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CONSUMER PREFERENCES FOR SCANNING MODALITY TO DIAGNOSE FOCAL LIVER LESIONS

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Objectives: Differences in the process of using liver imaging technologies might be important to patients. This study aimed to investigate preferences for scanning modalities used in diagnosing focal liver lesions.
Methods: A discrete choice experiment was administered to 504 adults aged ≥25 years. Respondents made repeated choices between two hypothetical scans, described according to waiting time for scan and results, procedure type, the chance of minor side-effects, and whether further scanning procedures were likely to be required. Choice data were analyzed using mixed-logit models with respondent characteristics used to explain preference heterogeneity.
Results: Respondents preferred shorter waiting times, the procedure to be undertaken with a handheld scanner on a couch instead of within a body scanner, no side-effects, and no follow–up scans ($p \leq .01$). The average respondent was willing to wait an additional 2 weeks for the scan if it resulted in avoiding side-effects, 1.5 weeks to avoid further procedures or to be told the results immediately, and 1 week to have the scan performed on a couch with a handheld scanner. However, substantial heterogeneity was observed in the strength of preference for desirable imaging characteristics.
Conclusions: An average individual belonging to a general population sub–group most likely to require imaging to characterize focal liver lesions in the United Kingdom would prefer contrast–enhanced ultrasound over magnetic resonance imaging or computed tomography. Insights into the patient perspective around differential characteristics of imaging modalities have the potential to be used to guide recommendations around the use of these technologies.

Imaging is an important intervention to support diagnosis, planning and ongoing surveillance in people with suspected or confirmed liver disease. An array of imaging modalities is now available to investigate and characterize focal liver lesions principally to distinguish between malignant and benign lesions not requiring further treatment (1). Techniques available include ultrasound (US), computed tomography (CT), and magnetic resonance imaging (MRI) with or without a contrast agent enhancement. There is a need for guidance on the comparative benefits, costs and place of these different modalities in the diagnostic pathway (1–3).

Contrast–enhanced ultrasound (CEUS) has been reported to have good overall sensitivity and specificity in the diagnostic work-up of focal liver lesions in most indications and to be a cost–effective alternative to contrast–enhanced CT or MRI (4). The United Kingdom (UK) National Institute for Health and Care Excellence (NICE) recently issued diagnostics guidance on the use of SonoVue® contrast agent (sulphur hexafluoride microbubbles) for CEUS imaging of the liver (1). CEUS using SonoVue® contrast agent has been shown to accurately discriminate between malignant and benign focal liver lesions (5) and characterize focal liver lesions (6;7) and liver metastases (8). Moreover, reports of serious adverse reactions to the SonoVue® contrast agent are very rare (9;10).

The NICE diagnostics guidance recommends SonoVue® CEUS for the characterization of incidentally detected focal liver lesions in adults where an earlier unenhanced ultrasound was inconclusive. It is also recommended for patients undergoing surveillance for cirrhosis or metastatic disease and for whom contrast–enhanced CT or MRI is not clinically appropriate, accessible or acceptable and an unenhanced US scan is unsatisfactory or inconclusive and where a contrast agent is required for further diagnosis (1). The NICE recommendation was made following a review of the comparative clinical and economic evidence suggesting CEUS to be a cost–effective alternative to contrast–enhanced CT or MRI (1). However, evidence reporting on patient preferences for CEUS compared with other imaging modalities is limited, leading to NICE recommending further research in this area (1).

Regardless of any difference in health and economic outcomes, there are differences in the process of using CEUS, CE-MRI, and CE-CT which might be important to patients. Advantages associated with CEUS include the availability of immediate results, low risk of serious adverse effects, and the avoidance of ionizing radiation (3;4). However, there is an

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increased risk of follow–up scans in selected patient groups (11). There is limited evidence documenting which component of the imaging process (CE-CT, CE-MRI, and CEUS) affects patients' experience, or the extent to which patients would be willing to trade between these different imaging characteristics.

Literature exploring the patient experience of CT and MRI is less sparse and the side effects (claustrophobia, anxiety) of these scanning modalities are well documented (12;13). A study investigating patient preferences for receiving radiology results (CT and US) concluded that patients preferred hearing results from their ordering provider or consultant radiologist with anxiety decreasing after consultation (14). In a further study, which interviewed UK clinicians, it was observed that they expected patients to prefer ultrasound compared with CT or MRI, due to it being the more patient–friendly, and the fact that scan results are given to patients in 80–90 percent of cases on the same day (15). No research specifically investigating patient experience of or preferences for CEUS has been identified.

