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Rationing health care by waiting list: an extra-welfarist perspective

R.T. Edwards and J. Barlow

DISCUSSION PAPER 114

Rationing Health Care by Waiting List:

An Extra-Welfarist Perspective

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Abstract

Waiting lists are the predominant rationing mechanism for non urgent health care services under the British NHS. Academic and political debate over waiting lists has until now focused on the rationing process itself with little consideration of the health consequences of rationing by waiting list.

Extra-welfarism provides a framework for comparing social welfare in alternative states of the world, more specifically here, the health-related-welfare to society. It provides a perspective with which to view the efficiency and equity consequences of how we are currently rationing health care by waiting list, and how we might go about it in the future.

This paper examines, in both process and outcome terms, alternative performance criteria for evaluating the waiting list rationing mechanism. It describes a new waiting list simulation model that has been developed to further the debate on waiting lists, and presents results from a pilot data set, suggesting some philosphical and pragmatic implications.

Introduction

Waiting lists are the predominant rationing mechanism for the allocation of non urgent health care services under the British NHS. Price and/or quantity rationing is introduced into markets when the distribution that results from the operation of the competitive price mechanism is felt to be inappropriate on equity grounds, for example, in the case of certain merit goods such as health care. The natural history of NHS waiting lists, and causes of their persistence have been well documented, (Yates, 1986) (Frankel, 1989). Attention has focused on the performance of the rationing mechanism itself, for example, the total number of patients waiting, waiting times and the distribution of waiting time between clinical specialties and geographical locations. In the late 1980s the politically sensitive nature of the waiting list problem led to a number of waiting list initiatives aimed at reducing waiting times,(IACC, 1990) culminating in the Patients' Charter that guarantees that no patient should have to wait for over 2 years for any treatment (DH,1991). Although these initiatives have found considerable success in reducing the number of patients waiting 12 months and longer (DH, 1993), there is a persistent underlying upward trend in the total number of patients waiting. It is only in the last 6 months that the waiting list debate has shown signs of moving beyond crisis management towards more fundamental discussions about how health is currently, and should, in the future be rationed through the waiting list mechanism.

Welfare economics provides a theoretical framework within which to compare the welfare of society within alternative states of the world. Since welfare is an elusive concept of little pragmatic appeal, economists have developed an extra-welfarist framework, for considering the welfare implications within a particular sector of the economy. Within this more restricted framework, welfare proxies may be more readily identified and measured. Extra-welfarist analysis of the health care sector might use health gain as a measure of health related social welfare (Wagstaff, 1991). The Quality Adjusted Life Year (QALY) provides such a measure of health related utility. Although in its early stages of development with many methodological problems, it provides a way forward in the rationing debate, allowing us to compare the health related utility implications of rationing health care by waiting list.

2. An Extra-Welfarist Perspective

Departure from Paretian welfarism leads us to attempt to specify certain variables that might appear in a social welfare function. Extra-welfarism focuses on components of the social welfare function. With regard to health, society is faced with a range of possible welfare criteria. Prominent amongst these is the efficiency criteria, of health gain maximisation, and a range of alternative equity criteria , (Mooney, 1983), (Wagstaff, 1991), (Culyer, 1992). These criteria may be formulated either as process criteria or outcome criteria, cast in terms of the efficiency or equity with which health care is delivered, or the efficiency and equity of the resulting distribution of health gain.

We attempt here to construct a taxonomy of process and outcome concepts of efficiency and equity for the rationing of health care by waiting list, table 1.

We identify two alternative concepts of efficiency, firstly the maximisation of health gain, which is clearly an outcome concept, secondly, the maximisation of the number of patients treated from waiting lists, which may be viewed either as a process concept (maximising throughput), or as an outcome concept (maximising the total number of patients treated per period.

A review of alternative concepts of equity in health was carried out by Pereira, (Pereira, 1989) we apply the alternative concepts identified by Pereira to the rationing of waiting lists. Three egalitarian concepts of horizontal equity may be identified. Firstly, equal wait, which is clearly a process concept. Secondly, equal health gain, which is an outcome concept. Thirdly, equal health, which again is an outcome concept.

Aristotelian egalitarianism invokes vertical as well as horizontal specification of equity. Aristotle demands the equal treatment of equals and unequal treatment of unequals. Where the relevant inequality is need, this concept becomes one of equal wait for equal need (where need means ability to benefit from treatment). It may be argued that this is both a process and outcome concept in our taxonomy.

