

Renal transplant patients' preference for the supply and delivery of immunosuppressants in Wales

Hagemi, Anke; Plumpton, Catrin; Hughes, Dyfrig

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1   **Title:** Renal transplant patients' preference for the supply and delivery of  
2   immunosuppressants in Wales: A discrete choice experiment.

3

4   **Running head:** Preferences for immunosuppressant prescribing

5

6   **Authors:** Anke Hagemi<sup>1</sup>, Catrin Plumpton<sup>2</sup>, Dyfrig A Hughes<sup>2\*</sup>

7

8   **Affiliations:**

9   <sup>1</sup> Betsi Cadwaladr University Health Board, Ysbyty Gwynedd, Bangor, Wales, UK

10   <sup>2</sup> Centre for Health Economics and Medicines Evaluation, Bangor University, Wales, UK

11

12   **\*Author for correspondence:**

13   Centre for Health Economics and Medicines Evaluation, Bangor University, Ardudwy,  
14   Holyhead Road, Bangor, Wales, UK, LL57 2PZ.

15   Tel: (01248) 382950 E-mail: d.a.hughes@bangor.ac.uk

16

17

18

1   **Abstract**

2

3   Background

4   Prescribing policy recommendations aimed at moving immunosuppressant prescribing for  
5   renal transplant patients from primary to secondary care may result in benefits of increased  
6   safety and reduced cost. However, there is little evidence of patients' preferences for  
7   receiving their immunosuppressant therapy from hospitals compared to community  
8   dispensing. The aim of this study was to elicit patient preferences for different service  
9   configurations focusing in particular on home delivery versus collection of medication from  
10   hospital.

11

12   Methods

13   A discrete choice experiment was administered to 265 renal transplant patients in North  
14   Wales. Respondents were presented 18 pairwise choices, labelled as either home delivery or  
15   hospital collection, and described by the attributes: frequency of supply, waiting time (for  
16   delivery or collection) and method of ordering (provider contact, patient contact via phone,  
17   patient contact electronically). Data were analysed using a random-effects logit model and  
18   marginal rates of substitution calculated based on the waiting time attribute.

19

20   Results

21   A response rate of 63% was achieved, with 5332 usable observations from 150 respondents.  
22   Method of delivery ( $\beta$  coefficient 1.21; 95% confidence interval 1.05 to 1.38), frequency of  
23   supply (0.05; 0.03 to 0.08) waiting time (-0.00, -0.00 to -0.00), provider contact (desirable)  
24   (0.20; 0.12 to 0.27), patient contact by telephone (desirable) (0.09; 0.01 to 0.17) and patient  
25   contact electronically (undesirable) (-0.292; -0.37 to -0.21) were statistically significant

1 (p<0.05). Results indicate that patients are willing to increase waiting time by nearly 10  
2 hours to have a home delivery service.

3

4 Conclusion

5 Patients indicate a clear preference for a home delivery service. They prefer providers to  
6 make contact when new immunosuppressant supplies are required and show preference  
7 against ordering medication electronically. A policy for secondary care prescribing and  
8 hospital collection of medicines does not align with this preference.

9

10 **Key words:**

11 Discrete choice experiment; Immunosuppressants; Drug prescribing; Patient preference;  
12 Kidney transplantation

13

14

# 1    **Introduction**

2

3    The safe and effective use of immunosuppressants in the prevention of organ transplant  
4    rejection requires careful prescribing, and a high degree of adherence. Adverse events may  
5    arise from missed doses [1], medication errors [2], from switching between different brands  
6    of the same immunosuppressants [3], or during dispensing. Measures to reduce the  
7    likelihood of adverse outcomes, including appropriate prescribing, medicines optimisation  
8    strategies and supporting medication adherence, are reinforced in clinical guidelines [4,5].

