An inquiry into needs-based allocation of health care resources*

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ABSTRACT

The concept of health care need is commonly used, particularly in the context of resource allocation. Any interpretation of what is meant by a need, if it is to be of practical use, must be able to take into account typical properties of health care interventions. Three such typical properties are: their probabilistic nature; variation between different interventions in the time course of the effect; and, the fact that the most effective treatments often combine more than one intervention. These three properties can readily be taken into account within the framework of welfare economics. In this paper, we examine the question of to what extent they can be accommodated within needs-based approaches. We argue that needs-based approaches cannot accommodate these three typical properties although some interpretations of ‘need’ are more problematic than others.

Keywords: Health care need; Resource allocation, Distributive justice, Non-welfarist approaches.

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1. Introduction

It is increasingly the case that cost-effectiveness analyses play a major role in resource allocation discussions as well as in actual decisions. This is illustrated for example in the UK by the National Institute for Health and Clinical Excellence (NICE)\(^1\), as well as by local decision making forums\(^2\).

The concept of need is often proposed as providing an additional (or alternative) criterion to cost-effectiveness. In this context, a need provides a reason for giving higher priority to an intervention that is less cost effective than another intervention which does not respond to a need. The concept of need can also be used to try and identify those health care interventions that a system of healthcare should ensure is available to all citizens or members. The implication is that these needed interventions should be provided whatever the cost (at least within some kind of limit). Claiming that a particular healthcare intervention is a ‘need’ therefore provides one kind of reason in priority setting that should be taken into account potentially alongside other reasons (such as cost-effectiveness).

Although some authors have defined needs-based health care resource allocation in what could be interpreted as a welfarist framework\(^3\), it seems generally agreed that the principle of allocating (health care) resources according to need is, or should be, distinct from that of maximizing (health-related) welfare.\(^4\)

If the concept of need is to be of practical use to decision makers then it must be sufficiently worked through to cope with the realities of the kinds of decisions that must be made. In a previous paper we have argued that a key feature of claiming that an intervention is a need is to claim that it provides benefit to some patients in a

\(^1\) National Institute for Health and Clinical Excellence (2005), *A Guide to NICE*.
significant way. In that paper we distinguished three principal interpretations of what might be meant by significant in this respect. In the first interpretation what is significant is that the patients who can obtain benefit from health care are, initially at least, very poorly off. In the second interpretation the intervention is significant because it improves patients’ quality of life and functioning across a threshold that has particular significance. For example, the threshold can determine the ‘normal functioning range’ for humans. If an intervention takes a particular patient from a state below ‘normal (species) functioning range’ into the normal functioning range (albeit below full health) then, on this interpretation, the intervention represents a ‘need’. The third interpretation of what is meant by need is that the intervention provides a significant benefit in the sense that it brings about a major improvement (in absolute or relative terms) in the patient’s health.

In this paper we consider three features that are typical of real health care interventions that challenge the applicability of need satisfaction as a guide to resource allocation.

The first feature is that many interventions have only a probability of achieving a desired effect. Any theory of health care resource allocation that is to be of general and practical value should be able to deal with this aspect in a consistent manner. In cost-effectiveness analysis uncertainty is readily dealt with by evaluating the expected outcome relative to costs, where ‘expected’ takes into account probability of obtaining the desired effect. We will argue that taking this probabilistic feature into account is problematic for needs theories and requires somewhat arbitrary solutions, in marked contrast to welfarist theories.

The second feature is that the health benefit of interventions occurs at varying times after the intervention. In some cases, such as cholesterol lowering drugs, for example, the health benefit may only be seen many years after the start of therapy. There should be a reasonable way of handling this aspect of health care interventions if the notion of need is to be useful in practical applications. Related to the question of timing of interventions, is also the role of the age of the patient at the point in time when the intervention has an effect. We treat these two aspects related to time

together. Whereas cost-effectiveness analysis often uses discounting to give meaning to inter-temporal comparisons of costs and effects, we shall argue that a needs approach cannot so readily take these temporal effects of treatment into account.

