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Allocating a Scarce Medical Resource: Liver Transplant and Lay Individuals' Patient Prioritisation

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Declarations

Ethical approval and consent to participate

Ethical approval was granted by the Department of Experimental Psychology, UCL, Ethics Committee (Ref: EP/2018/007). Informed consent was obtained from all participants in this study.

Consent for publication

Participants agreed to have their anonymised data published as part of this study

Data availability

The data are obtainable from the fourth author upon request. The patient descriptions used in the study are available as Supplementary Material

Competing interests

There were no competing interests

Funding

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Authors' contributions

SH and LG were responsible for the concept, study design and data collection/analysis and initial write up. AF was responsible for reviewing and editing. AM was responsible for research project supervision and editing.

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Abstract

Background

There is much debate on how scarce medical resources such as transplant organs should be allocated: in the UK, the NHS uses the principles of sickest first, prognosis and waiting list time – but not age (NHS Blood and Transplant, 2024). Furthermore, it has recently been reported that in the UK young patients tend to wait much longer than older patients for a liver transplant. The current study investigates younger and older lay people's preferences for the allocation of liver transplants using four criteria; the patient's age, time spent on the waiting list, pre-transplant life expectancy and post-transplant life expectancy.

Methods

In an online study, lay participants ($N = 400$) rated 16 hypothetical patients in terms of priority to receive an available donor liver, using only information on patients' age, time spent on the waiting list, pre-transplant life expectancy and post-transplant life expectancy. The relative 'importance' of the criteria in making decisions was indexed using a standardised effect size measure (generalised eta-squared).

Results

Pre-transplant life expectancy ('sickest first') was associated with the largest effect size, followed by post-transplant life expectancy ('prognosis'), then age ('youngest first') and finally waiting list ('first-come, first served'). In addition, participants assigned higher priority ratings to young patients, patients who had been on the waiting list for a long time, patients with a low pre-transplant life expectancy, and patients with a high post-transplant life expectancy. Both age groups prioritised younger over older patients, but younger participants prioritised younger over older patients to a greater extent than did older participants. There was no evidence for in-group bias.

Additionally, younger participants showed a stronger prioritisation of patients with a long waiting time and patients with a low pre-transplant life expectancy compared to older participants.

Conclusions

Lay individuals were able to effectively use the four allocation principles in a practical scenario to assign priority ratings to potential liver transplant recipients. The findings are consistent with previous findings that lay individuals see ‘sickest first’ (Pre-transplant life expectancy in this case) as being the most important criterion for the allocation of a scarce medical resource. However, the findings also reveal that both younger and older individuals support the notion that ‘youngest first’ is also an important criterion, something not currently reflected in the NHS allocation policy.

Keywords: liver transplant, organ allocation, public preferences

Allocating a Scarce Medical Resource: Liver Transplant and Lay Individuals' Patient Prioritisation

Donor organs are scarce resources because the number of patients who need organ transplantation frequently exceeds the availability of donated organs (Bunnik, 2023). This results in the challenge of deciding who should receive available organs (Danesh et al., 2012). Allocation decisions carry significant consequences since prioritising one patient over another for a transplant can determine their survival (Huynh et al., 2020).

This paper concerns the allocation of scarce medical resources which is of concern to ethicists, medical practitioners and the general public and has attracted a great deal of research across disciplines and countries, particularly during the COVID pandemic (Bartling et al, 2022; Buckwalter & Peterson, 2020; Emanuel et al., 2020; Huseynov et al., 2020; Yousef, et al., 2021; Wilkinson et al., 2020). Specifically, it is about patient selection for liver transplants which has attracted considerable research attention (Craxì et al., 2024; Ivanics et al.2021).

Various schemes for the fair allocation of scarce medical resources have been proposed (e.g., Beauchamp & Childress, 2001; Cookson, 2000; Daniels, 2007). Persad et al. (2009), in a celebrated and much quoted paper discussed eight ethical principles for allocation, classified under four categories. *Utilitarianism* is a key philosophical theory, focused on maximising total benefits through decision-making (Lamb, 1990). Within Persad et al.'s (2009) discussion, two utilitarian allocation principles emerged: 'number of lives saved' and 'prognosis or life-years saved'. *Egalitarianism*, another foundational philosophical theory, asserts equal worth for all individuals (Lamb, 1990). According to Persad et al. (2009), under an egalitarian allocation system, fair allocation principles include 'first-come first-served' and 'lottery' (i.e., random allocation). Beyond utilitarian and egalitarian principles, Persad et al. also discussed *Prioritarianism* as a

critical consideration in resource allocation. Prioritarianism is concerned with prioritising the worst-off individuals, that is, prioritising the ‘sickest first’ and the ‘youngest first’. Persad et al. also considered the importance of promoting and rewarding *Social Usefulness*. This can be accomplished via the allocation principles of ‘reciprocity’ (i.e., rewarding past usefulness) and ‘instrumental value’ (i.e., prioritising future usefulness).