Although the NICE guidance (1) research recommendations refer to more than one scanning modality patients are unlikely to experience more than two scanning modalities in the UK health service system (15) for the same medical condition. One approach that can be used to capture preference of the three imaging modalities, using hypothetical scenarios, is a discrete choice experiment (DCE). The DCE has its foundations in random utility and consumer choice theories (16), and has become popular as a method to evaluate stated preferences for healthcare interventions and services (17). It allows an assessment of the trade–offs individuals would make between different characteristics of an intervention and of the comparative value and priority given to interventions from the consumers' perspective. DCEs have been used to elicit patient preferences for choice of diagnostic tests (18), and scanning modalities (19). To-date, the DCE approach has not been used to measure patient preferences for scanning modalities in the context of liver disease.

This article reports a DCE investigating preferences for scanning modalities used in diagnosing focal liver lesions. The study adds to our existing understanding by focusing on preferences for the characteristics of three specific imaging modalities (CEUS, CE-MRI, and CE-CT) that have not previously been compared, to ascertain preferences for scanning modalities including CEUS which has been recommended in recent NICE guidance (1). The study aimed to determine these preferences in a population similar in characteristics to those most likely to undergo imaging to characterize focal liver lesions. This population was matched as closely as possible to the demographics of patients with liver conditions (cirrhosis and cancer) in the UK (20). Specifically, the study focuses on how preferences vary with waiting time (for scan), time to results (after scan), type of procedure, side effects, and the likelihood further procedures are necessary. It was intended that the results would inform the review and recommendations made in the NICE guideline (1) update.

METHODS

In a DCE, respondents are presented with a series of choices between two or more alternatives, and are asked to select the alternative they prefer in each choice set. Each alternative is described according to a combination of attributes and levels. The levels of the attributes are varied systematically across the alternatives. The relative importance of the attributes and the trade-offs individuals make when choosing one alternative over another are estimated through regression analysis of the choice data.

DCE Attributes and Levels

The first stage in developing a DCE involves the identification and selection of the attributes and levels used to describe the alternatives in the choice set. In developing the attributes and levels for the DCE use was made of the NICE Guidance (Diagnostics Guidance [DG]) (5) to identify pathways, diagnostic and referral processes associated with the scanning modalities (1). Furthermore, a targeted review of the literature was undertaken to identify issues and concerns of patients undergoing scans (e.g., claustrophobia, adverse events). Both of these were used to develop a set of questions which were used to guide semi–structured interviews with UK clinicians (radiologists or sonographers, $n = 7$) which provided an overview of clinical practice and patient pathways, as well as detailing the clinicians' views on patients' experience of the process (15).

The NICE guidance, literature review and clinician interviews were used to develop a patient experience questionnaire completed by 40 patients attending the Leeds St James's University Hospital clinic for CEUS to capture patients' perceptions of the (dis)advantages of the imaging modalities; to confirm if the clinicians' views of patient experiences were accurate and to draw out any experiences or side effects that had not been identified from the clinician interviews to finalize development of the attributes and levels. The final attributes and levels for the DCE choice sets are described in Table 1. The DCE also included questions related to respondents' socio-demographic characteristics, health status, and previous experience with the imaging modalities in general. The Short Form Health Survey 12 (SF-12) was also included in the DCE (21). The SF-6D may be derived from the SF-12 to provide a preference-based single index measure of health (22).

The DCE was piloted in a convenience sample ($n = 20$) to confirm the face validity of the task before being administered to respondents.

