 1999; 2000 Postulart & Adang, 2000; Bernhard, 2004; Kostopoulou, 2006; Goldberg, 2006; Dolan and Kahneman, 2007). Therefore, if patients' own valuations - as their health is experienced through time - are used in cost effectiveness analyses, then positive adaptation may introduce a downward bias in the effectiveness of treatment.

On the other hand, examples of the opposite, negative adaptation by patients, are not very common in the literature[2], although it seems quite possible that mental illness or pain may become increasingly burdensome with time. Instead, the literature on 'maximal endurable time' shows that when non-patients are asked to imagine themselves living with a moderate to severe disability, peoples' valuation of the same health state typically decline with duration (Sutherland et al, 1982; Stalmeier et al, 1996). Therefore, if hypothetical valuations obtained from the general public for different durations were used in cost effectiveness analyses, then anticipated negative adaptation introduces an upward bias in the effectiveness of treatment. It is not the purpose of this paper to debate whether or not health state valuations should reflect different durations, or whether health state valuations ought be obtained from patients or from the general public; suffice for our purpose here is to show that both positive and negative adaptation are real concerns (although, not at the same time).

Returning to our hypothetical example, we assume that the sick state has a HRQOL of 0.5. If the individual stays sick after the initial time period, we consider three straightforward

[2] One example is a study on positive and negative adaptation to fibromyalgia (Lindberg, 2002).

scenarios: *no adaptation* (constant HRQOL over the course of an illness); *positive adaptation* (increasing HRQOL over time); and *negative adaptation* (decreasing HRQOL) and provide hypothetical HRQOL for each (see *Table 1).* The values are generated by a logarithmic function and are assumed to approach 1 (for positive adaptation) and 0 (for negative adaptation) for an illness lasting over the 9 time periods. For illustration purposes we assume monotonically increasing/ decreasing functions, but our argument can in principle be extended to more complex HRQOL profiles over time.

(Table 1 here)

We assume that the overall burden of illness is the same in each of the three scenarios, but distributed differently over individuals, and over time. We only calculate aggregate QALYs for the 20 sick individuals. For *high mobility,* aggregate QALYs for the 9 time periods and the subgroup of sick individuals are equal to 90 (20 individuals * 0.5 HRQOL * 9 time periods, see *Table 2).* Aggregate QALYs are 90 independent of whether adaptation is positive, negative or none, because no patient ever suffers from an illness beyond one time period so adaptation cannot occur. Thus, for subgroups with high levels of health mobility, adaptation is less of a concern.

(Table 2 here)

In the case of *no mobility*, the amount of aggregate QALYs depends on the type of adaptation present. First, if individuals do not adapt (positively or negatively) to their illness, aggregate QALYs are 90. This is the same result as for the case of high mobility, although now, illness is distributed very differently across individuals within our sample as the same individuals stay sick over the course of the 9 time periods. If no mobility is coupled with positive adaptation, however, aggregate QALYs are 152 (20 individuals * (0.5+0.63+0.78+…+0.99 HRQOL) due to increasing HRQOL over time. For negative adaptation, aggregate QALYs are only 28 (20 individuals * (0.5+0.37+0.22+…+0.01) HRQOL) due to decreasing HRQOL.

For *intermediate health mobility,* aggregate QALYs again depend on the type of adaptation. The values are 121 (10 individuals * (0.5+0.63+0.78+…+0.99) HRQOL + 10 individuals * 0.5 HRQOL * 9 time periods) for positive adaptation and 59 (10 individuals * (0.5+0.37+0.22+…+0.01) HRQOL + 10 individuals * 0.5 HRQOL * 9 time periods) for negative adaptation. Comparing these results with high mobility, we can see that the results for intermediate mobility are somewhat mediated by the fact that only half of the sick individuals stay sick over the whole observation period, whereas the other half is made up of those experiencing ill health for one time period only. Again, aggregate QALYs are 90 if there is no adaptation, as for high mobility.

Health mobility and resource allocation: A hypothetical example

In our hypothetical example the proportion of sick to healthy individuals stays the same at each single point in time: 20 individuals are sick and 160 are healthy. A superficial analysis of these numbers would result in the same aggregate QALY for each time period. We show, however, that different types of health mobility and adaptation can result in greatly different aggregate QALYs for this relatively small sample.

To demonstrate the implications of health mobility with adaptation on resource allocation, we now return to our policy maker who wants to implement a mental health program for ethnic minority and low income groups. To recap, both groups have been shown to suffer from the same low mental health status at a point in time, but ethnic minorities experience high health mobility, whereas low income groups experience low health mobility. What do our scenarios above mean for resource allocation between these two subgroups? Let us, for the sake of simplicity, assume that intervention for these groups both achieve recovery to full health, and cost the same.

Low income and ethnic minority groups generate the same amount of aggregate QALYs only if there is no adaptation to illness in the low income group. In this situation, other things being the same, the two groups should attract the same amount of resources, because potential benefits of a health intervention would be the same. If, however, there is positive adaptation in the low income group, then the ethnic minorities group should attract more resources than the low income group. In this case, potential benefits from a health program would be greater for the ethnic minorities group, because over time the low income group 'suffers' less and less from an illness, in aggregate QALY terms. However, the low income group should attract more resources than ethnic minorities if there was negative adaptation in the low income group. Potential benefits would be higher for the low income group because they 'suffer' increasingly over time. We see that different scenarios on health mobility with adaptation can have widely different resource implications, despite the fact that both groups suffer from the same level of ill health at a point in time.