9    Prescribing policies that promote the safer use of immunosuppressants in the UK have  
10    centred on increased specialist input from secondary care or tertiary centres to meet the  
11    pharmaceutical care needs of patients [6,7]. Patients may either collect a supply of their  
12    medication from the hospital pharmacy following a clinic appointment, or receive a delivery  
13    of their immunosuppressants by a registered pharmacy that specialises in home delivery.  
14    Patient preferences are important in the context of recommendations that patients should  
15    be given a choice in how their medicines are supplied [8]. However, we are aware of only  
16    one evaluation of patients' perspectives of a home delivery service of immunosuppressants  
17    [9]. Conducted as a postal questionnaire involving 300 patients at the Oxford Transplant  
18    Centre, the study indicated over 98% respondents prefer the home delivery service to the  
19    medication supply service previously provided by the hospital. However, the study was  
20    limited in terms of methodology through the use of a non-validated questionnaire,  
21    incomplete reporting and a risk of social desirability bias that might arise from patients'  
22    reluctance to criticise their health care provider [10].

23    Discrete choice experiment (DCE) is a quantitative technique for eliciting patients' stated  
24    preferences. It has been applied extensively to assess service users' preferences for health  
25    care service delivery and organization [11], to inform health policy, planning and resource

1 allocation decisions. Within a DCE, respondents are asked to choose between a set of  
2 hypothetical but realistic scenarios, which are each described by a number of characteristics  
3 (attributes) for which the levels are varied. DCEs assume that respondents' preference is  
4 revealed through their choice decisions [12]. To our knowledge, the only DCEs conducted in  
5 renal transplant patients have considered prioritisation of transplant, rather than  
6 considering aspects of service delivery [13,14]. In the context of a policy change, moving  
7 prescribing from primary care (where patients obtain their medicines from a community  
8 pharmacy) to secondary care involving hospital pharmacies, we aim to elicit patients'  
9 preferences for obtaining their immunosuppressive therapy via home-delivery or by  
10 collection from hospital pharmacies.

11

## 12 **Subjects and Methods**

### 13 Setting

14 The health board in North Wales is responsible for three major hospitals, located in the  
15 West, Central and East of the region. The East region is mostly urban or semi-urban, whereas  
16 the West and Central areas are more rural with distances from patients' homes to the  
17 nearest hospital being up to 60 miles and requiring up to 2 hours of travel time. Current  
18 supply of immunosuppressants is via collection alongside other medication prescribed by  
19 the general practitioner (GP) on a monthly basis from a local community pharmacy. However  
20 the policy recommendation is a change of prescribing responsibility from the GP to hospital  
21 (secondary care) based nephrologists. This means that the supply of immunosuppressants  
22 has to be arranged by the hospital pharmacies, which can be direct collection from the  
23 hospital or provision of home deliveries.

### 24 Study Design

25

1 A mixed methods approach was taken, which involved qualitative research methods (focus  
2 groups) to inform the design of the DCE. Ethics approval was granted by the North Wales  
3 Research Ethics Committee (West) reference 11/WA/0244.

#### 4 DCE Attribute and level selection

5 Initial attributes and levels of the prescribing service were based on clinical experience with  
6 home delivery services of erythropoiesis stimulating agents, a programme which initiated in  
7 North Wales in 2007, and a patient satisfaction questionnaire administered to 198 patients  
8 in 2008 (response rate 76.8%). Responses to the questionnaire highlighted the importance  
9 to patients of the location of medication delivery (home versus hospital versus GP) and  
10 identified a prolonged waiting time as a cause of patient dissatisfaction [15]. In the context  
11 of this work, waiting time refers to either the length of an allocated delivery time slot for a  
12 home delivery, or the time waiting in the hospital pharmacy for collection of the  
13 prescription. The time waiting in hospital may be substantially shorter and the collection of  
14 medicines from hospital pharmacy usually follows a clinic appointment, however time spent  
15 at home may be used more productively. The additional attribute of the interval of ordering  
16 was chosen to reflect clinical practice.

17 Focus groups were convened to discuss the attributes and refine how they were to be  
18 presented as part of the DCE, to identify relevant levels, to ensure that they were important  
19 and relevant to the patient population and understood by DCE respondents [16]. Twenty  
20 patients, randomly sampled from the patient list of 265 patients, were sent an invitation  
21 letter outlining the key aims of the study and a consent form should they wish to participate  
22 in the focus groups. Nine patients consented to take part in the focus groups and two  
23 sessions were facilitated to maximise attendance considering participants' work  
24 commitments and travelling distance to the meeting venue.