Experimental Design

The attribute levels shown in Table 1 can be combined into 1,128 (i.e., (3∗(2^4))∗(3∗(2^4)-1)/2) different pairs of alternative scans. Therefore, statistical design theory was used to select the specific combinations of attributes and levels to be presented as alternatives in several choice sets that were not too

Table 1. DCE Attributes and Levels

Attribute	Levels	Level code
Waiting time for scan	2 weeks	2
	4 weeks	4
	6 weeks	6
Waiting time for results	Immediately for 8/10 cases (80%)	−1
	Within 2 weeks	1
Procedure	Handheld scanner: Patients lie down on a couch; a handheld scanner is moved over the patient's stomach; patients are able to talk to doctor/sonographer; patients may be accompanied.	−1
	Body scanner: Patients lie down within a scanner which surrounds most of their body (like a tube); patients are not able to talk to doctor/sonographer; patients may not always have others present	1
Side effects	No side effects	−1
	Minor side effects in 5/100 cases (5%) (headaches, dizziness, rash)	1
Further procedures	No	−1
	Possible for 2/10 cases (20%)	1

burdensome for respondents (23). A fractional factorial orthogonal design consisting of 72 choice sets was derived using the fold-over approach in NGENE software (ChoiceMetrics Pty Ltd, New South Wales, Australia) (24). The design was orthogonal for the main effects ensuring the impact of each attribute level on choice could be independently estimated, near orthogonal for all two–way interactions, and level–balanced (i.e., each attribute level appeared an equal number of times in the design). The seventy-two choice sets were blocked into 6 survey versions each including twelve choice sets. Respondents were randomly allocated to complete one of the six survey versions. For each version, the first choice set was reversed and repeated as a 13th choice set, as a consistency check to assess the internal validity of the data. Responses to the 13th choice set were not included in the preference model. Thus, each respondent was presented with thirteen choice sets (e.g., Supplementary Figure 1).

Recruitment and Data Collection

Respondents were recruited from a large internet survey panel by an independent third party (Qualtrics.com). As panel membership is voluntary informed consent may be implicitly assumed and formal ethical approval was therefore not required. The DCE was conducted in the United Kingdom, in February 2014. Using a DCE in a sample of the general population, rather than in–patients, allows preferences relating to the scan modality to be identified without the scan outcome potentially biasing responses. The DCE instrument was administered as an online survey and respondents were offered an incentive upon completion of the survey in the form of points that can be collected and exchanged for cash in certain increments.

It has been demonstrated that confidence intervals for the parameter estimates start to decrease significantly in sample sizes of 300 respondents and above (19). Therefore a target sample size of 500 was selected with the generous sample size chosen to support a more detailed analysis of preference heterogeneity. Stratified sampling was used to recruit the respondents, i.e. the panel was stratified to match as closely as possible the demographics of patients with liver conditions based on the UK incidence of cirrhosis and liver cancers (20). The respondents were stratified by gender and age (25–34, 35–44, 45–54, 55–64, 65+ years). The targets for these variables were as follows: fifty percent of respondents aged 25–44 or 55+ years old, the remaining 50 percent aged 45–54 years (peak age- incidence); 65 percent male and 35 percent female. Respondents were not eligible to complete the survey if they were aged below 25 years or if they chose not to answer either the question asking for their age or for their gender. The online platform (Research Suite, Qualtrics.com) utilized block randomization to randomly allocate respondents to one of the six survey versions.

Data Analysis

The choice data were analyzed in NLogit statistical software (version 5, Econometric Software Inc.) (24) using multinomial logit (MNL) models for preliminary analyses and then a mixed logit model (MXL) for the final analysis. The MXL model is a more generalized analytic approach that relaxes several assumptions associated with the MNL (17). Importantly in this context, the MXL allows for potential correlation in the multiple choice responses provided by any one individual, and allows preferences estimated by the model to vary across the individuals in the sample.

The utility function for the choice model was specified as a linear additive function of the main effects for each attribute level, as shown Equation 1:

$$V(i,j) = \beta_{1ij} WScanC + \beta_{2ij} WRes1 + \beta_{3ij} Proc1 + \beta_{4ij} SE1 + \beta_{5ij} FProc1 \quad (1)$$

In Equation (1), V(i,j) is the systematic (observed) utility for individual i associated with choice j (j = Alternative A or Alternative B); β_{1-5} are the beta coefficients (also referred to as preference weights, marginal utilities or part worths) associated with each attribute level; and WScanC, WRes1, Proc1, SE1, FProc1 are the attribute levels, as defined in Table 1.

Models were initially estimated with all attribute levels effects coded (23). Preliminary analysis using an MNL model confirmed the main effects for the attribute "waiting time for scan" were linear; therefore all models were specified with this attribute coded as a continuous attribute. Preliminary MNL analyses suggested none of the two–way interactions between the attributes significantly explained choice; therefore, they were not included in the final MXL model specification.