The equity concept held by most clinicians is more complex. A combination of equal access for equal severity of illness, (a triage concept of urgency), equal access for ability to benefit,(the difference between untreated and treated health state), and a final concept of equal health for all, (i.e. an attempt to reduce inequalities in health), a mixture of process and outcome concepts.

Two interpretations of utilitarian equity are applicable to the rationing of health care by

Table 1

A Taxonomy of process and outcome concepts of efficiency and equity in the rationing of health care by waiting list

Concept	Process Concept	Outcome Concept
Efficiency		
maximise health gain		●
maximise throughput	●	
Equity		
Egalitarianism		
equal access (wait)	●	
equal health gain		●
equal health		●
Aristotelian egalitarianism		
equal access for equal need	●	●
Clinical egalitarianism		
equal access for equal severity	●	
Libertarianism		
access according to means (means = ability to pay)	●	
Utilitarianism		
maximise sum health gain		●
minimise total waiting	●	
Rawlsian		
maximin (minimise maximum wait)	●	

waiting list. Firstly, a goal of maximising sum health gain to society from available resources, which was specified earlier as also being the efficiency goal. Secondly, the goal of minimising sum waiting time, which is a process concept.

Finally a Rawlsian maximin concept of equity, a process concept, would translate as a goal of minimising maximum waiting time, which describes the goal expressed in the NHS patients charter that states no patient would have to wait more than 2 years for treatment.

The above discussion is summarised in table 1. This taxonomy is highly simplified, but identifies the need to distinguish between the efficiency and equity criteria that we might use to judge the performance of the waiting list rationing process itself, and the distribution of health gain to which it can lead.

This conceptual discussion about what we mean by efficiency and equity in the rationing of health care by waiting list may be taken further through the construction of a "what if" model of how a waiting list operates. Such a model allows one to vary parameters and predict possible efficiency and equity implications.

3. A Dynamic Rationing Model

Models are used extensively in economics to simplify real world problems, to allow us to identify and understand relationships between variables and to predict the implications of varying parameters.

Traditional micro economic, two dimensional demand and supply models have been used in the economics literature to demonstrate the impact of dual pricing and quantity rationing, (Tobin, 1952) (Pauly, 1970). Since health care is often viewed as a merit good, with a zero price at the point of access in Britain, for which demand is a derived demand for health, its scope for modelling the rationing of health care is felt to be limited. In addition, rationing by waiting list is a dynamic process, whose implications for the distribution of health gain and waiting time can only be investigated using some dynamic modelling process.

The waiting list rationing mechanism that operates in the British NHS may be simplified for modelling purposes as follows. Government allocates funds to regional health authorities, whose purchasing commissions, within the new internal market, buy services from provider units. This first rationing process sets capacity. Within these capacity constraints, individual consultants manage their outpatient and inpatient waiting lists, deciding who gets treated, and in what order, the second rationing process. For modelling purposes, we may combine the two rationing stages, using queue theory, and set a bed capacity constraint (the prevailing binding constraint chosen here) and select patients from a waiting list for treatment according to alternative prioritisation criteria.

4. Computer Simulation of Hospital Waiting Lists

Simulation techniques can be used to mimic real world processes and predict the outcome of varying parameters,(Solomon, 1983), (L'ecuyer, 1990). There is a considerable literature on how these techniques have been applied to waiting lists in health care, Davies (1985)

Worthington (1987), Worthington (1991) and in particular to certain services, for example for kidney transplantation, Davies and Davies (1987). The NHS management executive has developed a macro waiting list simulation model which predicts how the total number of patients waiting in England will be affected by changes in referral rates and throughput rates.

These simulation models should not be confused with a number of computer waiting list management systems that have been developed commercially and within the NHS, (Oxford RHA, 1992). These are computerised filing systems that store individual patient information on a waiting list data base.