Recently, Emanuel and Persad (2023) outlined procedural principles for allocating scarce medical resources: transparency, engagement, and evidence-responsiveness. Transparency involves making the weightings of ethical principles within allocation systems publicly available. Engagement requires the integration of lay individuals’ perspectives into allocation systems. Evidence-responsiveness entails regularly reviewing and adapting allocation systems in light of emerging evidence. To inform these procedural principles, current lay opinions of allocation principles must be ascertained. Support for the importance of engaging lay people in organ allocation decisions arises from the fact that transplantation is primarily funded by lay individuals (O’Dell et al., 2019). Subsequently, Sypek et al. (2022) argued that lay people are key stakeholders in organ transplantation and their views should be respected. Additionally, the availability of donor organs is dependent on lay individuals’ willingness to altruistically donate their organs. Therefore, to increase future donor rates, it is critical that a publicly accepted allocation system is developed (Danesh et al., 2012; Irving et al., 2013; Neuberger and Ubel, 2000).

Lay Preferences for Allocating Scarce Medical Resources

A number of researchers have investigated how lay people evaluate medical resource allocation principles. Some have been very small scale and/or qualitative in nature (e.g., Ratcliffe et al., 2000; Dolan & Shaw, 2004; Gibbons et al., 2017). More recently, Krütli et al. (2016) asked

lay people, health professionals, and medical students to rate the fairness of allocation principles in three hypothetical scarce medical resource scenarios (kidney transplants, hospital beds, and joint replacements). In all three scenarios, lay participants rated ‘sickest first’ as the fairest allocation principle, followed by ‘first-come first-served’, and then ‘prognosis’. ‘Lottery’, ‘reciprocity’ and ‘instrumental value’ were the least favoured principles. Grover et al. (2020) asked lay participants to rank ethical principles based on their perceived fairness in guiding the allocation of scarce medical resources. Consistent with Krütli et al. (2016), ‘lottery’, ‘reciprocity’ and ‘instrumental value’ were ranked as the least fair principles. ‘Saves the most lives’ was the highest ranked principle, followed by ‘sickest first’. However, unlike Krütli et al., ‘youngest first’ and ‘prognosis’ were viewed as fairer than ‘first-come first served’. More recently, in partial replications of the Krütli et al. study, Yousef et al. (2021) and Campbell-Hewson et al. (2024) asked lay individuals (and other groups) to rank six ethical principles within three scenarios (Yousef et al.; hospital beds, cancer medication and transplant organ; Campbell-Hewson et al.; ICU beds, vaccine and transplant organ). As in the Krütli et al. study, for the transplant scenario lay individuals rated ‘sickest first’ as being most important principle in both studies. In Yousef et al., ‘prognosis’ was given higher priority than both ‘first-come, first served’ and ‘youngest first’; In Campbell-Hewson et al, ‘first-come, first served’ was ahead of ‘prognosis’ and ‘youngest first’. The discrepancies in the findings may be due to methodological differences between studies. For instance, ranking principles required participants to prioritise principles in relation to each other, whereas rating principles involved participants to evaluate each principle independently. However, ‘sickest first’ was consistently given the highest priority – despite this being rejected by Persad et al. (2009) as a valid selection criterion – something that has generated controversy (e.g., Kerstein and Bogнар, 2010).

Krütli et al. (2016) and subsequent studies have investigated lay people's evaluations of abstract *principles* of allocation. This may lack a sense of realism of allocating scarce resources to patients. Instead, it may be appropriate to assess directly lay people's allocation preferences when faced with descriptions of individual *patients*. As opposed to evaluating abstract principles, evaluating patient descriptions may prompt individuals to consider the tangible impact of their decisions on patients, potentially providing a more insightful understanding of lay beliefs regarding the fairest approach to allocating medical resources.

There have been a series of studies on ethical decision-making, in which participants have been presented with descriptions of hypothetical patients (who varied on several, generally binary, characteristics) and asked to rank or rate them for treatment. For example, these studies revealed that lay people prioritised hypothetical patients for kidney failure treatment according to 'instrumental value' (e.g., patients' intelligence) and 'reciprocity' (e.g., patients' volunteering record) (Furnham, 1996; Furnham et al., 2010; Huynh et al., 2020; Selvaraj et al., 2017). Such studies have also found that lay people prioritise younger patients over older patients for a range of scarce medical resources, such as life-saving medical treatments (e.g., heart transplants), life-enhancing medical treatments (e.g., IVF), stigmatised treatments (e.g., HIV medication) and mental health treatments (e.g., anorexia treatment) (Browning & Thomas, 2001; Furnham et al. 2002; Furnham et al. 2007; Gajre et al., 2017). This body of evidence suggests that lay people perceive 'instrumental value', 'reciprocity' and 'youngest first' as appropriate principles for medical resource allocation.

