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DETERMINING SOCIAL PREFERENCES FOR LIVER TRANSPLANTATION: A COMPARISON OF THE QALY AND CONJOINT MEASUREMENT MODELS

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Paper presented to the Health Economists' Study Group Conference, University of Aberdeen, July 1999

Abstract

This paper compares the policy implications of the application of the QALY and a conjoint measurement model in determining social preferences for donor liver graft allocation. A survey of the general public (n=303) using a conjoint measurement technique was undertaken. The results enabled the estimation of the relative weights attached to several key characteristics of patients awaiting transplantation including: age, expected health outcome, whether or not the liver disease was attributable to alcohol consumption and whether or not the patient was being re-transplanted. These weights were then used to develop a patient specific index (PSI) for all patients with chronic liver disease who had received a liver transplant during an eighteen month period at one regional liver transplant centre (n=104). The QALY model comprised the expected net survival following transplantation for the same study patients, adjusted for quality of life using the EuroQol EQ-5D descriptive system. The results suggest that priorities for resource allocation differ markedly according to whether the PSI or QALY are used. The PSI implied preference orderings were found to be highly statistically significantly different than the QALY implied preference orderings ($p<0.01$: Wilcoxon Signed Ranks Test). Relative to the QALY, the PSI gives greater weight to younger patients and less weight to those whose liver disease can be attributed to alcohol consumption. The PSI represents an innovative approach to investigating social preferences within health care, which enables the relative weight attached to specific patient characteristics to be determined.

Introduction

The methodology of economic evaluation in health care traditionally identifies the maximisation of health as the criterion by which priorities for resource allocation should be identified Typically, the benefits of health care interventions are measured in terms of life years gained or quality adjusted life years gained (QALY's). Although the calculation of QALY's is based upon a process of obtaining individual preferences for health states, QALY's themselves are often interpreted as a measure of health related social value or welfare [Weinstein and Stason, 1977]. An important illustration of QALY's being interpreted as such is through the promotion of the use of QALY league tables for priority setting in health care [Weinstein and Stason, 1977; Williams, 1988; Maynard, 1991]. In order for QALY's to be interpreted in this way, it must be assumed that health gain is the only element of importance in the SWF for health care, and hence that health maximisation equates with health related social welfare maximisation:

$$HRSWm = \Sigma P(HS_1 - HO_0)$$

Hence health related social welfare (HRSW) is maximised where the sum of individual health gains (HS_1-HO_0) as a result of the implementation of health care intervention/s is maximised for the population of interest (P). However, it is conceivable that there may be other elements in the social welfare function for health care, in particular equity considerations which the community would want to be taken into account in determining priorities for resource allocation in health care. In such a situation health maximisation, which can be thought of as a pure efficiency criterion, may no longer equate with health related social welfare maximisation.

Two recent surveys of the general public's allocation decisions in liver transplantation have suggested that, within this context, health maximisation may not equate with health related social welfare maximisation. In a survey undertaken in the United States, Ubel and Loewenstein [1995] asked respondents to allocate a finite number of donor organs between two groups of individuals who differed only in terms of their expected prognosis following transplantation. The results indicated that only a small minority of respondents chose to give all of the organs to the better prognostic group, thereby maximising survival. The author's reported that respondents sought, in general, to distribute organs in a way that balances efficacy and equity and concluded that the study...

'provides further evidence that many people are not solely interested in the aggregate medical benefit brought by different allocation systems, but are also interested in the amount of benefit brought to the worst off' (p151).

In a second survey undertaken in the United States by the same authors [1996], respondents were asked to allocate a finite number of donor organs amongst two groups of children who differed in terms of their expected prognosis following transplantation. Again, the results indicated that the vast majority of respondents were prepared to sacrifice some gain in the efficiency of the transplantation programme for an increase in equity or fairness in donor liver allocation.