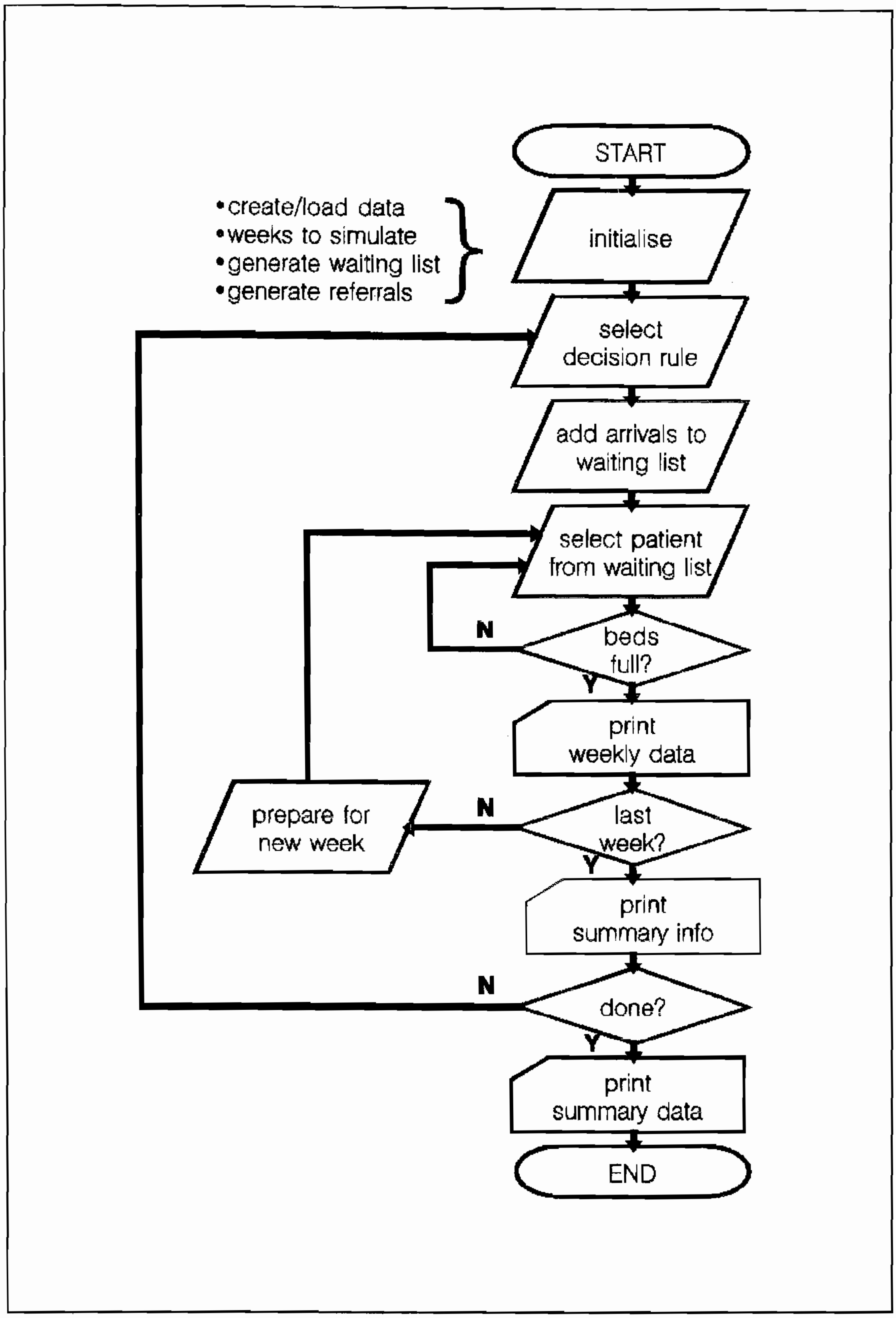
5. The Purpose of the Model

The purpose of our waiting list simulation model is to allow the analyst to predict the likely efficiency and equity implications of alternative patient prioritisation rules in the rationing of health care by waiting list. The model is unique in that it allows the analyst to predict not only patient throughput and waiting time, as existing waiting list simulation models have done, but also to predict the likely impact on total health gain and health sacrifice, in terms of QALYs, associated with the rationing process.

6. Using the Simulation Programme

The structure of the simulation programme is shown in the accompanying flow chart, Fig.1.

Figure 1 The "In-waiting" Programme



The analyst interacts with the simulation programme as follows.

At the beginning of a simulation run, the analyst is asked to specify

1. the number of conditions on the waiting list
2. the life expectancy of men
3. the life expectancy of women
4. theatre capacity (hours per day)
5. bed capacity
6. average waiting time for each condition

For each condition the analyst is asked to enter:

1. pre treatment health state (0 - 1)
2. post treatment health state (0 - 1)
3. perioperative mortality rate
4. proportion of patients gaining no symptomatic relief from treatment
5. average age of patient
6. theatre requirement (minutes)
7. bed day requirement (days)

The analyst is then asked to specify a simulation period of up to 104 weeks.

The analyst is then prompted to select one of the following patient selection rules

1.	FCFS	First come first served
2.	THG/B	Total health gain per bed day maximisation
3.	MHG	Marginal health gain maximisation
4.	CR	Claim on resources
5.	RAND	Random selection

Let us consider these alternative patient selection criteria in more detail.