Howard et al. (2015) investigated which principles were salient to lay people when allocating organ transplants to hypothetical patients. Consistent with studies in the field, participants prioritised patients according to their social value. For instance, participants prioritised

caregivers, registered donors and non-smokers. Importantly, participants favoured patients who were younger, had a longer waiting time, a lower pre-transplant life expectancy and a higher post-transplant life expectancy. This provides evidence that lay individuals prioritise hypothetical patients for organ transplants based on the ‘youngest first’, ‘first-come first-served’, ‘sickest first’ and ‘prognosis’ principles. Furthermore, they found that pre-transplant life expectancy was valued more highly than post-transplant life expectancy, suggesting that participants favoured allocation based on ‘sickest first’ more than ‘prognosis’, which is consistent with the findings from related studies (Campbell-Hewson et al., 2024; Grover et al., 2020; Krütli et al., 2016; Yousef et al. 2021). However, ethical values may vary between cultures and medical treatments as noted by Krütli et al. (2016).

It is also important that studies also examine the interactions between factors when examining allocation decisions (Oedingen et al., 2020). Very little research has been concerned with this issue. In a study by Stahl et al. (2008), US participants were asked to choose between pairs of hypothetical patients to receive an organ transplant. They found that patients with a lower post-transplant life expectancy needed a lower pre-transplant life expectancy in order to receive priority compared with patients with a higher post-transplant life expectancy. Moreover, older patients required a lower pre-transplant life expectancy to receive priority than did younger patients. These results underscore the integration of multiple patient characteristics in determining priority judgements, which many studies have failed to acknowledge.

‘Youngest First’ Principle

Previous research findings suggest that lay people support the allocation of organ transplants based on the ‘youngest first’ principle (Browning & Thomas, 2001; Furnham et al.

2002; Furnham et al. 2007; Gajre et al., 2017; Howard et al., 2015). In direct conflict with this widespread lay preference, there is evidence to suggest that in the UK, the allocation of liver transplants by the NHS currently prioritises *older* individuals. younger people wait, on average, 156 days longer for liver transplants than those over 60 (Burns & Loader, 2023).

There is some evidence to suggest that lay people's own age influences their support of the 'youngest first' allocation principle. Diederich et al. (2011) found that German individuals aged 18 to 29 tended to agree with the statement that 'younger patients should be preferred to older patients' in the allocation of donor kidneys, whereas individuals aged 30 to 80 tended to disagree with the same statement. Thus, young individuals favour the 'youngest first' allocation principle, whereas old individuals appear to disagree with it. This may indicate an in-group bias. Werntoft et al. (2007) found that in interviews with elderly Swedish individuals (aged 66-100), 84% of the participants said neither young nor old patients should be prioritised for life-saving treatment; 8% favoured younger patients, and 8% favoured older patients. This suggests that old individuals do not necessarily support medical resource allocation by patients' age.

Moreover, some studies investigating lay people's medical resource allocation decisions about hypothetical patients have found an in-group bias. For instance, non-smoking lay people prioritised non-smoking patients over smoking patients, and vice versa, and left-wing lay people prioritised left-wing patients over right-wing patients and vice versa (Furnham, 1996; Furnham et al., 2000). However, Selveraj et al. (2017) did not find an in-group allocation bias with respect to volunteering history or intelligence. The current study explores whether lay people demonstrate an in-group allocation bias based on age.

Current Study

The first aim of the current study is to investigate whether lay people in the UK agree with ‘youngest first’, ‘waiting time’, ‘sickest first’ and ‘prognosis’ as being important principles in allocating a liver for transplant – and the relative importance they attach to each principle. The second aim is to investigate whether patient characteristics interact in determining lay perceptions of their priority, supporting previous findings (Stahl et al., 2008). The third aim of the current study is to investigate whether lay people’s age influences their support for the ‘youngest first’ principle. This aims to understand the current liver allocation system in the UK, where older patients are receiving higher priority than are younger patients, despite evidence that lay people favour younger patients (Burns & Loader, 2023; Howard et al., 2015). Participants were presented with a hypothetical scenario in which one liver is available for transplant, and a list of hypothetical patients to rate for priority to receive the organ. The hypothetical patient descriptions varied with respect to their age, time spent on the waiting list, pre-transplant life expectancy, and post-transplant life expectancy.

The following hypotheses were proposed:

Main Effects

H1. Participants will prioritise younger patients over older patients.

H2. Participants will prioritise patients with a long waiting time over patients with a short waiting time.

H3. Participants will prioritise patients with a low pre-transplant life expectancy over patients with a high pre-transplant life expectancy.

H4. Participants will prioritise patients with a high post-transplant life expectancy over patients with a low post-transplant life expectancy.

Interaction Effects

H5. The influence of pre-transplant life expectancy on priority will depend on post-transplant life expectancy; pre-transplant life expectancy will have a greater influence on priority when post-transplant life expectancy is low than when post-transplant life expectancy is high.

H6. The influence of pre-transplant life expectancy on priority will depend on patient age; pre-transplant life expectancy will have a greater influence on priority ratings when patients are old than when patients are young.

The following research questions were also investigated:

RQ1. Will the relative importance of the four principles as indexed by a standardised effect size measure reflect the order observed in previous studies? In particular, will ‘sickest first’ be the most important principle in terms of effect size?

RQ2. Will priority be given to younger patients irrespective of the age of the participant, or will there be an in-group effect? Thus, will younger participants prioritise younger patients, and older participants older patients?