Although interesting and illuminating at one level, the results from these studies leave a number of unanswered questions. In particular, neither study was able to ascertain what the other elements (apart from health outcome) in the social welfare function relating to donor liver graft allocation might be and the relative weight attached by respondents to each of these elements. This paper highlights a new approach to establishing social preferences in this area based upon a conjoint measurement technique. This approach allows the relative weight attached to specific equity versus efficiency considerations in determining people's allocation decisions to be determined. The results from a conjoint measurement survey were used to derive a patient specific index (PSI) for a sample of patients with chronic liver disease who were listed for transplantation at one regional transplant centre. The net QALY gains were also calculated for the same study patient's by adjusting the expected net survival following transplantation for quality of life using the EuroQol EQ-5D descriptive system. The QALY implied preference orderings for donor liver graft allocation were then compared with the PSI implied preference orderings.

Methods

Calculating QALY's

The population of interest was all individuals with chronic liver disease who were eligible to receive treatment from the UK National Health Service (NHS) and who were selected to receive a transplant as part of the liver transplantation programme at the Queen Elizabeth Hospital in Birmingham during the time period 1st December 1995 to 30th June 1997 inclusive. A total of 104 patients were included in the study sample. A self completion questionnaire containing the EuroQol instrument was administered at regular time intervals during the course of the individual receiving

treatment as part of the transplantation programme during the period of the study. The questionnaire was administered initially to all eligible patients at the point of listing, then to those patients who were still waiting to receive a transplant at 3 months, 6 months and 12 months post listing (no patients in the sample waited longer than 14 months to receive a transplant). The questionnaire was re-administered to all patients following transplantation at 3 months, 6 months, 12 months and 24 months post transplantation.

Within the standard model, QALYs are estimated by multiplying the health state value by the length of time a patient spends in that state. These products are then summed over the time horizon of the study, or if a longer term perspective is adopted, over the life expectancy of the individual. In order to calculate QALYs gained as result of liver transplantation information is therefore required on:

i) survival or life expectancy in the absence of liver transplantation
ii) HRQL in the absence of liver transplantation
iii) Survival or life expectancy with liver transplantation
iv) HRQL with liver transplantation

For the purposes of the estimation of net quality of life (quality of life with transplantation minus quality of life in the absence of transplantation) for the calculation of QALY's several assumptions have been made. Firstly, HRQL in the absence of transplantation has been approximated by the Euroqol mean TTO tarriff values reflecting the pre-transplant experience by disease group of the study sample at listing, 3, 6 and 12 months pre-transplant. Where the estimates of survival in the absence of transplantation extend beyond the 12 months post-listing time point, the Euroqol TTO tarriff values for this time point have been used as a proxy measure of HRQL. With transplantation, HRQL has been approximated up to 24 months following the intervention by the Euroqol mean TTO tarriff values by disease group as measured from the primary data source. The TTO tarriff values measured at 24 months have been used as a proxy measure of HRQL thereafter.

For the purposes of the calculation of net survival (survival with transplantation minus survival in the absence of transplantation), the estimates of survival with transplantation up to 24 months are based upon the observed survival of the study sample. In the absence of transplantation the estimates of survival have utilised the probabilities of survival up to 24 months generated from published and validated prognostic indicators for PBC, ALD and PSC patients [Anand *et al*, 1997; Hughes *et*

al, 1991;]. These models have been generated based upon the survival experience of non-transplant patients and predict survival in the absence of transplantation on the basis of the values of several clinical variables immediately prior to transplantation. In the absence of information concerning survival in the absence of transplantation for patients with other types of liver diseases, the mean probabilities of survival over time generated from the prognostic indicators for the above three disease groups were used to approximate their survival experience.

Extrapolation of survival data

In the context of this analysis, a major limitation imposed by the study as the main source of data is the short period of follow up. Ideally a detailed estimate of the benefits of liver transplantation would be based upon the entire life span of the transplanted patient's. However such long-term data is currently not available and therefore has to be modelled. The exponential model represents one basic parametric form that is often applied to survival data [Collett, 1994]. Using non-linear regression techniques on the observed survival experience of the transplanted patients (n=104) an exponential projection for post-transplant survival has been estimated. Similarly, using the estimated survival experience of these patients in the absence of transplantation, an exponential projection for survival in the absence of transplantation has been estimated (Table 1).