1 The purpose of the first focus group was to assess the relevance and importance of the  
 2 identified attributes (waiting time, location of collection, interval between supplies, safety or  
 3 risk of errors, and cost to the National Health Service (NHS) in the UK), and to identify any  
 4 further attributes using a thematic analysis. The second focus group considered the  
 5 attribute list and again considered the relevance and importance, with a focus on  
 6 phraseology, and potential attribute levels.

7 Focus group participants did not identify any further attributes; however there was concern  
 8 that the inclusion of a price proxy would result in different interpretation of the meaning of  
 9 cost (e.g. cost to the patient, drug cost, overall service cost) in the context of healthcare  
 10 being free at the point of delivery. It was decided, therefore, not to include a price proxy in  
 11 the DCE. Waiting time was considered as an attribute to estimate DCE respondents'  
 12 willingness to give up time for improvements on other attributes. Clinical experience with  
 13 home delivery of medicines and data on local hospital dispensary waiting times were  
 14 considered when assigning levels to this attribute. Although the attribute pertaining to  
 15 prescribing safety/ risk of errors was considered to be important to some focus group  
 16 participants, it was identified as not suitable for inclusion in the DCE as no meaningful levels  
 17 could be established as no comparative risk data were available for the different service  
 18 models. The final selection of attributes and levels used in the DCE are detailed in table 1.

19 **Table 1:** Attributes and levels for the discrete choice experiment

Attribute	Definition	Levels
Supply Method	How you collect your supply of immunosuppressant medication	Hospital Supply  Home deliveries
Wait	Waiting time on day of tablet collection / delivery	Hospital supply:  10, 20, 60 minutes  Home deliveries:



		60, 150, 240 minutes
Frequency	How often are tablets supplied?	Every month Every 3 months Every 6 months
Ordering	How do I order a new supply of my tablets?	You don't need to do anything – the provider contacts you when your tablets are ready for collection  You order your tablets by phoning the provider  You order your tablets from the provider by email or online

1

## 2 DCE design

3 A labelled design was used to keep choice sets realistic [17], and to allow for different levels  
4 to be assigned to the “waiting time” attribute for the two supply methods.

5 A full factorial design would result in 54 ( $3^3 \times 2^1$ ) profiles and 1,431 choice sets, hence a  
6 fractional factorial design was used to arrive at a manageable number of choices. The design  
7 was based on an orthogonal main effects design taken from a published design catalogue  
8 (Design 19a) [18]. Choice options were generated as  $L^{MA}$ , a labelled experimental design,  
9 which allows for the independent estimation of alternative specific attribute effects aiming  
10 to increase participants' familiarity with the context and reduce cognitive burden. The first  
11 three columns of the design correspond to attribute levels for choice A, and columns 4-6 of  
12 the design correspond to attribute levels for choice B [19]. Choices were presented pair-

wise, with respondents being required to make a choice; no “opt out” alternative was presented, as the current situation of GP prescribing will not be continued and non-participation, i.e. not receiving a supply of medication was not considered a valid choice. Figure 1 shows an example of one of the 18 choice sets in the DCE questionnaire. A dominant choice set, sometimes used to test for validity of responses, was not included as respondents’ preferred levels for each attribute were unknown *a priori*.

\*insert Figure 1 here\*

Information on respondents’ characteristics were collected to test the hypotheses that: (i) previous experience with home deliveries might result in preconceptions about the new service; (ii) travelling distance to the hospital clinic may influence a patient’s willingness to collect their medication from hospital; (iii) patients in full time employment may find home deliveries more inconvenient; (iv) access to a computer may facilitate medication ordering by email or online; and (v) patients may have different preferences depending on their region of residence, which determines the serving nephrology centre. Responses to other supplementary questions informed an assessment of the feasibility of providing a secondary care based prescribing service (e.g. establishing the risk of waste as a result of frequent changes to drug treatment or dosing).

Considerate of the local population, the questionnaire was presented in a bilingual format (English and Welsh).