Method

Participants

Four-hundred living in the UK were recruited online via Prolific (<https://www.prolific.co/>). They were aged between 21 and 80 years ($M = 44.10$, $SD = 15.65$). One hundred and ninety-eight were female, 199 were male, two were other, and one preferred not to say. From ethnicity data of 394 participants available, 340 were White, 22 were Asian, 16 were Black, 15 were Mixed, and one was Other. The sample was closely representative of the UK population in terms of both ethnicity and gender. Participants were categorised into two age groups. Two-hundred participants were aged between 21 and 35 years ($M = 29.54$, $SD = 3.97$), 98 were female, 100 were male, one was other, and one preferred not to say. Two-hundred participants were aged between 46 and 80

years ($M = 58.66$, $SD = 7.04$), 100 were female, 99 were male, and one was other. A post hoc power analysis was conducted using G*Power (Faul et al., 2007) and this indicated that the power to detect moderate effect sizes ($f = .25$) with $N = 400$ at a significance level = .05 was 99.9%. Ethical approval was granted by the UCL Department of Experimental Psychology Ethics Committee (Number: EP/2018/007).

Design and Materials

The between-subject variable was the age of the participants with two levels: young (21-35 years old) and old (46-80 years old). The four within-subject variables were patient characteristics, each with two levels: age (young 20-25 years vs. old 55-60 years), waiting time (6 months vs. 5 years), pre-transplant life expectancy (1-2 years vs. 7-8 years), and post-transplant life expectancy (10-12 years vs. 20-25 years). These four variables map onto ‘youngest first’, ‘first-come, first served’, ‘sickest first’ and ‘prognosis’ respectively. Sixteen hypothetical patient descriptions were created by uniquely combining the two levels of the four patients (see Supplementary Material). Randomly generated initials preceded patient descriptions to avoid assigning a gender or race to patients, to mitigate any potential gender or race bias. Participants rated the hypothetical patients for priority to receive a liver transplant on a Likert scale from 1 (“they should be given very low priority”) to 7 (“they should be given very high priority”).

Procedure

All participants completed the study online, via a computer, laptop, or mobile phone. The tasks were completed without a time limit to ensure that participants carefully considered their

responses. Firstly, participants were presented with an information sheet and consent form. Once consent was given, participants reported their age and gender. They were then presented with the hypothetical scenario. They were told about the nationwide shortage of liver donors and that an NHS allocation committee decides who should receive these organs for transplant. Participants were asked to imagine that they were a member of this committee, and that one new liver had become available for transplantation. Participants were informed that their task was to rate 16 hypothetical patients who are waiting for a liver transplant on how much priority they believe each patient should receive for the transplantation. One patient description was presented at a time, each alongside a priority rating scale (see Figure 1). Participants were randomly assigned to one of five groups, each presented with patient descriptions in a different random order to control for order effects. After the participants had finished rating the 16 patients, they were thanked for participating and were debriefed with respect to the aims of the experiment.

Figure 1.

Example of One Patient Description and Rating Scale.

Please rate how much priority you think this patient should be given for the liver transplant.

Patient R.L. is 21 years old. They have been on the liver transplant list for 5 years. Their life expectancy if they DO NOT receive the transplant is 7-8 years. Their life expectancy if they DO receive the transplant is 20-25 years.

1 - They should
be given very
low priority

7 - They should
be given very
high priority

Results

Main Effects

A 2 x 2 x 2 x 2 x 2 mixed ANOVA was conducted in R Studio (R Studio Team, 2020). Generalised eta-squared (η_G^2) was chosen as the standardised effect size measure as it is particularly suited to mixed designs (Olejnik & Algina, 2003).

All within-subject factors were significant. As hypothesised, participants gave higher priority ratings to young patients ($M = 5.11$) over old patients ($M = 4.31$), $F(1, 389) = 349.10$, $p < .001$, $\eta_G^2 = .088$, and patients with a long waiting time ($M = 4.91$) over patients with a short waiting time ($M = 4.51$), $F(1, 389) = 181.99$, $p < .001$, $\eta_G^2 = .023$. Patients with a low pre-transplant life expectancy ($M = 5.31$) were favoured over patients with high a pre-transplant life expectancy ($M = 4.12$), $F(1, 389) = 748.55$, $p < .001$, $\eta_G^2 = .180$, and patients with a high post-transplant life expectancy ($M = 5.18$) were favoured over patients with a low post-transplant life expectancy ($M = 4.24$), $F(1, 389) = 758.20$, $p < .001$, $\eta_G^2 = .120$. These findings support hypotheses 1 to 4. With respect to the first research question, pre-transplant life expectancy ('sickest first') was associated

with the largest effect size, followed by post-transplant life expectancy ('prognosis'), then age ('youngest first') and finally waiting list ('first-come, first served').