Table 1: Extrapolating survival using an exponential model

Years after transplant	Post-transplant Survival probs.	Survival in absence of transplant			
		PBC	ALD	PSC	OTHER
0.5	0.87*	0.69	0.65	0.67	0.67
1	0.85*	0.55	0.52	0.55	0.54
1.5	0.84*	0.44	0.43	0.45	0.44
2	0.83*	0.35	0.32	0.35	0.34
3	0.81	0.22	0.20	0.22	0.21
4	0.79	0.14	0.12	0.14	0.13
5	0.76	0.09	0.05	0.09	0.07
6	0.70	0.03	0.01	0.04	0.03
7	0.67				
8	0.64				
9	0.61				
10	0.58				
11	0.55				
12	0.52				
13	0.49				
14	0.46				
15	0.43				
16	0.40				
17	0.36				
18	0.33				
19	0.30				
20	0.27				
21	0.24				
22	0.21				
23	0.18				
24	0.15				
25	0.12				
26	0.09				
27	0.06				
28	0.03				

* = observed survival probabilities

In order to calculate patient specific life expectancies, the survival probabilities in Table 1 were then adjusted for the age sex weighted general population life expectancy using the declining exponential approximation of life expectancy or DEALE method [Beck *et al*, 1982]. The DEALE method has been used to approximate life expectancy in several previous economic evaluations within health care [O'Brien *et al*, 1992; Vermeer *et al*, 1988]. In this approach, the reciprocal of the age and sex adjusted life expectancy is used to estimate the annual mortality rate of a healthy person. This figure is then added to the reciprocal of the disease specific survival probabilities generated using an exponential function (from Table 1) and the reciprocal of the sum is calculated for each remaining year of healthy or disease specific life expectancy, whichever is the lesser period. For example, Table 2

illustrates the calculation of the age sex adjusted post-transplant life expectancy of a 50 year old male.

Table 2: Calculating Patient Specific Post-Transplant Life Expectancy

YEAR	EXP1	RECIP	RECIP50M*	LIFEXP50M
1	0.85	1.18	0.04	0.83
2	0.82	1.22	0.04	0.80
3	0.79	1.27	0.04	0.77
4	0.76	1.32	0.04	0.74
5	0.73	1.37	0.04	0.71
6	0.7	1.43	0.04	0.68
7	0.67	1.50	0.04	0.65
8	0.64	1.56	0.04	0.63
9	0.61	1.64	0.04	0.60
10	0.58	1.72	0.04	0.57
11	0.55	1.82	0.04	0.54
12	0.52	1.92	0.04	0.51
13	0.49	2.04	0.04	0.48
14	0.46	2.17	0.04	0.45
15	0.43	2.33	0.04	0.42
16	0.4	2.78	0.04	0.39
17	0.36	2.78	0.04	0.35
18	0.33	3.03	0.04	0.32
19	0.3	3.33	0.04	0.29
20	0.27	3.77	0.04	0.26
21	0.24	4.17	0.04	0.23
22	0.21	4.79	0.04	0.20
23	0.18	5.56	0.04	0.17
24	0.15	6.67	0.04	0.14
25	0.12	8.33	0.04	0.11
26	0.09	11.11	0.04	0.08
27	0.06	16.67	0.04	0.05
28	0.03	33.33	0.04	0.03
TOTAL LIFEXP21 (YEARS)				

* average remaining healthy life expectancy of 50 year old male is 26 years: source OHE Compendium of Health Statistics, 1997

The remaining life expectancy is calculated by summing the reciprocal of the remaining life expectancy at age 50 (RECIP50) and the reciprocal of the observed and estimated survival probabilities over time (EXP1), taking the reciprocal of the sum (1/RECIP50+EXP1) and summing over the remaining post-transplant life expectancy of the individual. The remaining life expectancies of all other study patients was calculated using the same methodology.