First Come First Served

Patients are selected for treatment in the order that they joined the waiting list. If the waiting list size is static then each patient should wait the same length of time for treatment.

Total Health Gain Per Bed Day Maximisation

Patients are selected for treatment in order of their expected health gain from treatment per bed day (total QALY gain/ bed days required)

Marginal Health Gain Maximisation

Patients are selected for treatment according to the QALY gain they would forgo as a result of having to wait one more week, with those sacrificing most being treated first.

Claim on Resources

Patients are selected for treatment in the order of their claim on resources, with those requiring least resources being treated first. Where there is more than one patient with the same resource requirement, one is selected randomly.

Random Selection

Patients are selected for treatment on a random basis.

7. Simulation Model Output

Three output files are currently generated. A summary output file presents

1. total number of patients treatment
2. total health gain per bed day (QALYs per bed day) generated during the simulation period
3. total health sacrifice of patients who were treated, as a result of having to wait for treatment
4. average number of patients on the waiting list during the simulation period

Two further output files show admissions and waiting time by condition.

Table 2

Guy's Hospital General Surgical Waiting List

Condition	No. patients on waiting list	Cumulative % age on waiting list
Subcutaneous lumps	325	28.7
Skin lesions	115	38.9
Unilateral VV (F)	107	48.4
Unilateral IH (M)	99	57.1
Bilateral VV (M)	89	65.0
Unilateral VV (M)	50	69.4
Ganglion	37	72.7
Piles	37	76.0
Bilateral VV (F)	28	78.4
Ingrowing toenail	24	80.5

source: Gudex et al (1990)

VV = Varicose veins
IH = Inguinal hernia

Table 3

Guy's Hospital General Surgical Waiting List

QALY gain from treatment versus no treatment

Condition	QALYs mean	S.D.
Subcutaneous lumps	0.28	0.13
Skin lesions	0.26	0.22
Unilateral VV (F)	0.29	0.20
Unilateral IH (M)	1.34	0.70
Bilateral VV (M)	0.26	0.16
Unilateral VV (M)	0.22	0.06
Ganglion	0.39	0.25
Piles	0.77	0.40
Bilateral VV (F)	0.41	0.24
Ingrowing toenail	0.56	0.25

source: Gudex et al (1990)

VV = Varicose veins
IH = Inguinal hernia

Table 4

Guy's Hospital General Surgical Waiting List

Resource requirements for treatment of each condition

Condition	Bed days (days)	Theatre time (minutes)
Subcutaneous lumps	1.9	32
Skin lesions	0.4	24
Unilateral VV (F)	2.3	50
Unilateral IH (M)	3.5	44
Bilateral VV (M)	2.8	54
Unilateral VV (M)	4.0	33
Ganglion	1.4	31
Piles	6.0	36
Bilateral VV (F)	2.8	62
Ingrowing toenail	1.4	29

source: Gudex et al (1990)

VV = Varicose veins
IH = Inguinal hernia

Table 5

Guy's Hospital General Surgical Waiting List

QALY gain from treatment versus no treatment per bed day

Condition	QALY gain/bed day
Subcutaneous lumps	0.15
Skin lesions	0.65
Unilateral VV (F)	0.13
Unilateral IH (M)	0.38
Bilateral VV (M)	0.09
Unilateral VV (M)	0.06
Ganglion	0.28
Piles	0.13
Bilateral VV (F)	0.15
Ingrowing toenail	0.40

source: Gudex et al (1990)

VV = Varicose veins
IH = Inguinal hernia

8. Pilot Data Set

A first attempt at gathering qualitative data on waiting lists was made by Gudex et al (1990). In their paper the authors examined the top 22 conditions on an inpatient general surgical waiting list from Guy's Hospital, calculating the total QALY gain from treatment, and the QALY gain from treating each condition now rather than in one years time. The paper provides a useful set of activity and QALY data with which to test our waiting list simulation model. We reproduce some of the raw activity and QALY data from the Gudex et al paper here in tables 2,3,4 and 5.

The first ten conditions that represented 80 percent of the Guy's Hospital waiting list were entered as a pilot data set. With a starting waiting list of 911 patients, a 26 week simulation period was specified.

Each of the five patient selection criteria was run nine times, 45 simulation runs in total. From the output of these nine runs, means and standard deviations were calculated. Results from our simulation experiment are shown in tables 6,7 and 8.

9. Analysis

We may usefully divide the criteria we might use to judge the performance of the waiting list rationing mechanism into process criteria and outcome criteria.