The above illustration is a simplification of the issues involved. Individual patients with the same illness may have different adaptation processes and experience different HRQOL, and of course there may be overlaps between sub-groups. Adaptation processes have been shown to be quite complex, generating distinct aggregate QALY profiles (Salomon and Murray 2002). Also, health mobility is likely to be more complicated with individuals shifting in and out of illness over the observation period. We assume that the costs of implementing the mental health program are the same for both groups, which may well not be the case if the causes of differing mobility affect the cost effectiveness of treatment. Furthermore, not all interventions in the real world achieve recovery to full health. Taking account of these points will make the analysis more realistic, but also more complex, and may require extensive simulation. Nevertheless, we demonstrate that policy conclusions can be drawn, even from the simple analysis presented above.

Political and ethical implications of health mobility

The above illustration focuses on health outcomes. Health mobility can also have political and ethical implications, which in turn may affect resource allocation. There is debate concerning the ethical implications of positive adaptation, regarding whether it is fair that those who manage to positively adapt may, other things being equal, be given a lower priority in resource allocation (see for example Menzel et al, 2002). Our example provides a new dimension to this debate. It is possible that the public would regard lower health mobility of a sub-population as something that should be given higher priority to, when prevalence is the same between sub-groups. In other words, if the same amount of disease burden is distributed across a defined group, it is likely that people will prefer it to be dispersed widely so that more people suffer a little each (high mobility) than to be concentrated so that a smaller number of people suffer a great deal each (low mobility). If total disease burden is fixed, then high mobility is associated with shorter spells of sickness, and low mobility with longer spells of sickness. The moral difficulty associated with positive adaptation being penalised with lower priority may be ameliorated to some extent with longer duration (low mobility) being awarded with higher priority.

Health mobility is also likely to have political implications. If health mobility for a particular illness is high, this means that a comparably large proportion of the population is affected. A policy maker (possibly concerned about re-election) may want to allocate large amounts of resources on alleviating this illness, because it affects a large number of voters. On the other hand, an illness which is characterized by low health mobility may be more conducive to the formation of patient lobby groups which require time and a relatively stable member base to become politically influential. Such strong lobby groups can have considerable influence on resource allocation decisions. There may well be ethical and political implications of health mobility which may influence resource allocation decisions, possibly even in opposing directions.

Conclusions

Studies on resource allocation tend to focus on health outcomes in subgroups of the population at a point in time. We propose an innovation in suggesting that static analyses should be supplemented by information on health mobility of population subgroups and adaptation. Increased availability of panel data and measures of long term health make this feasible.

We show that a snap-shot of the overall distribution of health within a population at a point in time is not a sufficient basis for resource allocation decisions. Two groups with the same aggregate health outcomes may still attract differing amounts of resources depending on levels of health mobility and type of adaptation. We find that the two groups would only attract the same amount of resources if both experience high health mobility or do not experience adaptation to their illness. Otherwise, one group would receive more resources than the other, despite having the same extent of ill health at a point in time. This is because aggregated QALYs and potential benefits of health interventions differ. We find that if health mobility is high, adaptation is no concern. Conversely for low health mobility, adaptation matters. In addition, if there is no adaptation, HRQOL is the same whatever the degree of health mobility. Thus, the implications of health mobility are influenced by adaptation and whose valuations are considered. If patients own valuations are taken (which often seem to exhibit positive adaptation), groups with low mobility may be given lower priority because patients in that group learn to cope with their illness better than patients in groups with high mobility where illness is a short term phenomenon. In this scenario, short-term illness would be more undesirable than long-term illness. Conversely, if the general public valuations are taken (which tend to exhibit negative adaptation), groups with low mobility may be given higher priority because long-term illness would be more undesirable than short-term illness.

All of this has implications for cost effectiveness ratios, particularly models of effectiveness of interventions if the link between mobility and adaptation is not accounted for. In policy terms, funding may be moved between chronic and acute illnesses, depending on the impact of health mobility and adaptation on cost effectiveness of interventions. There may also be consequences in moving funding from treatment to prevention, to ameliorate effects of mobility, or in deciding how to allocate funds to an ageing population. Not considering health mobility and adaptation phenomena may result in over or underestimating the effectiveness of health care technologies. Clearly, more empirical work on health mobility, adaptation and implications for aggregate QALYs is required.

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Table 1: Hypothetical HRQOL for a sick individual and three adaptation scenarios

	Adaptation		
Time period	*none*	*positive*	*negative*
1	0.50	0.50	0.50
2	0.50	0.63	0.37
3	0.50	0.78	0.22
4	0.50	0.86	0.14
5	0.50	0.92	0.08
6	0.50	0.95	0.05
7	0.50	0.97	0.03
8	0.50	0.98	0.02
9	0.50	0.99	0.01

Table 2: Aggregate QALYs for different adaptation and health mobility scenarios

		Adaptation		
		none	*positive*	*negative*
Health mobility	*high*	90	90	90
	intermediate	90	121	59
	none	90	152	28