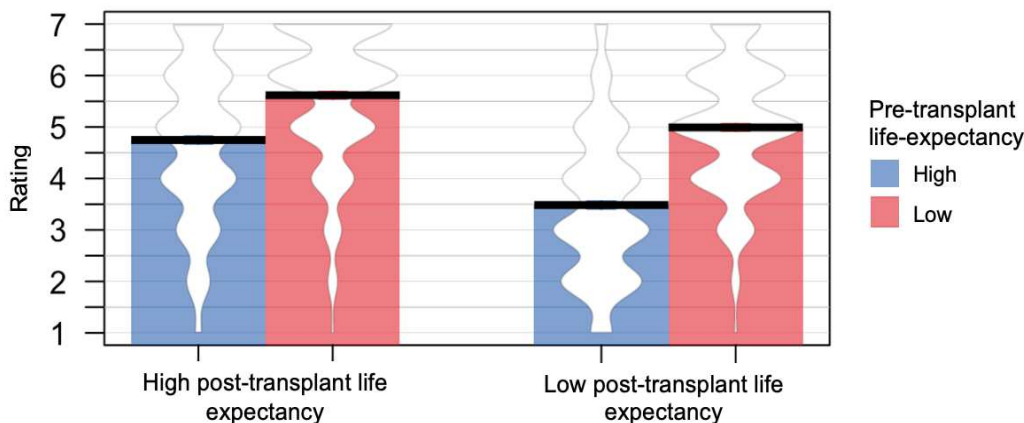
Unexpectedly, there was a significant effect of participant age. Old participants ($M = 4.87$) gave higher priority ratings than young participants ($M = 4.55$), $F(1, 389) = 16.20$, $p < .001$, $\eta_G^2 = .016$.

Within-subject Interactions

As hypothesised, there was a significant interaction between post-transplant life expectancy and pre-transplant life expectancy, $F(1, 398) = 177.36$, $p < .001$, $\eta_G^2 = .015$. A simple effects analysis revealed that patients with low post-transplant life expectancy were given higher priority ratings when they had a low pre-transplant life expectancy ($M = 4.99$) than when they had a high pre-transplant life expectancy ($M = 3.48$), $t(399) = 31.64$, $p < .001$. The same pattern was found for patients with high post-transplant life expectancy, who were given higher priority ratings when they had a low pre-transplant life expectancy ($M = 5.62$) than when they had a high pre-transplant life expectancy ($M = 4.75$), $t(399) = 17.53$, $p < .001$. However, the effect of pre-transplant life expectancy was larger for patients with low post-transplant life expectancy ($d = 1.12$) than for patients with high post-transplant life expectancy ($d = .62$) (see Figure 2).

Figure 2.

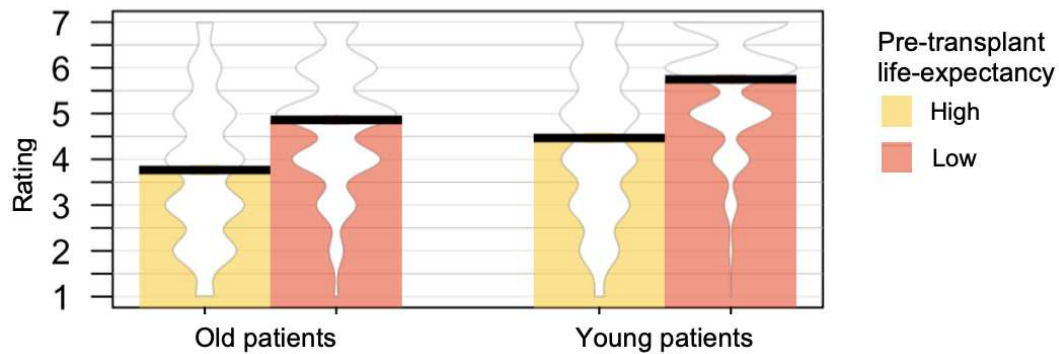
Post-Transplant Life expectancy x Pre-Transplant Life expectancy Interaction



There was also a significant interaction between patient age and pre-transplant life expectancy, $F(1, 398) = 19.64, p < .001, \eta_G^2 = .001$. Young patients were given higher priority ratings when they had a low pre-transplant life expectancy ($M = 5.75$) than when they had a high pre-transplant life expectancy ($M = 4.47$), $t(399) = 25.99, p < .001$. Old patients were also given higher priority ratings when they had a low pre-transplant life expectancy ($M = 4.86$) than when they had a high pre-transplant life expectancy ($M = 3.77$), $t(399) = 21.81, p < .001$. Contrary to our hypothesis, the effect of pre-transplant life expectancy was larger for young patients ($d = .92$) than for old patients ($d = .77$) (see Figure 3).

Figure 3.

Patient Age x Pre-Transplant Life expectancy Interaction



There was a significant interaction between patient age and waiting time, $F(1, 398) = 5.46, p < .020, \eta_G^2 = .0003$. Young patients were given higher priority ratings when they had a long waiting time ($M = 5.33$) than when they had a short waiting time ($M = 4.89$), $t(399) = 8.09, p < .001$. Old patients were also given higher priority ratings when they had a long waiting time ($M = 4.49$) than when they had a short waiting time ($M = 4.14$), $t(399) = 6.51, p < .001$. However, the

effect of waiting time was slightly larger for young patients ($d = .29$) than for old patients ($d = .23$).