The third feature is that better outcomes for patients are often obtained through a combination of interventions. Although this is of course a trivial point to make, it is rarely discussed in theories of needs-based resource allocation, and gives rise to a difficulty with the idea of allocation according to health care need. It turns out to be impossible to separate the specification of medical interventions from the assessment of individual needs. Again, we find that the consequences of this difficulty depend on the specific notion of need.

Overall, we argue that whereas welfare considerations, such as cost-effectiveness analysis, are able to take each of the three features of health care interventions mentioned above systematically into account in a relatively clear cut way, these factors pose serious problems for an account of health care need. We indicate ways in which the concept of health care need may have to develop in order to take these factors into account.

The paper is organised as follows. In the following section we introduce some notation and define three possible interpretations of health care needs. Sections 3-5 discuss how each interpretation might try and deal with each of the three factors: outcome uncertainties, time aspects, and combined or mutually exclusive ‘needed’ interventions. We conclude that only one of the interpretations of health care need, the poor initial state interpretation, can readily cope with these three factors, although even in this case the approaches required are not satisfactory. In Section 6 we discuss the implications of our findings and argue that needs-based decision-rules are overall problematic, and if used systematically, may lead to undesirable resource allocation. Section 7 provides summary and conclusion.
2. Three models

In a previous paper we proposed a framework for thinking about health care need.\(^6\) We will summarise this framework since it provides a basis for the arguments in this paper.

We will use the term *health state* to mean the state of health of a person, including all aspects relevant for the particular resource allocation decision. We refer to health states as \(A, B, \ldots\) etc. The analysis does not depend on any particular assumptions about the factors defining health states. However, we assume that health states can be ranked according to betterness, i.e. that there is a complete and transitive *betterness relation* between health states.\(^7\) Restricting attention to a finite number of health states, it is well-known that there exists an index \(v(\cdot)\), such that \(v(A) < v(B)\) if and only if health state \(B\) is better than health state \(A\).\(^8\)

We write ‘intervention \((A, B)\)’ to refer to an intervention that takes the patient from state \(A\) to state \(B\). In order to keep the notation to a minimum, we do not introduce a specific notation for the intervention itself – only *ex ante* and *ex post* health states are specified. This means that we do not distinguish between interventions that have exactly the same effect, because this distinction is not crucial to our arguments. If two different interventions had identical effects for a particular group of patients then one might be preferable for various reasons, such as cost or convenience, but not on the grounds of a difference in the degree of need.

Using this notation we distinguish three different models or interpretations of what might be meant when a health care intervention is termed ‘a need’ for patients in a particular health state: the *poor initial state interpretation*; the *normal functioning range interpretation*; and the *significant gain interpretation*.\(^9\)

According to the *poor initial state interpretation* intervention \((A, B)\) is a need if \(v(A) < v(B)\) and \(v(A) < \alpha_1\), where \(\alpha_1\) is a given threshold. Figure 1 illustrates a needed intervention. On this model the health state \(B\) must be better than health state \(A\), but as long as this condition is met, the reason why the intervention is a need is because of

\(^6\) We refer to our previous paper op. cit. (5) for further references and discussion.


\(^8\) Assuming that there is only a finite set of health states is not strictly necessary; see, e.g., Fishburn, P. (1970), *Utility Theory for Decision Making* (chapter 2 and 3), New York: John Wiley & Sons, Inc.

the low level of state \( A \), not because of the magnitude of the gain in health state.\(^{10}\) Note that \( v(B) \) might be below or above \( \alpha_1 \).

In the *normal functioning range interpretation*, exemplified in Figure 2, intervention \((A,B)\) is a need if \( v(A) < \alpha_2 \leq v(B) \), where \( \alpha_2 \) is the threshold for ‘normal functioning’. The idea behind this concept of need is that it takes the patient from a level below some ability to functioning to a level above such a level. The relevant level of functioning might be, for example, the ability to lead an independent life,\(^{11}\) or, more specifically, the ability to walk unaided by others.