Development of the Patient Specific Index (PSI)

To investigate the nature of public preferences in the allocation of donor liver grafts for transplantation a conjoint measurement technique was adopted for a questionnaire survey (further details of the methods and results of this survey are summarised in a previous HESG paper by Ratcliffe, 1999). Respondents were initially asked to indicate their level of agreement with five main decision criteria for discriminating amongst liver transplant candidates in a situation of a scarce supply of donor organs. The vast majority of respondents indicated that they either agreed or strongly agreed with each of the criteria presented. Respondents were then presented with several choice situations in which they were asked to allocate 100 donor liver grafts between two groups of 100 individuals in urgent need of a transplant. The groups of individuals differed in terms of the length of time spent waiting, the life years gained following transplantation, age, personal responsibility for their illness and whether they were primary or re-transplant candidates. An example of a choice question included in the questionnaire (Figure 1A) and the codings used for the data analysis (Table 1A) are presented in the Appendix to this paper. The data from this survey were analysed using random effects linear regression. The results indicated that all of the attributes were significant in influencing respondent's allocation decisions and the following model was generated:

DL=-1.49(Age)-38.18(Alco)+4.05(Surv)+1.14(Wait)+7.90(Re-trans)-0.50 [1]

Where DL is the difference in the number of livers allocated between groups A and B, Age is the difference in age, Alco is the difference in alcoholic vs non-alcoholic liver disease status, Surv is the difference in expected length of survival, Wait is the difference in time spent waiting and Re-trans is the difference in primary vs re-transplant status. Using the model, it is possible to predict how respondents would make allocation decisions between two groups of individuals on the basis of their characteristics. In the choice replicated in the Appendix, for example, the individuals in group B are younger, and have naturally occurring liver disease whereas those in group A are older and have alcoholic liver disease. In all other respects the groups are assumed to be the same. Using the estimated equation for DL in [1] and the codings for the levels of the attributes presented in the Appendix this gives:

DL = -1.49 (-10) – 38.18 (-1) + 4.05 (0) +1.14 (0) + 7.90 (0) - 0.50 [2]

Solving this equation for DL gives a value of +54 which means that on average the group would allocate 54 more livers to group B than to group A.

The equation generated from the conjoint measurement survey was then modified to develop a Patient Specific Index (PSI) which could be used to generate a score for chronic liver disease patients who had received a transplant. A consistency check was carried out whereby the absolute values of each of the characteristics presented in the choice situations of the conjoint measurement questionnaire were entered into the DL equation. The difference in the total DL was then calculated and compared with the original DL estimate to check that the values generated were the same. For example, using the choice replicated in the Appendix (Figure 1A) and inserting the absolute values for each characteristic in the DL equation gives:

PSI Group A = -1.49 (50) – 38.18 (1) + 4.05 (5) +1.14 (3) + 7.90 (0) - 0.50 = -90 [3]
and
PSI Group B = -1.49 (40) – 38.18 (0) + 4.05 (5) +1.14 (3) + 7.90 (0) - 0.50 = -36 [4]

Hence:
DL= Group A – Group B = -90-(-36)=+54 [5]
Which is the same value as generated directly from equation [2].

The PSI equation was then applied to a sample of chronic liver disease patients who had received a liver transplant at one regional transplant centre in the UK during the time period 1st December 1995 to 30th June 1997 (n=104). Given that the actual time spent waiting for a transplant was the only characteristic included in the original analysis which could not be attributed directly to the individual per se and given that the time spent waiting is dependant upon the available supply of donor organs, this factor was set to 0 for all study patients. Hence the PSI for each study patient was generated using the following model:

PSI=-1.49(Age)-38.18(Alco)+4.05(Surv)+7.90(Re-trans)-0.50 [6]

Results

Tables 3 and 3a illustrate the results of the QALY and PSI index estimation exercise for a sub-sample of the transplanted patients. Table 3 illustrates the lowest 20 ranked patients in terms of their QALY score (RANKQ).

Table 3: Ranking according to net QALY's gained (lowest 20 patients)