### Pilot

Patients who attended either focus group meeting were invited to return for a second meeting to review the questionnaire design. Participants were asked to complete and

comment on various versions on the DCE questionnaire and the participant invitation letter, aiming to ensure that the DCE task was clearly presented and not overly burdensome. To facilitate understanding and consistency in respondents' choices, a clearly explained example of a choice set was presented on the first page of the questionnaire.

## Recruitment

Questionnaires were mailed to all transplant patients under the care of the three nephrology centres of the Betsi Cadwaladr University Health Board which serves the North Wales population of 678,000 people. A pre-paid return envelope was included. Where necessary, one reminder was sent out two weeks after the initial distribution of the questionnaires. Consent to participate was assumed with the return of completed questionnaires.

## Data analysis

The DCE was analysed using a random effects logit model in STATA® Version 13 (Statacorp, TX), with choice of delivery method specified as the dependent variable. The home-delivery or hospital collection label was entered as the alternate specific constant. Effects coding was applied for categorical variables to ensure that preference statements could be interpreted independent of the current state [20]. The significance, sign and relative magnitude of the regression coefficients were used to estimate the importance of attributes. A positive coefficient indicates that higher levels of the attribute are preferred. Trade-offs among attributes were estimated by marginal rates of substitution (MRS), calculated as the ratio of coefficients of one attribute relative to the coefficient for waiting time. From this, the amount of extra time which a patient is willing to wait for different levels of other attributes can be inferred.

1 Utilities of home delivery and hospital supply were calculated by weighting the results of the  
2 regression against potential outcomes using the formula

$$\begin{aligned} 3 \quad \text{Utility} = & \beta_{\text{Delivery}} * \text{Delivery} + \beta_{\text{Freq}} * \text{Frequency} + \beta_{\text{Wait}} * \text{Wait} + \beta_{\text{Provider}} * \text{Provider} \\ 4 \quad & + \beta_{\text{Phone}} * \text{Phone} + \beta_{\text{Electronic}} * \text{Electronic} \end{aligned}$$

5

6 We assumed home deliveries would be made on a 3-monthly basis with a typical wait of 4  
7 hours; whilst for hospital supply, we assumed a 20 minute waiting time, 3-monthly delivery,  
8 and telephone contact for re-supply.

9

10 Confidence intervals for coefficients and MRS were calculated using a non-parametric  
11 bootstrap approach. Subgroup analyses were performed to aid further interpretation and  
12 generalisability of the results. These were defined *a priori* according to patients' experience  
13 of home delivery; region; distance to clinic; employment status and type of transport. A  
14 subgroup was considered valid for analysis if it included 50 or more patients; we considered  
15 smaller samples to lack statistical powering. Subgroup models were compared with the  
16 base-case model for goodness of fit using a log-likelihood ratio test. The potential for false  
17 positive results from multiple comparisons required a Bonferroni correction which reduced  
18 the p-value for 95% significance to  $p=0.0125$ .

19

## 20 **Results**

21 All 265 renal transplant patients across North Wales were invited to participate. Of these,  
22 166 questionnaires were returned, resulting in an overall response rate of 63%. The  
23 response rate varied by region of nephrology centre: 55.8% for east, 62.5% for central and  
24 72.3% for west. Patient characteristics are summarised in Table 2.

25 **Table 2:** Patient characteristics.

Characteristic		
Age [years], n (%), N=166		
	18 to 30	3 (1.8)
	31 to 50	48 (28.9)
	51 to 70	83 (50.0)
	Over 70	32 (19.3)
Gender, n (%), N=166		
	Male	108 (65.1)
Betsi Cadwaladr University Health Board Region, n (%), N=164		
	East	72 (43.9)
	Central	45 (27.4)
	West	47 (28.7)
Current supply of immunosuppressants, n (%), N=162		
	GP and community pharmacy	125 (77.2)
	GP (dispensing practice)	19 (11.7)
	Hospital	18 (11.1)
Transport to clinic, n (%), N=151		
	Car	128 (84.8)
	Public transport	15 (9.9)
	Taxi	0 (0)
	Hospital transport	8 (5.3)
	Walk	0 (0)
	Other	0 (0)
Distance to local transplant clinic [miles], n (%), N=156		