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There are two versions of the signification gain model: an absolute version and a relative version. In the significant absolute gain interpretation intervention \((A,B)\) is a need if the absolute gain in health state is sufficiently large, i.e. if \(v(B) - v(A) \geq \alpha_3\), for some positive threshold \(\alpha_3\).\(^{12}\) In the significant relative gain interpretation \((A,B)\) is a need if the gain, relative to the value of initial health state, is sufficiently large, i.e. if \[
\frac{v(B) - v(A)}{v(A)} \geq \alpha_4,
\]
for some positive threshold \(\alpha_4\). For a given health index \(v(\cdot)\), the absolute and relative interpretations are, of course, different. But since one can always translate from one interpretation to the other by a logarithmic (exponential) transformation of the index \(v(\cdot)\), they both belong to the same family of methods, and share similar properties. Figure 3 illustrates the significant absolute gain interpretation.

![Figure 3: Significant gain (absolute) interpretation](image)

According to this analysis there are four distinct criteria by which interventions can be claimed to be health care needs. The particular thresholds (i.e. \(\alpha_1, \alpha_2, \alpha_3\) and \(\alpha_4\) in the specific interpretations) can be viewed as exogenous parameters, or endogenously determined by a stock of available resources (for example, the threshold can be selected such that all available health care resources will be used when resources are allocated to all needed interventions). We discuss in detail the latter, more flexible, interpretation in Sections 5 and 6.

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\(^{12}\) This definition seems to correspond to the interpretation of health care need suggested in chapter 4 in Culyer, A. (1976), Need and the National Health Service, Oxford: Martin Robertson. Culyer discusses in this chapter ‘need’ independently of any specific underlying health care resource allocation problem.
We now go on to consider three particular aspects of health care interventions that have relevance to a concept of health care need and priority setting in health care more broadly: uncertainty, time, and multiple (combined or mutually exclusive) interventions. We will discuss each of these in turn.

3. Need and uncertainty

In defining need we have so far assumed that an intervention \((A,B)\) will take the patient from state \(A\) to state \(B\), but without reference to the probability of its being a successful treatment. It is characteristic of many, perhaps most, medical treatments that they are effective in only a proportion of patients with the relevant condition. It is for this reason that concepts like ‘numbers needed to treat’ have been developed to help in medical decision-making.\(^{13}\) If, therefore, a particular intervention has a probability significantly less than 1 of being effective with regard to an individual patient, or patient group, the question arises as to how this probability is to be taken into account in understanding the concept of need.

Suppose, for simplicity, a particular therapeutic drug will almost certainly take the patient from state \(A\) to state \(B\), and that it would count as a need on the basis of any of the three interpretations discussed above. It might, for example, save the lives of young adults, and we say that intervention \((A,B)\) is a health care need. Now, suppose that the drug is only effective in some patients. For example it will take 10% of patients from state \(A\) to state \(B\), but has no impact on the other 90%, and it is impossible to predict which patients will benefit. Is this drug still a need for patients in the relevant condition?

We can formulate this aspect using the notation \((A,B,p)\) to refer to an intervention that will take a patient from state \(A\) to state \(B\) with probability \(p\), where \(p\) can take any value between 0 and 1.\(^{14}\) The question that we are considering is the following. If intervention \((A,B,p)\) would count as a need (in the relevant group of patients) when the probability of \(p\) is unity, how is its status as a need affected by changes in \(p\)?

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\(^{13}\) See, e.g., [http://www.shef.ac.uk/scharr/ir/nnt.html](http://www.shef.ac.uk/scharr/ir/nnt.html) for a bibliography.

\(^{14}\) More generally still, an intervention could generate a probability distribution over a number of possible outcomes. To keep it simple, we restrict attention to situations with two possible outcomes: \(A\) (status quo) and \(B\) (improved health).
Intuitively, for a condition-intervention pairing to be a need, the intervention has to have at least some minimal chance of working. This is the case even for the poor initial state interpretation which otherwise focuses exclusively on the patient’s initial health state. The fact that interventions have different probabilities of bringing about the desired effect bears on the question of what is meant by an intervention’s being effective.

A theory of health care need must include not only the considerations highlighted in the three interpretations defined previously but also a consideration of the probability that the intervention is effective.