All attribute levels were specified as random parameters in the MXL model, and were assumed to follow a normal distribution. Respondents' characteristics (Table 2) were entered into the MXL model as potential predictors of preference heterogeneity around the mean parameter for each attribute level, and then removed using a backward-step approach if they did not explain preference heterogeneity at the 20 percent and then 10 percent significance level. All characteristics explaining heterogeneity at the 10 percent level for at least one attribute were retained in the final MXL model. A sensitivity analysis explored the stability of findings to the removal of inconsistent responders, by estimating an MXL model including only the sub–group of responders who provided a consistent response to the repeat choice task. All preliminary MXL models were estimated using 50 Halton draws, the final model was specified using 1,000 Halton draws.

RESULTS

Sample Characteristics

Data from a total of 504 respondents were available for analysis before all age and gender quotas were filled. A total of 708 surveys were started with 204 surveys returned incomplete. The completion rate was therefore 71.2 percent. A similar number of respondents (between eighty-two and eighty-five respondents) completed each survey version.

A summary of the respondent characteristics is provided in Table 2. Consistent with the stratified approach to sampling, all respondents were over 25 years old, 50 percent of the sample were aged 45–54 years old, there were more males (65.1 percent) than females (34.9 percent) in the sample. All education categories were represented, the category with the most respondents (32.1 percent) was the highest level of education being undergraduate university. The majority of respondents were in full–time work (52.0 percent).

There were 475 previous US, CT, or MRI scans reported (these categories were not mutually exclusive). The majority of respondents had not been admitted to hospital in the past 12 months (58.3 percent) and had spent no time in hospital as an inpatient in the last five years (52.6 percent). Few respondents (9.3 percent) reported a history of liver disease.

DCE Analysis

The majority of respondents (n = 424, 84.1 percent) provided a consistent response to the repeated choice task. The sensitivity analysis comparing the model estimates for all responders to those based on the sub–group of consistent responders indicated the mean coefficients for the attribute levels were similar for both models in terms of significance, direction of preference and relative size, and were highly correlated (Supplementary Figure 2; R^2 = 0.905). Therefore, the findings are not considered to be sensitive to the inclusion/exclusion of inconsistent responders. All responders were retained for the analysis.

A total of 6,048 choice observations were included in the preference model (12 choices each from 504 respondents, excluding the repeated consistency task). All characteristics tested except whether a respondent was employed explained preference heterogeneity ($p \leq .10$) in the preliminary MXL model and were therefore included in the final MXL model. The final model with covariates explained a greater proportion of the choice variance (AIC/N 0.985) than the MXL model without covariates (AIC/N = 0.998) and represented a substantial improvement in fit over an MNL model (AIC/N = 1.047). The final model had a pseudo R^2 of 0.305, representing an acceptable fit for a discrete choice model. The final model is presented in Supplementary Table 3 (parameters significant at the 5 percent level only; with all model parameters presented in Supplementary Table 2).

The coefficients in the MXL model indicate the relative strength of preference or "preference weight" for improvements in the attributes (characteristics) of a scan. All attributes were statistically significant in impacting choice between different scan alternatives at the 1 percent level or higher, and coefficients were in the anticipated direction (Supplementary Table 3). On average, respondents preferred shorter waiting time for the scan and for results, the procedure to be undertaken with a handheld scanner on a couch instead of within a body scanner, no side effects, and no follow–up scans. However, these were the average respondent preferences, and substantial heterogeneity was observed in the strength of preference around the mean preference weights for the attribute levels across the sample.

There were several characteristics that significantly explained the variation in preference between respondents for each attribute ($p \leq .05$: Supplementary Table 2; with a summary of statistically significant effects presented in Table 3). Younger respondents (≤34 years) and those with a history of hospital admission(s) were less averse to waiting for a scan;

Table 2. Respondent Characteristics for DCE ($N = 504$)