	<20	111 (71.2)
	≥20	45 (28.8)
Travelling time local transplant clinic [min], mean (SD), N=147		34 ( 32.0)
	<30	84 (57.1)
	≥30	63 (42.9)
Experience with home delivery, n (%), N=162		
	Yes	69 (42.6)
	No	93 (57.4)
Employment status, n (%), N=159		
	Full time work	42 (26.4)
	Part time work	20 (12.6)
	Not in employment/ retired	97 (61.0)
Access to the internet at home, n (%), N=159		
	Yes	115 (72.3)
	No	44 (27.7)
Last change to immunosuppressant medication, n(%), N=163		
	In previous 1 month	17 (10.4)
	In previous 1-3 months	14 (8.6)
	In previous 3-6 months	16 (9.8)
	More than 6 months	116 (71.2)

- 1 The number of patients (N) varies due to missing data
- 2 Seven DCE responses were excluded as respondents' annotations of the questionnaire
- 3 clearly indicated a limited understanding of the DCE methodology. Nine further responses
- 4 were excluded due to a small number (6 or less) of completed choice sets. 133 respondents
- 5 completed all 18 choice sets. 76 respondents (51%) exhibited evidence of a dominant

1 preference towards either home deliveries (n = 55) or hospital supply (n=21), that is, they  
 2 were non-traders. These were included in the base case analysis, resulting in 5,332  
 3 observations from 150 patients.

#### 4 Base case results

5 All attributes were statistically significant ( $p < 0.05$ ). The directions of coefficients are  
 6 consistent with expectations, where hypothesised *a priori*. For example the negative  
 7 coefficient ( $\beta_{\text{wait}} = -0.0021$ ) for waiting time indicates a preference towards a shorter wait for  
 8 medication supply. Table 3 summarises the results of the base case model.

9 **Table 3:** Discrete choice modelling results

Attribute	$\beta$ -coefficient (95% confidence interval)	P-value	Marginal rate of substitution (95% confidence interval)
Home deliveries	1.21 (1.05, 1.38)	0.000	588 (422, 1010)
Frequency	0.05 (0.03, 0.08)	0.000	26 (12, 54)
Wait	-0.00 (-0.00, -0.00)	0.000	n/a
Ordering_provider	0.20 (0.12, 0.27)		96 (50, 196)
_ phone	0.09 (0.01, 0.17)	0.026	43 (5, 110)
_ electronic	-0.29 (-0.37, -0.21)	0.000	-139 (-276, -85)
Constant	-0.61 (-0.75, 0.50)	0.000	n/a

10  
 11 The absolute values of coefficients indicate their relative importance on patients' choice.  
 12 Method of delivery had the greatest absolute value of the coefficient ( $\beta_{\text{delivery}} = 1.21$ , 95% CI  
 13 1.05 to 1.39), followed by the methods patient order their medication supply. The frequency  
 14 of supply ( $\beta_{\text{freq}} = 0.05$ , 95% CI 0.03 to 0.08) and a unit change in waiting time [minutes] ( $\beta_{\text{wait}}$   
 15 = -0.00, 95% CI -0.00 to -0.00) were the least important attributes. Patients were more likely  
 16 to choose infrequent delivery of medicines and initial contact for ordering made by the

1 health care provider. Increased waiting time and the need for patients to initiate the  
2 medication ordering process themselves –either by phone or online– decreased the  
3 probability of patients choosing a method of medication delivery.

4 Based on calculations of marginal rates of substitution (MRS), the results indicate that  
5 patients will accept an additional 26 minutes (95% CI, 12 to 54 minutes) of waiting time if  
6 the interval between medication supplies was increased by one month. Home delivery  
7 supplies were valued at almost 10 hours of waiting time. A reduction in waiting time of over  
8 2 hours would be required for patients to accept online ordering of their medications.

9 Total utility for home delivery was 0.458 (95% CI 0.316 to 0.601). Hospital supply yielded a  
10 significantly lower utility of -0.410 (95% CI -0.514 to -0.302).

#### 11 Subgroup analysis

12 Four subgroups satisfied the criteria for analysis: region (west and central versus east),  
13 distance to clinic, experience with home deliveries, and employment status. All subgroups  
14 were shown to be significant in terms of model fit, compared with the base case ( $p < 0.01$ ).