PATNO	SEX	RETX	LIVDIS	AGE	NTSURV	NTQALY	PSI	RANKQ	RANKPSI	RANK^
181	M	0	PBC	58	4.94	3.211	-66.913	83	71	12
108	M	0	PBC	59	4.49	2.9185	-70.2255	86	74	12
8	F	0	PBC	63	4.49	2.9185	-76.1855	86	85	1
147	F	0	ALD	64	4.07	2.7269	-117.557	88	102	-14
272	F	0	PBC	64	4.07	2.6455	-79.3765	89	88	1
183	M	0	PBC	60	4.06	2.639	-73.457	90	79	11
159	M	0	POSB	60	4.06	2.5984	-73.457	91	79	12
98	F	0	ALD	65	3.69	2.4723	-120.586	92	103	-11
134	F	0	ALD	65	3.69	2.4723	-120.586	92	104	-12
155	F	0	PBC	65	3.69	2.3985	-82.4055	94	91	3
93	F	0	PBC	65	3.69	2.3985	-82.4055	95	91	4
240	M	0	PBC	61	3.67	2.3855	-76.5265	96	86	10
28	M	0	POSB	61	3.67	2.3488	-76.5265	97	86	11
116	M	0	CIRRU	60	4.06	2.3954	-73.457	98	79	19
171	F	0	POSC	65	3.69	2.1771	-82.4055	99	91	8
244	M	0	AUTO	63	2.82	1.9176	-82.949	100	94	6
223	M	0	SBC	64	2.6	1.768	-85.33	101	96	5
88	M	0	PBC	63	2.82	1.833	-82.949	102	94	8
271	M	0	CIRRU	62	3.31	1.9529	-79.4745	103	89	14
86	M	0	PBC	65	2.48	1.612	-87.306	104	98	6

Table 3a illustrates the lowest 20 ranked patients in terms of their PSI score (RANKPSI).

Table 3a: Ranking according to PSI (lowest 20 patients)

PATNO	SEX	RETX	LIVDIS	AGE	NTSURV	NTQALY	PSI	RANKQ	RANKPSI	RANK^
8	F	0	PBC	63	4.49	2.9185	-76.1855	86	85	1
28	M	0	POSB	61	3.67	2.3488	-76.5265	97	86	11
240	M	0	PBC	61	3.67	2.3855	-76.5265	96	86	10
272	F	0	PBC	64	4.07	2.6455	-79.3765	89	88	1
271	M	0	CIRRU	62	3.31	1.9529	-79.4745	103	89	14
36	F	0	ALD	54	9.6607	6.472669	-80.0142	35	90	-55
171	F	0	POSC	65	3.69	2.1771	-82.4055	99	91	8
93	F	0	PBC	65	3.69	2.3985	-82.4055	95	91	4
155	F	0	PBC	65	3.69	2.3985	-82.4055	94	91	3
88	M	0	PBC	63	2.82	1.833	-82.949	102	94	8
244	M	0	AUTO	63	2.82	1.9176	-82.949	100	94	6
223	M	0	SBC	64	2.6	1.768	-85.33	101	96	5
6	M	0	ALD	53	7.65	5.1255	-86.6675	66	97	-31
86	M	0	PBC	65	2.48	1.612	-87.306	104	98	6
26	M	0	ALD	55	6.48	4.3416	-94.386	72	99	-27
4	M	0	ALD	57	5.42	3.6314	-101.659	80	100	-20
99	M	0	ALD	58	4.94	3.3098	-105.093	82	101	-19
147	F	0	ALD	64	4.07	2.7269	-117.557	88	102	-14
98	F	0	ALD	65	3.69	2.4723	-120.586	92	103	-11
134	F	0	ALD	65	3.69	2.4723	-120.586	92	104	-12

These patients would receive lowest priority for a donor organ according to each of these criteria. The change in the ranking when moving from the QALY to the PSI indicated by the column headed RANK^.

Compared with ranking according to net QALY's gained, ranking according to PSI results in a much greater prevalence of patients with alcoholic liver disease (ALD) with these patients making up 40% of the PSI group and 15% of the QALY group.

Alternatively, Tables 4 and 4a illustrate the results of the QALY and PSI index estimation exercise for the highest 20 patients. These patients would receive highest priority for a donor organ according to each of these criteria. The results indicate that ranking according to PSI gives greater weight to younger patients on average than does ranking according to the QALY. The higher prevalence of patients with sclerosing cholangitis (SCC) in the QALY group (50%) relative to the PSI group (25%) reflects the fact that patients with this condition reported higher post-transplant quality of life scores, on average, than patients from other disease groups.