Table 6

Simulation Experiment Summary Table

Decision Criteria

	FCFS	THG/B	MHG	CR	RAND
Average Admissions	1283 (13)	1298 (19)	1030 (23)	1564 (18)	1276 (19)
Average Total Health Gain per bed day	34.60 (.7531)	58.32 (.3386)	36.16 (.4899)	17.27 (.5287)	45.19 (.7900)
Average Total Health Sacrifice per bed day	.0493 (.0008)	.044 (.005)	.172 (.0129)	.187 (.0166)	.029 (.0018)
Average Waiting List Size	913 (8.91)	876 (12.06)	1110 (8.23)	724 (12.49)	920 (11.61)

* Standard deviations in parentheses

LEGENDS

FCFS - First come first served

THG/B - Total Health Gain per bed day maximisation

MHG - Marginal Health Gain maximisation

CR - Claim on Resources

RAND - Random Selection

Table 7

Simulation Experiment Output

Admissions by condition

Condition	FCFS mean (S.D.)	THG/B mean (S.D.)	MHG mean (S.D.)	CR mean (S.D.)	RAND mean (S.D.)
Subcutaneous lumps	502 (3)	453 (10)	0 (0)	814 (0)	475 (15)
Skin lesions	169 (5)	269 (3)	93 (24)	276 (0)	163 (9)
Unilateral VV (F)	146 (1)	202 (13)	249 (0)	249 (0)	151 (9)
Unilateral IH (M)	141 (2)	131 (2)	233 (0)	97 (19)	139 (8)
Bilateral VV (M)	116 (1)	108 (3)	202 (0)	0 (0)	122 (4)
Unilateral VV (M)	58 (0)	56 (1)	108 (0)	0 (0)	65 (4)
Ganglion	41 (2)	0 (0)	0 (0)	77 (0)	48 (2)
Piles	49 (1)	47 (1)	84 (0)	0 (0)	48 (2)
Bilateral VV (F)	33 (0)	33 (0)	61 (0)	0 (0)	35 (3)
Ingrowing toenail	29 (1)	0 (0)	0 (0)	51 (0)	31 (3)
TOTAL	1284 (16)	1299 (33)	1030 (24)	1564 (19)	1277 (59)

LEGEND

FCFS - First come first served

THG/B - Total Health Gain per bed day maximisation

MHG - Marginal Health Gain maximisation

CR - Claim on Resources

RAND - Random Selection

Table 8

Simulation Experiment Output

Average waiting time by condition
(Days)

Condition	FCFS	THG/B	MHG	CR	RAND
	mean (S.D.)	mean (S.D.)	mean (S.D.)	mean (S.D.)	mean (S.D.)
Subcutaneous lumps	38.47 (0.56)	60.87 (4.55)	0.00 (0.00)	163.07 (14.98)	34.40 (0.35)
Skin lesions	39.38 (0.63)	37.28 (2.59)	47.70 (1.33)	52.26 (6.65)	35.32 (0.98)
Unilateral VV (F)	39.03 (0.77)	30.00 (0.00)	48.83 (0.42)	36.79 (1.26)	35.53 (1.12)
Unilateral IH (M)	39.52 (0.70)	30.00 (0.00)	76.20 (25.27)	30.00 (0.00)	35.11 (0.84)
Bilateral VV (M)	38.82 (0.70)	30.00 (0.00)	134.44 (33.67)	0.00 (0.00)	35.67 (1.05)
Unilateral VV (M)	40.50 (0.70)	30.00 (0.00)	30.00 (0.00)	0.00 (0.00)	36.93 (0.91)
Ganglion	40.78 (0.70)	0.00 (0.00)	0.00 (0.00)	30.00 (0.00)	36.93 (1.12)
Piles	40.92 (0.70)	30.00 (0.00)	134.72 (2.87)	0.00 (0.00)	37.00 (1.61)
Bilateral VV (F)	40.08 (0.98)	0.00 (0.00)	30.00 (0.00)	0.00 (0.00)	37.49 (1.47)
Ingrowing toenail	36.58 (0.49)	0.00 (0.00)	0.00 (0.00)	84.81 (4.06)	32.59 (0.84)
Average total Waiting time	39.41 (0.69)	24.82 (0.71)	50.19 (6.35)	39.69 (2.69)	35.70 (1.02)

LEGEND

FCFS - First come first served

THG/B - Total Health Gain per bed day maximisation

MHG - Marginal Health Gain maximisation

CR - Claim on Resources

RAND - Random Selection

9.1 Process Performance Criteria

i. average number of patients on the waiting list

ii. average waiting time

iii. distribution of waiting time across conditions

Let us consider each of these in turn:

i. number of patients on the waiting list

There were originally 911 patients on the starting waiting list. During the 26 week simulation period, the average number of patients on the waiting list was smallest under the CR (Claim on Resources) rule, 724 patients, as would be expected given that this rule maximises throughput by selecting patients according to their claim on resources, with those requiring least resources treated first.