There was a significant interaction between patient age and post-transplant life expectancy, $F(1, 398) = 53.72, p < .001, \eta_G^2 = .003$. Patients with high post-transplant life expectancy were given higher priority ratings when they were young ($M = 5.65$) than when they were old ($M = 4.71$), $t(399) = 19.12, p < .001$. Patients with low post-transplant life expectancy were given higher priority ratings when they were young ($M = 4.56$) than when they were old ($M = 3.92$), $t(399) = 12.09, p < .001$. However, the effect of age was larger for patients with high post-transplant life expectancy ($d = .68$) than for patients with low post-transplant life expectancy ($d = .43$).

There was a significant interaction between waiting time and post-transplant life expectancy, $F(1, 398) = 48.29, p < .001, \eta_G^2 = .002$. Patients with a short waiting time were given higher priority ratings when they had a high post-transplant life expectancy ($M = 4.92$) than when they had a low post-transplant life expectancy ($M = 4.11$), $t(399) = 15.28, p < .001$. Patients with a long waiting time were given higher priority ratings when they had a high post-transplant life expectancy ($M = 5.44$) than when they had a low post-transplant life expectancy ($M = 4.37$), $t(399) = 20.56, p < .001$. However, the effect of post-transplant life expectancy was larger for patients with a long waiting time ($d = .73$) than for patients with a short waiting time ($d = .54$).

There was a significant three-way interaction between patient age, waiting time, and pre-transplant life expectancy, $F(1, 398) = 30.20, p < .001, \eta_G^2 = .002$. The effect of patient age x waiting list interaction was larger in patients with high pre-transplant life expectancy, $F(1, 399) = 23.03, p < .001, \eta_G^2 = .003$, than in patients with low pre-transplant life expectancy, $F(1, 399) = 7.10, p < .001, \eta_G^2 = .001$.

There was a significant three-way interaction between patient age, post-transplant life expectancy, and pre-transplant life expectancy, $F(1, 398) = 5.83, p = .016, \eta_G^2 = .0003$. The effect of post-transplant life expectancy x pre-transplant life expectancy interaction was larger in old patients, $F(1, 399) = 143.95, p < .001, \eta_G^2 = .02$, than in young patients, $F(1, 399) = 76.87, p < .001, \eta_G^2 = .01$.

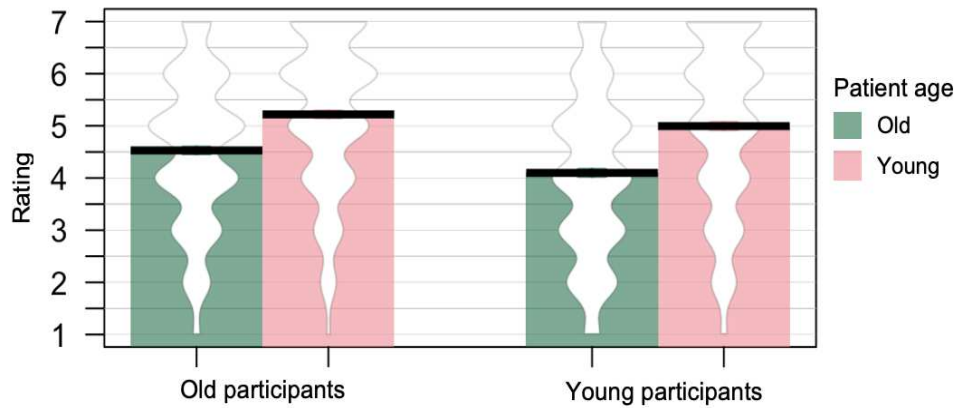
There was a significant three-way interaction between patient age, post-transplant life expectancy, and waiting time, $F(1, 398) = 9.88, p = .002, \eta_G^2 = .0005$. The effect of post-transplant life expectancy x waiting list interaction was larger in old patients, $F(1, 399) = 46.33, p < .001, \eta_G^2 = .006$, than in young patients, $F(1, 399) = 7.73, p = .006, \eta_G^2 = .001$.

Between-subject Interactions

There was a significant interaction between participant age and patient age, $F(1,398) = 5.85, p = .016, \eta_G^2 = .002$, but with respect to the second research question, this did not indicate in-group bias. Young participants gave higher priority ratings to young patients ($M = 5.00$) than to old patients ($M = 4.10$), $t(398) = 15.88, p < .001$. Old participants also gave higher priority ratings to young patients ($M = 5.22$) than to old patients ($M = 4.53$), $t(398) = 13.60, p < .001$. However, the effect of patient age was larger for young participants ($d = .56$) than for old participants ($d = .48$) (see Figure 4).

Figure 4.

Patient Age x Participant Age Interaction



There was a significant interaction between participant age and waiting time, $F(1,398) = 8.64, p = .003, \eta_G^2 = .001$. Young participants gave higher priority ratings to patients with a long waiting time ($M = 4.79$) than to patients with a short waiting time ($M = 4.31$), $t(398) = 8.22, p < .001$. Old participants also gave higher priority ratings to patients with a long waiting time ($M = 5.03$) than to patients with a short waiting time ($M = 4.72$), $t(398) = 5.89, p < .001$. However, the effect of waiting time was larger for young participants ($d = .29$) than for old participants ($d = .21$).