According to the poor initial state interpretation of need it is a feature of the condition treated (i.e. \( v(A) < \alpha_1 \)) that merits interventions being needed. As uncertainty is an inherent characteristic of many interventions, but does not interfere with the patient’s initial health state \( A \), it might be argued that the determination of a need for treatment interventions should remain unaffected by uncertainty of outcome. In other words, if allocating resources according to need is simply about compensating those who are worst off prior to treatment, any (well-documented) chance of success is sufficient for the intervention to be a need.

The normal functioning range interpretation reflects the view that the intervention elevates the patient above a certain health state value of particular importance. We might argue that as uncertainty is an inherent aspect of the effect of the intervention, uncertainty of effect must affect which drug treatments we call needs since the value of the outcome generally matters. Thus, even though both intervention \((A,B,1)\) and intervention \((A,B,0.1)\) could potentially elevate the patient above the threshold, they cannot be needs to the same extent, because the latter intervention will have the desired effect for only one in every ten patients. The definition of a needed intervention as it stands in the normal functioning range interpretation does not take account of the problem of uncertain effects.

The significant gain interpretations of need have similar implications. According to these interpretations, it is the size of the gain \( v(B) - v(A) \) that renders the intervention a need. It would seem generally consistent with the idea of this model that there has to be a significant probability that the effect will be realised for the intervention to be counted as a need. Although intervention \((A,B,1)\) and intervention
(A,B,0.1) potentially procure the same health gain they are not needed to the same extent.

If a needs-based decision-rule is applied, and if need is defined either in terms of the normal functioning range interpretation or a significant gain interpretation, then the definition of need must include, further, how the probability that the intervention is successful is to be taken into account. In order to make the criteria for need operational as decision rules under conditions of uncertainty it is necessary to include a decision-rule, which takes account of uncertainty. That decision-rule could be one of three general types. First, it could provide a probability threshold such that if the intervention is a need if \( p = 1 \) then it is a need, if and only if \( p \) is greater than the threshold. Second, the concept of need itself could be graded so that the greater the value of \( p \), the greater the need, for example using the expected gain \( p(v(B) - v(A)) \) as the outcome measure in the significant gain model. Third, if an intervention is a need when \( p \) is unity it is a need when \( p \) takes any non-zero value. In other words, if \((A,B,1)\) is a need then \((A,B,p)\) is a need for all positive values of \( p \). We have argued that both the normal functioning range model and the significant gain models would, most naturally, adopt one of the first two decision rules concerning probability. The poor initial state interpretation, might, more naturally, adopt the third decision rule although this rule is highly problematic since an intervention with virtually no chance of success could be a need. This would have the effect of giving high priority to potentially expensive interventions with very low chances of success thus leading to large resources being used in what turn out to be useless interventions. There is, however, no logical requirement for any particular model of need to adopt any particular decision rule regarding probability and effectiveness. What is required is that any account if health care need, must, if it is to be complete and of practical value in decision-making, specify how probability is to be taken into account.
4. Need over time

The discounting of future outcomes is often used by economists in the setting of cost-benefit and cost-effectiveness analysis.\textsuperscript{15} Some of the grounds for such discounting are concerned with the cost side of the analyses (e.g. adjusting for price inflation, cost of capital, etc.), that are not directly relevant to needs assessments. There has been much debate on how delay of effects should be taken into account, in a context of health\textsuperscript{16}, and in a context of need.\textsuperscript{17} What reasons might there be for considering that an intervention that has its effect a long time in the future is less of a need than an intervention that has a similar, but immediate, effect? For our purpose, several reasons might be considered.

The concept of need seems, perhaps, particularly appropriate in the case of urgent interventions that have an almost immediate effect. A characteristic of some health care interventions however is that they have their effect on a person’s health at some time in the (distant) future. We may for example think of preventive medicine. This raises the question of whether interventions that have their effect on health at some time in the more distant future are therefore lesser needs.