15 Patients served by the central and west (more rural) regional nephrology centres within the  
16 Health Board show a higher preference to home deliveries than patients in the east, with a  
17 willingness to wait an extra 711 minutes (more than 11¾ hours) and 444 minutes (almost 7½  
18 hours) for home delivery, respectively. The travel attribute was not significant for patients  
19 living within 30 minutes of their local hospital clinic; but for those living 30 minutes or more  
20 away, were willing to wait an extra 347 minutes (5¾ hours) for home delivery.

21 Patients with previous experience of home deliveries show a weaker preference for home  
22 delivery supply compared to those who have not received medication deliveries to their  
23 homes. They were willing to increase waiting time by 531 minutes (nearly 9 hours)



1 compared to 623 minutes (over 10 hours), respectively. Of all subgroups, patients in full time  
2 employment showed the lowest preference for home deliveries and willing to increase  
3 waiting time by only 271 minutes (4½ hours) for this service.

4 Marginal rates of substitution (Online appendix A1) for the subgroup analysis showed no  
5 significant differences in trading, either among subgroups, or compared to the base case.

## 6 **Discussion**

7 The present study reports on preferences of renal transplant patients in North Wales for the  
8 method of obtaining supplies of immunosuppressive therapy. We found the method of  
9 delivery to have, by far, the greatest impact on patients' preference, with home deliveries  
10 identified as the preferred option. Respondents were willing to increase wait time by nearly  
11 10 hours for home delivery, and patients' utility, based on a typical home delivery service,  
12 was significantly higher than for collection at hospital pharmacies. The least desired  
13 attribute was electronic ordering, with respondents willing to increase waiting time by over  
14 2 hours extra to avoid this option. This result should be in the context of 28% of respondents  
15 not having access to the internet at home.

16

17 Patients were more likely to choose a delivery method if the interval between deliveries was  
18 high and the initial contact for ordering a supply was made by the health care provider.

19 Implementing a service addressing both these attributes may however significantly increase  
20 the cost of providing the service: more staffing time is required for actively contacting  
21 patients compared to responding to requests for a medication supply. Increased intervals  
22 between deliveries may result in medication wastage due to dose changes or expired  
23 medication if stocks are not rotated following the receipt of a new supply. However, in the  
24 sampled population, the risk of medication wastage due to dose changes is low as most  
25 patients were on stable doses of immunosuppressants.

1

2 Analysis of marginal rates of substitutions within the subgroups “region” and “distance to  
3 hospital” supports the hypothesis that patients living further away from the base hospital in  
4 rural settings have a stronger preference for home deliveries compared to patients in an  
5 urban setting. No published studies have been identified that explored the influence of  
6 rurality on patient’s preference on the method of medication supply in transplant patients  
7 or other patient groups. Our findings add to other known characteristics of transplant  
8 patients who do not live in close proximity to a hospital. Research from the USA, for  
9 instance, indicates that distance to a transplant centre may reduce transplant waiting list  
10 registration rate and transplant rate [21,22] while patients living in rural areas may exhibit  
11 reduced adherence to immunosuppressant therapy [23] compared to patient in urban areas.  
12 No similar studies on the possible impact of rurality on renal transplant patients have been  
13 published in the UK [24].

14

15 The results of this study are generalizable to other regions of Wales and to other  
16 comparable regions of the UK. Despite the administration of the NHS having been devolved  
17 to individual countries within the UK, the delivery of pharmacy services for transplant  
18 patients is modelled on the same options as considered in our DCE. While North Wales is  
19 sparsely populated in comparison to many urban locations in the UK, our sub-group analysis  
20 allowed for exploration of differences between urban and rural regions, and indicated a  
21 higher preference for pharmacy collection in populated areas which are closer to hospitals.  
22 Many countries operate a home delivery service, and our analysis of patients with prior  
23 experience of this indicates that they would prefer not to wait as long for their medicines  
24 compared to patients with no prior experience. This may indicate a revealed preference of  
25 some dissatisfaction with home delivery service, though overall, this was still greatly  
26 preferred over hospital pharmacy collection. In common with other DCEs, our analysis is

1 restricted in its generalisability to healthcare systems and settings where the choice of  
2 attributes and their associated levels are applicable, and which are represented by our  
3 sample population. As such, the findings may have limited generalisability to patients,  
4 payers, healthcare systems or jurisdictions beyond the UK.