There was also a significant interaction between participant age and pre-transplant life expectancy, $F(1,398) = 10.99, p = .001, \eta_G^2 = .003$. Young participants gave higher priority ratings to patients with a low pre-transplant life expectancy ($M = 5.21$) than to patients with a high pre-transplant life expectancy ($M = 3.88$), $t(398) = 24.82, p < .001$. Old participants also gave higher priority ratings to patients with a low pre-transplant life expectancy ($M = 5.40$) than to patients with a high pre-transplant life expectancy ($M = 4.35$), $t(398) = 21.36, p < .001$. However, the effect of pre-transplant life expectancy was larger for young participants ($d = .88$) than for old participants ($d = .76$).

Discussion

Consistent with our hypotheses, participants prioritised: 1) young patients over old patients, 2) patients with a long waiting time over patients with a short waiting time, 3) patients with a low pre-transplant life expectancy over patients with a high pre-transplant life expectancy, and 4) patients with a high post-transplant life expectancy over patients with a low post-transplant life expectancy following a liver transplant. These findings mirror those of Howard et al. (2015), who found that Australian lay people preferentially allocated kidney transplants to hypothetical patients who were younger, had a longer waiting time, a lower pre-transplant life expectancy, and a higher post-transplant life expectancy. Thus, the current study extends these findings to the allocation of liver transplants.

‘Prognosis’

A moderate effect size was found for the influence of patients’ post-transplant life expectancy on priority ratings. Participants prioritised patients with a higher post-transplant life expectancy, suggesting that lay people support the ‘prognosis’ allocation principle for liver transplant allocation (Persad et al., 2009). This decision was influenced by utilitarianism, because allocating the resource to an individual who will live for longer is expected to bring greater benefits to future society (Emanuel et al., 2020; Persad et al., 2009).

In the UK, liver transplants are allocated to patients with the highest transplant benefit score (TBS) which is the difference between the patient’s predicted survival without the transplant over a five-year interval (i.e., pre-transplant life expectancy) and their predicted survival with the transplant over a five-year interval (i.e., post-transplant life expectancy) (NHS Blood and Transplant, 2018; 2022). Unexpectedly, post-transplant life expectancy had a greater influence on priority ratings for patients with a long waiting time than for patients with a short waiting time.

Thus, participants appear to have based their priority judgements on the weighted information of patients' post-transplant life expectancy and waiting time.

'Sickest First'

We also found that patients' pre-transplant life expectancy had the largest effect of all the investigated patient characteristics on priority ratings. Participants prioritised patients with a lower pre-transplant life expectancy, consistent with the 'sickest first' allocation principle, and following the philosophical principle of prioritarianism (Persad et al., 2009). The large effect of pre-transplant life expectancy is in line with previous research which has indicated that lay individuals consider 'sickest first' to be one of the fairest allocation principles – and more so than 'prognosis' (Grover et al., 2020; Howard et al., 2015; Krütli et al., 2016). This decision is consistent with the current UK liver allocation scheme (NHS Blood and Transplant, 2018; 2022).

However, lay people's support of the 'sickest first' principle is at odds with the views of some ethicists, who argue that 'sickest first' is morally unjustifiable because it fails to account for prognosis, prioritising patients who may be worst-off in the future (Persad et al., 2009). Thus, participants prioritised patients with a low pre-transplant life expectancy (i.e., the sickest patients) over patients with a high pre-transplant life expectancy to a greater extent when patients' prognosis was low compared to when it was high. This result is in accordance with Stahl et al. (2008), who found that patients with a lower prognosis needed a lower pre-transplant life expectancy for lay people to allocate a transplant to them than did patients with a higher prognosis. Additionally, when allocations are based on 'sickest first', participants also considered patients' age. That is, participants prioritised patients with a lower pre-transplant life expectancy to a greater degree when patients were young than when they were old. This finding contrasts with Stahl et al. (2008),

who observed that older patients required a lower pre-transplant life expectancy than younger patients to receive priority by US citizens.

Nevertheless, the ‘sickest first’ allocation principle arguably remains inherently flawed (Persad et al., 2009). This is because allocating the resource to a sicker individual assumes that other patients who are less ill can wait to be treated later (Bunnik, 2023). This fits with the ‘rule of rescue’, in that those who face imminent death should be saved first (Jonsen, 1986). However, given the scarcity of donor organs, an organ might not become available before the less ill individual becomes more ill and dies (Stahl et al., 2008).

‘First-come First-served’

Participants only marginally prioritised patients with a long waiting time over those with a short waiting time. This result is consistent with the ‘first-come first-served’ allocation principle, reflecting an egalitarian perspective (Persad et al., 2009). This finding implies that lay people from the UK do regard ‘first-come first-served’ as a reasonable principle for the allocation of liver transplants but suggests that the philosophical perspective of egalitarianism may not be as salient as utilitarianism and prioritarianism. This result is not consistent with Krütli et al. (2016), who found that German lay individuals rated ‘first-come first-served’ as the second fairest principle for the allocation of kidney transplants, above ‘prognosis’.