Table 4: Ranking according to net QALY's gained (highest 20 patients)

PATNO	SEX	RETX	LIVDIS	AGE	NTSURV	NTQALY	PSI	RANKQ	RANKPSI	RANK^
139	1	0	SCC	31	9.75	7.511	-7.184	1	6	-5
281	1	0	SCC	35	9.74	7.485	-13.279	2	11	-9
247	1	0	SCC	40	9.72	7.485	-20.729	3	16	-13
234	1	0	SCC	36	9.74	7.484	-14.705	3	13	-10
35	2	0	SCC	45	9.72	7.484	-28.186	5	24	-19
185	1	0	SCC	41	9.72	7.481	-22.244	6	17	-11
17	2	0	SCC	50	9.69	7.461	-35.756	7	38	-31
11	1	0	SCC	48	9.67	7.448	-32.845	8	30	-22
256	2	0	WILS	25	9.78	6.652	1.871	9	3	6
92	2	1	AUTO	26	9.78	6.650	8.268	10	1	9
19	2	0	AUTO	29	9.77	6.646	-4.127	11	4	7
106	2	0	AUTO	29	9.77	6.646	-4.127	11	4	7
189	1	1	CHOLA	26	9.77	6.643	8.224	13	2	11
245	2	0	WILS	33	9.76	6.639	-10.129	14	7	7
30	2	0	OLD	34	9.76	6.637	-11.632	15	8	7
176	1	0	CHOLA	34	9.74	6.626	-11.695	16	9	7
231	1	0	OLD	38	9.73	6.616	-17.718	17	15	2
174	2	0	POLLIV	44	9.72	6.612	-26.683	18	22	-4
107	2	0	SCC	56	8.30	6.391	-50.325	19	59	-40
32	1	0	SCC	52	8.29	6.383	-44.406	20	54	-34

Table 4a: Ranking according to PSI (highest 20 patients)

PATNO	SEX	RETX	LIVDIS	AGE	NTSURV	NTQALY	PSI	RANKQ	RANKPSI	RANK^
92	2	1	AUTO	26	9.78	6.650	8.268	10	1	9
189	1	1	CHOLA	26	9.77	6.643	8.224	13	2	11
256	2	0	WILS	25	9.78	6.652	1.871	9	3	6
19	2	0	AUTO	29	9.77	6.646	-4.127	11	4	7
106	2	0	AUTO	29	9.77	6.646	-4.127	11	4	7
139	1	0	SCC	31	9.75	7.511	-7.184	1	6	-5
245	2	0	WILS	33	9.76	6.639	-10.129	14	7	7
30	2	0	OLD	34	9.76	6.637	-11.632	15	8	7
176	1	0	CHOLA	34	9.74	6.626	-11.695	16	9	7
143	1	0	POSC	35	9.74	5.747	-13.200	51	10	41
281	1	0	SCC	35	9.74	7.515	-13.122	2	11	-9
169	2	0	POSC	36	9.76	6.246	-14.612	50	12	38
234	1	0	SCC	36	9.74	7.505	-14.705	3	13	-10
273	2	0	PBC	38	9.75	6.336	-17.644	36	14	22
231	1	0	OLD	38	9.73	6.616	-17.718	17	15	2
247	1	0	SCC	40	9.72	7.485	-20.729	3	16	-13
185	1	0	SCC	41	9.72	7.481	-22.244	6	17	-11
246	2	0	PBC	42	9.73	6.326	-23.667	37	18	19
38	1	0	PBC	42	9.71	6.311	-23.755	38	19	19
251	1	0	PBC	42	9.71	6.311	-23.755	38	19	19

The NTQALY and PSI raw scores were then re-scaled on a 0 to 1 scale in order that the rankings for the group could be statistically compared. Each of the raw scores was converted by calculating the difference between the raw score and the minimum score for the sample and dividing this sum by the difference between the minimum and maximum scores. The results of the statistical comparison of the re-scaled PSI and QALY scores, presented in Table 5, indicate that there were no ties in the ranking of patients using either allocation mechanism. The PSI implied preference orderings were highly statistically significantly different than the QALY implied preference orderings ($p<0.01$).