What are the possible scenarios? Suppose that a person is in health state $A$ at the moment. He will remain in that health state without treatment. There is an intervention $(A,B,0)$ (where ‘0’ indicates the time delay in effect) that will take him immediately to $B$. Suppose that $(A,B,0)$ is a need on whatever theory of need is adopted (for example that we hold the normal functioning views and $(A,B)$ takes the person across the threshold). There is another intervention $(A,B,t)$ that if given now will have its effect in $t$ years time. This intervention also takes the person from $A$ to $B$. If these two treatments are treatments for the same person then clearly the first treatment is better than the second (if other factors are equal) since it does the same thing, only sooner. But if only a treatment $(A,B,t)$ existed would it be a need? It seems to us that it would be need unless either the effect of the intervention would be


different in \( t \) years time or that the person would then be so old that it would alter how we see the states \( A \) and \( B \). This does not mean that if we have a choice of two interventions, one of which acts sooner than the other, there would not be grounds for preferring the one that acts sooner. In the same way if two interventions acted immediately and represented a need we would prefer the one that was cheaper. But that preference is not about need, in either situation.

With regard to typical prophylactic medicine the situation is somewhat different. Consider someone with high blood pressure for example. Let us suppose that treating now will save his life in ten years time (through preventing a heart attack). Compare this (with regard to need) to another situation with another patient where an intervention saves that person’s life now. Assuming that the intervention that saves a life now is a need (on whatever theory of need we adopt) is the intervention that saves the life in ten years time also a need? In those ten years the person is perfectly healthy (other than having high blood pressure which itself, we will assume, does not impact on quality of life) in contrast with the situation above, where the person remained ill until the intervention started to take effect. On the three interpretations of need outlined above it seems to us difficult to argue that the time delay affects whether the intervention is a ‘need’. The effect of the prophylactic treatment would become a need when the person is about to have the heart attack. Taken from that perspective the prophylactic treatment was a needed intervention over the previous ten years. However we suspect that a common intuition is that the immediate life saving treatment was a need but the prophylaxis is not. This tells us that it is intuitively plausible to view urgency of effect as part of the concept of need, a quite separate and additional consideration from the effects of the intervention on the health state. What drives this intuition might not be the time delay itself but uncertainty over the effect of the prophylaxis – this intuition might therefore be about probability. It might alternatively be about the ability to know whether you have benefited the person which is different from, but related to, probability. Thus when we give the blood pressure tablets we might have good evidence that it has, say, a 10% chance that it will save the person’s life. But if the person does not die we do not know whether he would have lived even without our treatment. Similarly if we do not treat him and he

\[ \text{17 E.g., Thaler, R.H. (1994), } \text{The Winner’s Curse, Princeton, NJ: Princeton University Press.} \]
dies we do not know whether he would have died even had we treated him. Again, it seems to us that if a 10% chance of saving a person’s life is a need, then it remains a need even if we cannot know which individuals have benefited. This issue relates to the ‘rule of rescue’.18

In the three models of need that we have put forward we focus on need as being defined and defended in terms of one or other of three aspects of the states of health before and after treatment. Our view is that one of these models, or a combination19, forms a necessary part of a particular theory of need. For some this might not be sufficient. For some, an intervention is a need only if there is some limit on the time delay between the giving of the intervention and the effect of the intervention. We think that this makes little sense in the situation where a person remains in state $A$ from the start of treatment until it takes effect. It is a more plausible position in situations of prophylaxis where the person remains healthy through most of the period between starting treatment and benefiting from it. But even here the question arises as to what justifies the view that time delay affects whether something is a need – once one has taken out considerations of probability and uncertainty of effect when it takes effect.20

Related questions concern the role of the age of the patient at the point in time where health care is received or has its effect. It can be argued that an intervention that saves the life of a 35 year old patient now should have higher priority than one that if given now to a 35 year old will save his life in fifteen years time. This argument is a version of the ‘fair innings’ argument.21 If we have to choose, it is better to save the life of a 35 year old than a 50 year old on grounds of equity in number of years lived. The 50 year old has already lived for 15 years beyond 35 years. This

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18 See, for example, Hope, T., (2001), Rationing and life-saving treatment: should identifiable patients have higher priority? Journal of Medical Ethics 27, 179-185.
19 For example, a health care need might simultaneously require that the initial state is sufficiently poor and the intervention achieves a health gain that is above a particular threshold level.
20 One feature is that it may be reasonable that less weight is given to the interests of future generations – to people who do not exist at the moment. Even if it would be right to do this, however, this is not relevant to the interventions we are currently considering which affect people, albeit in the future, who do exist at the point in time where decisions are made. The concept of need is, we believe, primarily used to address a concern for specific patients who exist.
argument could be incorporated into a concept of need. That is, one could claim that a (life-saving) treatment for a 35 year old represents a greater need than a similar treatment for a 50 year old.