Focus groups comprising lay individuals from the UK have provided insights into the rationale behind allocating by waiting list (e.g., Wilmot & Ratcliffe, 2002). Lay individuals supported the ‘first-come first-served’ approach, reporting its cultural acceptance in the UK, where queuing is a common practice. Further, this approach was seen as a way of avoiding difficult decision-making based on other patient characteristics. However, Persad et al. (2009) argued that

the ‘first-come first-served’ principle is unfair due to the potential for corruption within transplant waiting lists.

‘Youngest First’

Participants assigned higher priority ratings to younger patients over older patients, with a moderate effect size. This is consistent with the ‘youngest first’ allocation principle (Persad et al., 2009) and is in accordance with previous studies indicating that lay people prioritise hypothetical younger patients across a range of scarce medical treatments (Furnham et al. 2002; Furnham et al. 2007; Gajre et al., 2017; Howard et al., 2015).

The decision to assign higher priority to younger patients over older patients may have been guided by utilitarianism. Younger individuals may be expected to contribute more to society in the future, such as through employment or raising children (Gajre et al., 2017). Although the strength of the influence differed, patients' age did influence priority ratings for both patients with low and high post-transplant life expectancy. Consequently, there must be an additional explanation for participants’ support of the 'youngest first' principle. Participants have been guided by prioritarianism, seeing younger patients who have lived fewer years than have older patients as therefore being worse-off (Furnham et al., 2002). This notion aligns with the concept that older individuals have had their 'fair innings' in life (Gibbons et al., 2017; Harris, 1985). However, Lupo and Bayod (2022) argued against prioritisation by patient age, deeming this as ageist and unfair towards older patients. Instead, Montero-Odasso et al. (2020) argued that patients’ health before the onset of their chronic illness, frailty and functional ability should be evaluated when making transplant allocation decisions, rather than age.

The current NHS liver transplant allocation system appears to prioritise older patients (Burns & Loader, 2023) which conflicts with the salience of the ‘youngest first’ allocation

principle among lay people. This raises concerns about the possible reduction of public willingness to donate their organs, which would increase the scarcity of donor livers (Danesh et al., 2012; Neuberger and Ubel, 2000). The most common reason that people do not want to donate their organs is mistrust in the fairness of the organ allocation system (Morgan et al., 2008). This reinforces the critical need for public acceptance of donor-organ allocation systems and highlights the cause for concern regarding the disparity between lay people's support of 'youngest first' and the current system for allocating liver transplants. Recent research suggests that age is not associated with expected post-transplant survival, while older age is associated with lower expected pre-transplant survival (Gavara et al., 2018; Mikulic & Mrzljak, 2020). Consequently, older patients may often have a higher TBS than younger patients, potentially leading to the prioritisation of older individuals.

Between-participant Effects

Consistent with our hypothesis, there were differences in support for the 'youngest first' allocation principle on the basis of participants' age. Younger participants prioritised young patients over old patients more than did older participants. Werntoft et al. (2007) found that older individuals in Sweden prefer not to allocate medical treatments by age. Diederich et al. (2011) found that younger lay individuals in Germany agreed with the 'youngest first' allocation of kidney transplants, whereas older individuals tended to disagree with it, indicating an in-group bias in Germany.

These findings contrast with the current study's observation that older participants prioritised young patients over old patients in the UK, albeit to a lesser extent than younger participants. Participants in Diederich et al.'s and Werntoft et al.'s study evaluated patients simply

categorised as ‘young’ or ‘old’, lacking information on the patients’ specific ages, in contrast to the current study. This difference in methodology could potentially explain the differences in the findings, as participants in Diederich et al.’s and Werntoft et al.’s study may have had different perceptions of what ages constitute ‘young’ and ‘old’ compared to the specific ages given in the current study. Although in-group allocation biases have been found on the basis of other criteria, such as smoking habits and political beliefs, the current study did not find an in-group allocation bias on the basis of age (Furnham, 1996; Furnham et al., 2000). Unexpectedly, the effect of patients’ pre-transplant life expectancy and waiting time on priority ratings was also larger for young participants than for old participants. Considering the age-related differences in allocation preferences, it is important to take into account the views of both young and old lay individuals when constructing allocation frameworks. This could potentially lead to the creation of fair systems that are reflective of the broader population’s values.

Limitations

Participants were asked to rate the priority that patients should receive for a liver transplant, a method that has limitations, as it allows participants to assign equal priority ratings to all patients, thus avoiding actually making a decision (Grover et al., 2020). Consequently, the results may not fully represent participants’ views. An alternative methodology commonly used in this field involves participants ranking hypothetical patients in order of priority (Selvaraj et al., 2017). While the ranking task forces participants to make priority decisions, people express anxiety when ranking patients, potentially raising ethical concerns (Grover et al., 2020). Additionally, using rankings would have limited the range of statistical analyses that could be performed,

including the between-subject analyses (Grover et al., 2020). Considering the limitations of the ranking task, a rating task was chosen for the current study.

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