The THG/B (Total health gain per bed day maximisation) rule resulted in an average waiting list size of 876 patients, a slight fall in average waiting list size from the starting figure.

The FCFS (first come first served) rule resulted in an average waiting list size over the simulation period of 913, very close to the starting figure.

The RAND (random selection) rule led to an average waiting list size of 920 patients over the simulation period, again similar to the starting waiting list figure.

The MHG (marginal health gain maximisation selection) rule led to an average waiting list size of 1110 patients, considerably larger than the starting population figure.

ii. average waiting time

Of the five patient selection rules we experimented with, the THG/B (total health gain per bed day) rule led to the lowest average waiting time of 24.82 days. The highest average waiting time occurred under the MHG (marginal health gain maximisation) rule, 50.19 days. The FCFS, CR and RAND rules resulted in fairly similar average waiting times of 39.41, 39.69 and 35.70 days respectively.

Average waiting time is used in published waiting list statistics but is misleading. It is necessary to look at the distribution of waiting time across conditions.

iii. distribution of waiting time between conditions

The FCFS (first come first served) patient selection rule generates very similar waiting times across the ten conditions. The RAND (random) patient selection rule also generates fairly similar waiting times across conditions though they are a little smaller than under the FCFS rule. Both these outcomes are to be expected if, as happens, the waiting list remains a constant size over the simulation period.

Greater variation in waiting time between conditions is experienced under the THG/B, MHG, and CR rules. Zeros in the accompanying table show where no patients with that particular condition were treated in the simulation period.

Note that the above comments refer to the distribution in mean waiting times across conditions, calculated from the 9 simulation runs for each patient selection rule.

In addition to these process criteria we need also to consider the following outcome criteria for judging the performance of the waiting list rationing mechanism.

9.2 Outcome Performance Criteria

i. total health gain per bed day

ii. total health sacrifice per bed day

iii total number of patients treated

iv. distribution of admissions by condition

Let us consider each of these in turn:

i. total health gain per bed day

If we compare the total health gain per bed day achieved under each patient selection rule we see that the THG/B (total health gain per bed day maximisation) rule yields the greatest number of QALYs per bed day, 58.32 QALYs, as would be expected. The RAND (random selection rule) yields 45.19 QALYs per bed day. The MHG (marginal health gain maximisation) rule yields 36.16 QALYs per bed day, which is similar to the figure for the FCFS (first come first served) rule, of 34.60 QALYs per bed day. The corresponding figure for the CR (Claim on resources rule) is considerably lower, 17.27 QALYs per bed day, as would be anticipated, given that this rule selects patients who require least resources first, and who also expect the least gain from treatment.

ii. total health sacrifice per bed day

This is a measure of the health sacrifice (i.e. QALY wastage per bed day) of patients who were treated from the waiting list during the simulation period, as a result of having to wait. It is expressed here in terms of the resource constraint (bed days), though some other measure may prove to be more appropriate, eg per patient or per time period. This is still to be decided.

One might expect the total health sacrifice per bed day to be in some way inversely related to the total health gain per bed day. As the results indicate this is not the case due to the way in which health gain and health sacrifice are calculated. Total health gain is the total gain that a patient receives over his/her remaining life time from treatment versus no treatment. Health sacrifice is calculated on a week by week basis and, for the individual, is measured in terms of the difference in QALY gain from being treated in one weeks time rather than now. It is cumulative over the waiting period.

The results of the simulation experiment suggest that the smallest total health sacrifice per bed day is achieved under a random patient selection rule. The largest total health sacrifice per bed day occurred under the CR (Claim on resources) patient selection rule. Why this is so is not currently clear to us.

iii. total number of patients treated

If we compare the total number of admissions from the waiting list during the 26 week simulation period we see that the greatest number of patients were admitted under the CR (Claim on resources) rule, 1564 patients, as would be anticipated, corresponding to a fall in the average number of patients on the waiting list during this period, 724 patients. The THG/B (total health gain maximisation) rule led to 1298 admissions, closely followed by the number of admissions under the FCFS (First come first served) rule, 1283 patients, and 1276 admissions under the RAND (Random selection) rule. Considerably fewer patients were admitted under the MHG (marginal health gain maximisation) rule, 1030 admissions, corresponding to the highest average waiting list size figure of 1110 patients for the 26 week simulation period.

iv. distribution of admissions by condition

The figures below refer to the distribution of admission averages (obtained from the nine simulation runs per patient selection rule) under each patient selection rule.