Characteristic	Category	*N* (%)
Age[a]	25–34	63 (12.5)
	35–44	53 (10.5)
	45–54	252 (50.0)
	55–64	77 (15.3)
	65 and over	59 (11.7)
Gender	Male	328 (65.1)
Education	Primary school	2 (0.4)
	Some secondary school	9 (1.8)
	Completed secondary school	139 (27.6)
	Some additional training (apprenticeships)	130 (25.8)
	Undergraduate university	162 (32.1)
	Postgraduate	60 (11.9)
	Prefer not to answer	2 (0.4)
Occupational status	Not working	88 (17.5)
	Full–time	262 (52.0)
	Part–time	61 (12.1)
	Temporary leave	3 (0.6)
	In training (apprentice)	0 (0.0)
	Student	4 (0.8)
	Retired	86 (17.1)
Previous scan[b]	US	192 (38.1)
	MRI	185 (36.7)
	CT	98 (19.4)
Last admitted to hospital	This month	8 (1.6)
	1–3 months	27 (5.4)
	>3–6 months	22 (4.4)
	>6–12 months	47 (9.3)
	>12 months	294 (58.3)
	Never	106 (21.0)
No. of weeks in hospital (past 5 years)	No time in last 5 years	265 (52.6)
	Less than 1 week	126 (25)
	1–2 weeks	59 (11.7)
	>2–4 weeks	27 (5.4)
	>4–6 weeks	8 (1.6)
	>6–8 weeks	11 (2.2)
	>8–10 weeks	3 (0.6)
	10+ weeks	5 (1.0)
History of liver disease	No history	457 (90.7)

[a] Only respondents over 25 years were eligible to complete the DCE.
[b] Does not add to 100% as some answers were other/don't know/none. Categories were not mutually exclusive.

whereas, respondents with a higher education level, better quality of life (QoL; SF-6D Index score >0.7), or history of previous ultrasound imaging were more averse to waiting for a scan. Respondents with a history of hospital admission(s) were less averse to waiting for results. Males were less averse to having a scan in a body scanner; whereas, respondents with better QoL were more averse to having a scan in a body scanner. Older respondents (≥65 years) were less averse to suffering minor side

Table 3. Summary of Direction of Preference and Preference Heterogeneity for the Five Attributes

On average, respondents preferred ($p \leq 0.05$)	Respondents who were less averse ($p \leq 0.05$)	Respondents who were more averse ($p \leq 0.05$)
Shorter waiting time for scan	Less averse to wait: • Younger (≤34 years) • History of hospital admission(s)	More averse to wait: • Higher education level • Better QoL (SF-6D > 0.7) • History of previous ultrasound imaging
Shorter waiting time for results	Less averse to wait: • History of hospital admission(s)	
To avoid body scanner (i.e. preferred handheld scanner)	Less averse to body scanner: • Males	More averse to body scanner: • Better QoL (SF-6D > 0.7)
No side effects	Less averse to minor side effects: • Older (≥65 years)	More averse to minor side effects: • Better QoL (SF-6D > 0.7)
No further procedures		More averse to further procedures: • Better QoL (SF-6D > 0.7)

effects than younger respondents; whereas, respondents with better QoL were more averse to suffering side effects. Respondents with better QoL were more averse to requiring possible further procedures.

In addition, some further respondent subgroups appeared to have different preferences for some of the scan characteristics ($p \leq .1$); although, these effects failed to reach statistical significance at the conventional 5 percent level (Supplementary Table 2). Older respondents (≥65 years) and males appeared less averse to waiting for results; younger respondents (≤ 34 years) appeared less averse to having a scan in a body scanner; respondents who had no history of imaging appeared less averse to suffering minor side effects, and respondents with a history of hospital admission(s) appeared slightly less averse to requiring possible further procedures.

A substantial amount of heterogeneity still remained, even after including these characteristics in the model (indicated by the significant standard deviations for all random parameters; $p \leq .01$). This was particularly the case for the type of procedure (handheld scanner on couch versus body scan). For this attribute, the standard deviation was relatively high compared with the mean sample preference, indicating that the direction of preference was likely reversed for some respondents; that is, a minority of respondents preferred the body scan over the handheld scanner.

Willingness to Wait For Preferred Scan Characteristics

The estimated average marginal time that respondents were willing to wait to gain an improvement in an imaging characteristic were estimated as a ratio of the relevant mean parameter weights from the MXL model (Supplementary Table 3). Confidence intervals were estimated using the Delta method.