But these grounds do not provide a reason for considering that an intervention that immediately saves the lives of fifty year olds now is more of a need than an intervention that will save the lives of thirty-five year olds when they have reached the age of fifty. In other words this argument provides no grounds for the view that immediately life-saving interventions are more of a need than interventions which save life in the more distant future when the age at which the effect is realised is taken into account. The age of patients may also be relevant in resource allocation, not in terms of number of years lived, but in number of expected years to benefit from the intervention. A third, more radical, way in which age may affect resource allocation is by giving greater value to each year of life at different ages. For example, valuing one year of life at age 20 years more than one year of life at age 80 years.

How do these considerations affect the concept of need for each of the three models? The answers parallel, we believe, the discussion on probability of effect. Since the poor initial health model relies only on the value of initial health, time delay should not affect the issue of whether an intervention is a need. Thus, if the needed intervention is one that helps individuals who are particularly badly off in terms of health, the point in time at which the intervention has its effect should not be relevant. Thus within the poor initial health interpretation, delays in effect have no impact on needs-assessment. Similarly, the age of the patient should not play any role either, since neither the time lived nor the number of years that the patient is likely to benefit from treatment relate to the initial health state.

For both the normal functioning range interpretation and the significant gain interpretations, it is the effect of the intervention which renders it a need. Again, and for the reasons given above, delayed effect should not impact on need, unless the delay either significantly affects the probability of the intervention being effective; or unless by the time the intervention takes effect the patient will no longer enjoy the same benefit.

Whether our views on the question of need and time of effect are correct or not, any comprehensive theory of need must specify how delay in the effect of an intervention affects, or does not affect, the question of need. In other words, analysts
making reference to health care needs must also, in principle, account for the problems of delayed outcomes of health care.

5. Multiple ‘needed’ interventions

A third feature that is typical of health care interventions is that it is often a combination of interventions (rather than a single intervention), that produces the best results for patients in a particular condition. This raises the question of what constitutes an intervention when considering whether a particular condition-intervention pairing is a need.

A critical complication is that theories of resource allocation based on notions of need depend on the way the interventions themselves are characterised. It is often the case that there is no unique way of characterising a health care intervention. An intervention is often a combination of a whole series of diagnostics and treatments involving drugs, surgery and nursing care. Can a person need only some aspects of the ‘total package’ or all components, and what considerations are relevant to answering such a question?

Consider, for example, a person in some health state $A$. Drug 1 moves the person to health state $B_1$, whereas drug 2 moves the person to health state $B_2$. Now, assume that a combination of drug 1 and 2, ‘drug $1+2$’, is most effective and brings the patient to a health state $B_{1+2}$, where $v(B_{1+2}) > v(B_2) > v(B_1)$. Effectively, we have three interventions ($A,B_1$), ($A,B_2$) and ($A,B_{1+2}$).

Generally, by considering all possible combinations of interventions as independent interventions, we ultimately obtain a list of mutually exclusive interventions.

![Figure 4: Three interventions](image-url)
In the situation illustrated in Figure 4, \( v \) lies between 0 and 1, and there are three possible interventions \((A, B_1), (A, B_2), (A, B_3)\) related to drug 1, 2 and 1+2. Of course, without reference to a particular interpretation of need, there is no way of selecting between these interventions. In Figure 5, the poor initial state interpretation is illustrated in which all three interventions fulfil the criteria of a need.

![Figure 5: Three interventions and the poor initial state interpretation.](image)

This illustrates a general limitation of this interpretation of need: in many situations a person needs some treatment, but this interpretation is silent with respect to which particular intervention(s) to select. In making medical decisions therefore, including resource allocation decisions, the ‘poor initial state’ interpretation of need will not always be sufficient. We need further concepts – such as cost-effectiveness – to help choose between different interventions for the same patient at the same time, all of which qualify as ‘needs’.