5

6 The study benefited from an acceptable response rate and a high proportion of  
7 questionnaires completed in full. We used a rigorous and robust choice-based format to  
8 elicit patients' stated preferences, and a systematic approach to identify relevant attributes  
9 and assign appropriate levels.

10

11 There are a few caveats to the study, however, including responder bias arising from the  
12 familiarity of patients in the west region with the lead researcher, and opt-out being offered  
13 while patients were in possession of the questionnaires (those who did not participate might  
14 not have done so because they had first read through the questionnaire). A second potential  
15 limitation was the use of a forced choice format which, while being appropriate to the policy  
16 context, does not allow for patients to indicate that they did not prefer one supply method  
17 over the other. Inclusion of an option of "no preference", however, would have impacted on  
18 the number of discrete choices to the extent that response rate might have been adversely  
19 affected. Labelling the choice sets with the two possible supply methods represented a third  
20 limitation as this led to a significant number of patients exhibiting a dominant preference by  
21 choosing home deliveries irrespective of the levels of other attributes in the choice set. We  
22 also note that when analysing data on waiting time, no distinction was made between time  
23 waiting at the hospital versus time waiting at home, and no account was made for travel  
24 time to the hospital, however given that patients collect their prescriptions following an  
25 appointment, this is not an additional expense. No attributes describing adherence to  
26 treatment or medication safety were included in this DCE. While there is no difference in the

1 frequency of clinic appointments with either method of medication delivery, collection of  
2 medicines at hospital pharmacies might provide an opportunity for patient counselling,  
3 including matters relating to adherence. Finally, a transcription error meant that 2 of the 18  
4 choice sets did not correspond to the original design; but extensive testing for level balance  
5 and orthogonality confirmed that neither were compromised nor affected the validity of the  
6 results.

7  
8 Waiting times are often used as a key performance indicator to measure workload and  
9 performance in pharmacy outpatient medication supplies. However, this study showed that  
10 patients are willing to accept a significant increase in waiting time for other preferred  
11 attributes describing a medication supply service. This should be considered by policy  
12 decision makers when evaluating services affecting medication supply. Recent changes to  
13 commissioning of solid organ transplantation by NHS England (2014) will result in a  
14 significant shift of immunosuppressant prescribing from primary care to transplant centres  
15 or secondary care providers with assumed benefits on prescribing safety and cost [7]. The  
16 implication of a strong preference for home delivery service, particularly for patients more  
17 distant from specialist renal centres, ought to be considered in future commissioning of  
18 pharmaceutical services.

## 20 **Conclusions**

21 These first insights into the preferences of renal transplant patients suggest that patients  
22 have a preference for home-delivery of their immunosuppressant medications. The strength  
23 of this preference is increased for patients who live in more rural areas, but decreases in  
24 patients who are in full time employment. These findings and influencing factors should be  
25 considered in arriving at policies aimed to maximise adherence and patient safety.

1   **Declarations**

2   Ethics: Ethics approval was granted by the North Wales Research Ethics Committee (West)  
3   reference 11/WA/0244.

4   Consent for publication: Not applicable

5   Availability of data and material: The datasets generated and/or analysed during the current  
6   study are not publicly available due to containing patient-level data. Data are available from  
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2 **Figure 1:** Example of choice set

3 **Question** Which methods of obtaining your anti-rejection drugs would you prefer if  
 4 these were the only options available to you:  
 5

	Hospital supply	Home deliveries
<b>How often are tablets supplied?</b>	Every month	Every 6 months
<b>Waiting time on day of tablet collection/ delivery:</b>	20 minutes	2.5 hours
<b>How do I order a new supply of my tablets?</b>	You order your tablets by phoning the hospital	You order your tablets by phoning the delivery company

Which medication supply  
 service would you prefer?  
 (please tick one box only)

**Prefer hospital supply**

☐

**Prefer home deliveries**

☐

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