Under the FCFS (first come first served) rule and RAND (Random selection) rule, at least some patients with each condition are admitted. This is not the case with the other patient selection rules.

Under the THG/B (total health gain per bed day maximisation) rule, no patients with condition 7, ganglion, and 10, ingrowing toenail, are admitted during the 26 week simulation period. This is because their QALY gain per bed day is smaller than the other eight conditions on the list.

Under the MHG (marginal health gain maximisation) rule, no patients with condition 1, subcutaneous lumps, were admitted from the waiting list, even though this condition accounted for 28.7 percent of the starting waiting list. This is because the marginal gain from being treated now as opposed to in one week's time was so small for this condition as compared with the other conditions. Likewise, under this patient selection rule no patients with conditions 7, ganglion, or condition 10, ingrowing toenail, were admitted for treatment.

Under the CR (claim on resources) rule, 814 patients with condition 1, subcutaneous lumps, were admitted during the 26 week simulation period. This was a much higher admission rate for this condition than under any of the other patient selection rule. No patients with conditions 5, bilateral varicose vein (male), 6 unilateral varicose vein (male), condition 8, piles, and condition 9, bilateral varicose vein (female), were admitted during the simulation period. These conditions all require relatively long average lengths of stay, 2.8, 4.00,6.00 and 2.8 bed days respectively, so would be selected after patients making a smaller claim on resources under this patient selection rule.

10. Extra-Welfarist Implications

If we consider each of the efficiency and equity concepts set out in the taxonomy in table 1, in turn, the results of the simulation experiment suggest the following.

If our goal in rationing health care is to maximise health gain from available resources, our results demonstrate that patients should be selected from the waiting list according to their expected QALY gain per bed day. We would have expected that this decision rule would minimise the health sacrifice associated with the rationing mechanism, but our results show the random patient selection rule to lead to a smaller total health sacrifice per bed day than the total health gain per bed day maximisation rule.

If our objective is to maximise throughput of patients treated from the waiting list, our results demonstrate that patients should be selected for treatment according to their claim on resources, with those requiring least resources treated first.

If our objective is to achieve an equal distribution of waiting across conditions then our simulation experiment results suggest that patients should be selected from the waiting list on a first come first served or random selection basis.

If, however, our objective is to link waiting time to expected health gain through aristotelian egalitarianism, then we need to establish some inverse relationship between expected QALY gain and waiting time.

If our objective is to link waiting time to clinically judged severity of illness, then more research is needed to ascertain the relationship between severity of illness and expected total health gain from treatment.

If our objective is one of libertarianism then we can leave health care rationing to the market mechanism which operates in the private health care sector.

If our objective is a utilitarian one of maximising total health gain, our results suggest that patients should be selected from a waiting list according to their expected health gain per bed day.

Finally, if our objective is a Rawlsian one of minimising the maximum waiting time for any patient, our results suggest that patients should be selected on a random basis as this rule has the smallest maximum waiting time across conditions. Note that the above comments refer to distributions of averages obtained from the nine simulation runs carried out for each of the patient selection criteria.

11. Pragmatic Implications

Within the NHS internal market there has been a debate as to whether waiting lists belong to purchasers or providers, (Mullen, 1992). Professionally, waiting lists are the responsibility of individual consultants within provider units. Purchasers however bear responsibility of meeting the health needs of their population, some of whom will be on waiting lists for treatment.

Given that these needs are likely to outstrip available budgets, purchasers must decide whether meeting their responsibilities should be in terms of maximising health gain from available resources, maximising the number of patients treated (i.e. minimising the size of waiting lists), minimising waiting times for all or certain conditions.

The NHS management executive has moved on from a blanket waiting time reduction policy to a more selective policy demonstrated by their 1992 directive to ensure that patients waiting for hip and knee replacements and cataract operations wait no longer than 18 months for treatment. Although these procedures account for some of the largest lists and waiting times, this directive perhaps heralds a recognition of the need to consider the health gains that different procedures provide, and the health sacrifices associated with waiting for them.

Our waiting list simulation model can go beyond demonstrating the impact on patient throughput and waiting time of varying capacity, and demonstrate the health gains and health sacrifices associated with alternative waiting list management regimes.