The poor initial state interpretation however does have one interesting implication. Suppose intervention \((A, B_1)\) takes the individual to a health state \(B_1\) for which \(v(B_1) < \alpha_1\) (as in Figure 5). In other words, the patient would still be in need of any effective treatment even after being given intervention \((A, B_1)\). This would be grounds for saying that the person needed either intervention \((A, B_2)\) or \((A, B_3)\) (rather than \((A, B_1)\)) if both these interventions take the person above threshold \(\alpha_1\).

We can take this reasoning one step further and argue that when improving the person’s health and bringing it to a state above value \(\alpha_1\) there would be good reasons to view only the least effective such intervention as a need. This is because, once the person’s state is above the threshold, any further improvement in health state is not
‘needed’. This implication of the poor initial state model could have particular appeal, assuming that the more effective treatment \((A,B_3)\) is more expensive than treatment \((A,B_2)\). In giving priority to the cheapest interventions that bring patients’ health states above the threshold, the limited resources are used to maximise the number of people whose health state is above this threshold. By contrast allocating resources according to welfare maximisations would maximise overall health gain but would probably leave more patients below the health state \(\alpha\). There is, however, one interpretation of welfare maximisation – represented by the leximin social welfare ordering - that is consistent with giving priority to the less effective (cheapest) intervention that brings peoples’ health states above the threshold value \(\alpha_i\). To see this, suppose for simplicity that there is a fixed number of people in the population \((n)\) and recall that a welfarist approach would consist of a specification of individual utility (which in our case is represented by the index \(v\)) and an ordering of all conceivable distributions of individual health states (a social welfare ordering). The leximin social welfare ordering is that ordering that gives maximal priority to the worst off in the sense that distribution \((v_1,\ldots,v_n)\) is socially more desirable than distribution \((v'_1,\ldots,v'_n)\) if the worst off in \((v_1,\ldots,v_n)\) is better off than the worst off in \((v'_1,\ldots,v'_n)\), and if the worst off are in the same position, then the second worst off are compared etc. If the poor initial state interpretation is used for resource allocation as described above, the final distribution of health would be consistent with welfare maximisation based on the leximin criterion, since the health states of the worst off (ex post) are, effectively, taken to the highest possible level.

Now, consider the normal functioning range interpretation. The needs-criterion is illustrated in Figure 6.

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22 The leximin ordering is an example of a maximin ordering giving maximal priority to the worst off individual, an idea which has been extensively discussed in the literature, see, e.g., Rawls, J. (1971), *A theory of justice* (2 edition 1999), Cambridge, MA: Harvard University Press. For recent discussions, see also Tungodden, B. (1999), Rawlsian reasoning and the distribution problems, *Social choice and Welfare* 16, 599-614, and Tungodden, B. (2000), Egalitarianism: is leximin the only option? *Economics and Philosophy* 16, 229-245.

23 Weale argues that if we say that person A has greater needs than person B we simply mean that A needs a larger set of primary goods than does B in order to achieve the same level of welfare (Weale, A. (1978), *Equality and Social Policy*, London: Routledge and Kegan Paul). Unless total equalisation of the (health-related) welfare of people within the population is possible, the specific implications of this interpretation of need for allocation of health care resource decisions are not clear. See also Culyer, A. and Wagstaff, A. (1993), Equity and equality in health and health care, *Journal of Health Economics* 12, 431-457 (p. 435-336).
For ease of comparison, the threshold level in Figure 6 is similar to that in Figure 5, but this may of course not necessarily be the case. Here, intervention \((A,B_1)\) is not needed, whereas intervention \((A,B_2)\) and \((A,B_3)\) both qualify as needs. Again, a rule is required to select among ‘needed’ interventions.