Table 5: Wilcoxon Signed Ranks Test

	N	Mean rank	Sum of ranks
PSI-QALY Negative ranks	6[a]	11.83	71.00
PSI-QALY Positive ranks	98[b]	54.99	5389.00
Ties	0[c]		
Total	104		

a. PSI<QALY
b. PSI>QALY
c. QALY=PSI

PSI-QALY
Z=-8.623
P=0.000

Discussion

The results from this comparative exercise indicate that priorities for donor liver organ allocation differ greatly according to whether the PSI or QALY are used as the allocation mechanism. Respondents to the conjoint measurement survey exhibited a very strong preference in favour of individuals with naturally occurring liver disease and away from individuals with alcoholic liver disease. In common with several previous studies which have explored public preferences for resource allocation in health care, respondents also expressed a preference for younger rather than older people. These preferences are reflected in the PSI rankings for the study patients.

Presently, the UK has no explicit guidelines for the allocation of donor liver grafts. A recent publication indicated that the majority of transplant clinicians believe that patients should be treated irrespective of the cause of their liver failure and based upon their capacity to survive and benefit [Ghent, 1996]. This view appears to be in general accordance with the traditional health economics view that scarce resources should be allocated according to the criterion of health maximisation as measured by life years or quality adjusted life years gained (QALY's) [Williams, 1997]. However, it would appear that the general public do not share this view. Their preferences differ quite markedly in that they would be willing to exchange an overall reduction in the efficiency of the transplantation system, as defined by health maximisation, for what they perceive to be a fairer or more just distribution of donor livers for transplantation

Care should be taken in interpreting the results from this comparative exercise. The conjoint measurement survey upon which the PSI was based was undertaken on a convenience sample of University employees that cannot be considered as entirely representative of the general public. On average, respondents to this survey were better educated than members of the general population. In addition, considerable uncertainty surrounds the estimates of the long term benefits of liver transplantation. The base case results used in calculating QALY's for this exercise are based upon the firm basis of a prospective study of survival and quality of life in patients entering the liver transplantation programme at one centre, and a reasonable level of confidence can be attached to these results over the period of primary data collection and follow up of two years. However, the prognosis of individuals' in the longer term may alter the results substantially. The extrapolation exercise presented suggests that the net QALY gain from liver transplantation is likely to increase markedly in the longer term. However, this conclusion must be interpreted with caution and the model

presented here should be up-dated once longer term follow up data becomes available.

In contrast to other techniques proposed in the health economics literature for incorporating equity considerations into the valuation of the benefits of health care e.g, the person trade off approach (PTO) [Nord, 1995], the conjoint measurement approach upon which the PSI is based has the advantage that the relative weight attached to each of several characteristics presented can be ascertained simultaneously. Studies using the PTO in hypothetical trade offs have recently been criticised because of their inability to disentangle the relative weights which respondents attach to each of the characteristics presented in determining their allocation decisions [Dolan, 1998]. Whilst further research is required to assess the theoretical and empirical validity of the conjoint measurement approach, the results of the preliminary study reported here suggest that it may provide an innovative approach to investigating social preferences in health care.

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Appendix

Figure 1A: Example of choice question from conjoint measurement survey

Choice 4	Group A	Group B
Age	**50 years**	**40 years**
Alcoholic liver disease	**Yes**	**No**
Expected length of survival	**5 years**	**5 years**
Time already spent on waiting list	**3 months**	**3 months**
Re-transplanted	**No**	**No**

How would you allocate the available livers between the two groups of individuals?
(the total for the two groups should add up to 100)
(please write the number of livers allocated to each group in the boxes below)

Group A	Group B	
		TOTAL=100

Table 1A: Variables and their coding for data analysis

Variable	*Type*	*Coding*
DL – difference in the number of livers allocated as move from group A to group B	Continuous	-100 to +100
AGE – difference in age as move from group A to group B	Continuous	-20 to +20
ALCO – difference in alcoholism as move from group A to group B	Discrete Alcohol Yes=1 Alcohol No =0	-1, 0 ,+1
SURV – difference in expected survival as move from group A to group B	Continuous	-10 to +10
WAIT – difference in waiting time as move from group A to group B	Continuous	-9 to +9
RETRAN – difference in transplantation status as move from group A to group B	Discrete Re-transplantation Yes=1 Re-transplantation No=0	-1, 0 ,+1