12 Conclusions

The NHS has had considerable success at reducing the number of patients waiting over two years for treatment and is now concentrating on those waiting 12 months and more. Successful reductions in the size of the worst waiting lists and times have been achieved

through short term expansion of capacity, and have been in some cases short lived with numbers increasing again once waiting list initiative funding was withdrawn.
Despite these successes, there is a persistent upward underlying trend in the total number of patients waiting.

This paper has focused on inpatient waiting lists which are only half the story. No apology is made for this, since little is known about individual patient characteristics such as resource requirements and expected health gain from treatment before the outpatient consultation. Analysis of the rationing mechanism, i.e. priority given to different kinds of patients through the patient selection criteria under operation, is therefore, more appropriate to the management of inpatient waiting lists where more information about patients should be available.

The waiting list rationing mechanism is a dynamic process, the analysis of which requires dynamic modelling techniques. A technique such as computer simulation is constraining in that it forces simplifying assumptions to be made, though this is no different to graphical and econometric modelling techniques in economics. Simulation experiments have the advantage of generating results that, if unexpected, encourage the analyst to check his or her hypothesis, assumptions and data, unlike static analysis.

This paper reports work in progress and represents a first attempt to demonstrate the potential of collaboration between health economics and computer science in the development of a unique waiting list simulation model. Comments and suggestions for further research will be gratefully received by the authors.

References

Culyer, A.J. The Morality of Efficiency in Health Care: Some Uncomfortable Implications. Health Economics 1: 7 - 18, 1992

Davies, H and Davies, R. A Simulation Model for Planning Services for Renal Patients in Europe. J.OPL. RES.SOC 38: 697 - 700, 1987

Davies, R. An Assesment of Models of Health Systems. J. OPL. RES. SOC 35: 679 - 687, 1985

Department of Health. Elective Admissions and Patients waiting: England at 30th September 1992. Statistical Bulletin, Government Statistical Service, February 1993.

Department of Health. The Patients Charter. Department of Health , 1991.

Donaldson, L.J. et al. Review of an Orthopaedic inpatient waiting list. Health Trends, 16: 14-15, 1984

Ellis, B.W. Management Importance of Common Treatments: Contribution of top 20 procedures to Surgical workload and cost. British Medical Journal, 302: 882-4, 1991

Frankel, S. The Natural History of Waiting Lists: Some wider explanations for an unnecessary problem. Health Trends, 21: 56-58 1989

Gudex, C. and Kind, P. The QALY Toolkit. Discussion Paper 38, Centre for Health Economics, York University, 1988.

Gudex, C. et al. Prioritising Waiting Lists. Health Trends, 22: 103-108, 1990

IACC, Examining some of Englands longest waiting lists. Report for 1989/90, Health Services Management Centre, 1990

L'ecuyer, P. Random Numbers for Simulation. Communications of the ACM 33: 86 -97, 1990

Mooney, G. Equity in Health Care: Confronting the Confusion. Effective Health Care, 1: 4; 179 - 186, 1983

Mordue, A, and Kirkup, B. An Appraisal of Waiting List Problems. Health Trends, 21: 110-113, 1989

Mullen, P. Waiting Lists and the NHS Review: Reality and Myths. Research Paper 29, Health Services Management Centre, 1992

Oxford RHA, WIN: Waiting Information System. Version 5.0, Oxford RHA, 1992

Pauly, M.V. Efficiency in the Provision of Consumption Subsidies. Kyklos 23: 33 - 57, 1970

Pereira, J. What Does Equity in Health Mean? Discussion Paper 61, Centre for Health Economics, University of York, 1989

Propper, C. Estimation of the value of time spent on NHS waiting lists: using stated preference methodology. Discussion Paper 49, Centre for Health Economics, University of York, 1988

Solomon, S.L. Simulation of Waiting Line Systems. Prentis Hall Inc. 1983

Tobin, J. A Survey of the Theory of Rationing. Econometrica 20: 421 - 553, 1952

Wagstaff, A. QALYs and the Equity / Efficiency Trade-Off. Jounal of Health Economics, 10: 21-41, 1991

Worthington, D.J. Queuing Models for Hospital Waiting Lists. J. OPL RES. SOC, 38; 5, 413 -422, 1987

Worthington, D.J. Hospital Waiting List Management Models. J. OPL. RES. SOC, 42: 10, 833 - 84, 1991

Yates, J. Why are we Waiting? An Analysis of Hospital Waiting Lists, Oxford University Press, 1986