As in the poor initial state interpretation one could argue that only the less effective (or cheapest) intervention that qualifies as a need should be provided. It is, however, generally not the case that this would allow more people to be treated, since moving the threshold level could possibly lower the number of people treated and involve other types of patients. Thus, in the normal functioning range interpretation, there seems to be no particularly strong case for any specific rule for selecting between needed interventions.\(^{24}\)

\(^{24}\) The normal functioning range interpretation is consistent with a social welfare ordering dividing the population into two groups, those without a health state value below \(\alpha_2\) and those with a health state value equal to or above \(\alpha_2\), attributing unitary social value only to the number of people above the threshold. However, many aspects of human functioning (for example, ability to see, hear, walk, etc.) are not all or none, but can be graded and measured on a continuous scale. A simplification in which the analyst only distinguish between ‘acceptable health’ and ‘unacceptable health’ would in many cases not be sensible since individuals may also have strong and reasonable desires to improve health even though they are unable to pass a certain threshold (e.g. go from ‘abnormal species functioning’ to ‘normal species functioning’).
In the significant gain interpretation, an intervention is needed if the capacity to benefit from treatment is sufficiently large. This is illustrated in Figure 7 for the ‘absolute’ version of this interpretation:

![Figure 7: Three interventions and the significant gain interpretation (absolute)](image)

In this example, interventions \((A,B_2)\) and \((A,B_3)\) are both needs whereas intervention \((A,B_1)\) is not a need, so that either \((A,B_2)\) or \((A,B_3)\) should be provided. In this specific case, there is a strong argument for selecting the most effective intervention: the hypothetical intervention \((B_2,B_3)\) would also be a need. We may notice how this stands in contrast with what was argued to be the most reasonable selection in the poor initial health interpretation. Thus, a rule saying that only the less effective (cheapest) health care need should be met is much less sensible in this case, and other rules would be more in line with intuition.

### 6. Implications for needs-based allocation methods

We have argued that any needs-based allocation of health resources requires, in addition to an account of what is meant by ‘need’, decision rules to deal with uncertainty of outcome, delayed effects of treatment, and the fact that disease management typically involves a combination of interventions.

There is however another possible approach in dealing with uncertainty and delay, to the one we have taken. One could include uncertainties and delays as part of the health states themselves. This ‘trick’, however, will hide, but will not eliminate, the problems we have discussed. The problems have been moved to the question of how the index \(v(\cdot)\) should depend on uncertainty and delay parameters.
When the principles behind needs-based resource allocation are formulated explicitly, the limitations of these methods become clearer. It appears that if additional decision-rules are not specified, the only needs-based decision-rule, among those outlined here, which readily can be used to allocate resources to health care programmes, is the one entailed in the poor initial state interpretation.

In order to provide a clear basis for allocating resources a needs theory requires decision-rules to take account of uncertainty, delay of effect and the complexity of treatments. Such rules could be given in the case of any of the three underlying theories of need that we have considered, although different rules seem plausible with the different models. These additional rules however, are complex and do not fit comfortably with the intuitive appeal of the concept of need. These complications, in particular that of translating an abstract needs-criterion into an allocation method, could well be the root of the profound disagreement (or diversity) in the literature on the meaning, reasonableness and implications of needs-based resource allocation.

7. Conclusion

In the allocation of health care resources it is often argued that we should take into account ‘health care need’. This might be instead of, or in addition to, other considerations and in particular cost-effectiveness and welfarist considerations. If the concept of need is to be of practical benefit it must be sufficiently precisely characterised to be useful to decision makers. In a previous paper we proposed three different meanings that can be given to the idea of health care need. In this paper we consider the impact of some typical characteristics of health care interventions on the concept of need. In particular we consider first, the fact that many interventions have only a probability of having the desired effect with regard to any particular patient. Second the fact that some interventions, such as prophylactic treatments, have their impact on health only after what is often a considerable time delay from the beginning of treatment. Third the fact that the best treatments are often a combination of different health care interventions. Whereas welfarist accounts can generally cope with these features fairly readily, we argue that all three of these features are problematic for the concept of need. At the very least, a concept of need, if it is to be useful, must specify how these three aspects of health care interventions are to be taken into account. We remain sceptical, however, of whether a plausible account of
how these aspects of health care interventions can be given within a needs based theory. If such scepticism is justified, needs based theories of resource allocation will be of little general use in solving practical problems in health care.