The average respondent was willing to wait almost an additional 2 weeks to have the scan if it resulted in avoiding side effects, approximately 1.5 weeks to avoid further procedures or to be likely to be told the results immediately, and almost 1 week to have the scan performed on a couch with a handheld scanner rather than inside a body scanner (Figure 1; Supplementary Table 1).

DISCUSSION

Overall, the findings of this study suggest that an individual belonging to a general population sub–group most likely to require imaging to characterize focal liver lesions would on average prefer CEUS over contrast-enhanced MRI/CT. Respondents preferred shorter waiting times for the scan and results, the ultrasound scanning process compared with the body scanner and no side effects, all of which are associated with CEUS as opposed to CE-MRI/CT. However, there was a preference for not having follow–up scans. Repeated imaging is associated with the CEUS process in around 20 percent of cases (as reported in the clinician interviews) whereas, a repeated scan is likely to be required less frequently following an initial contrast–enhanced MRI or CT scan (11). Nevertheless, the strength of preference for avoiding a follow–up scan was relatively small, as compared to the collective preference for the other characteristics associated with CEUS. Research exploring patient experience of CEUS is absent from the literature and few studies have examined patient preferences comparing imaging modalities (13); to–date no studies have used a DCE to measure preferences for CEUS, CE-MRI, or CE-CT. Therefore, these findings provide valuable insight into preferences, and the factors that influence preference between CEUS and CE-MRI or CE-CT.

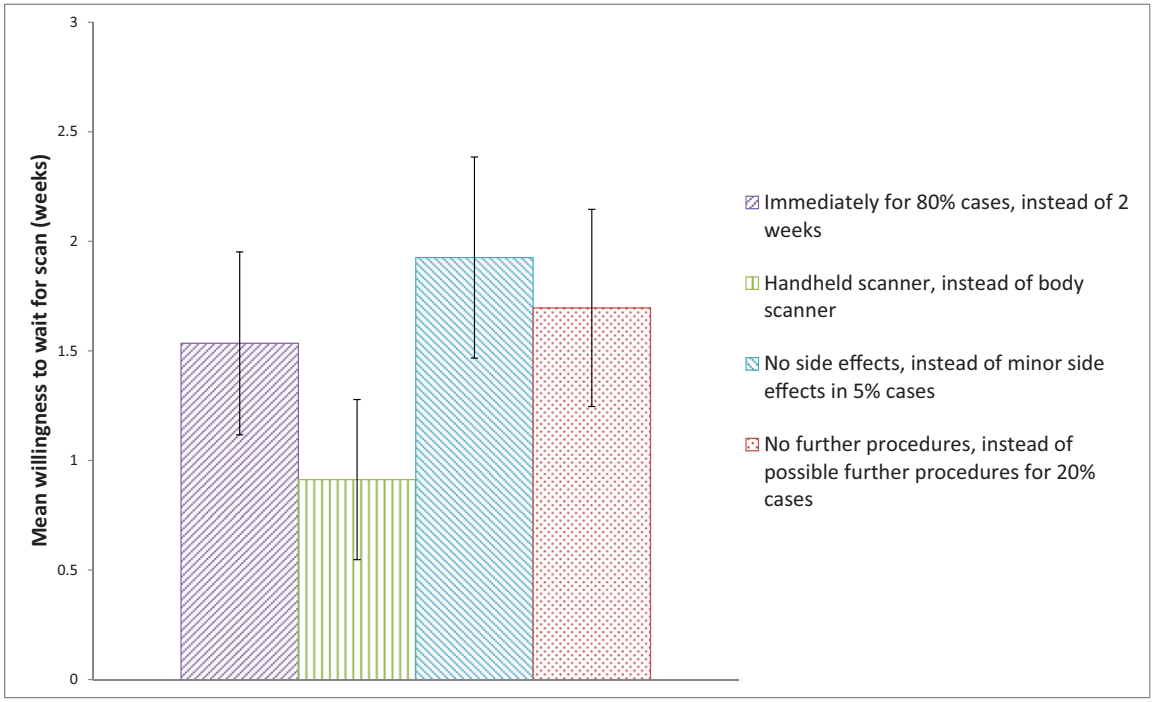

Figure 1. Mean marginal willingness to wait for improvements in imaging characteristics. Error bars represent 95 percent confidence intervals.

The attributes in the DCE (waiting time for scan, waiting time for results, type of procedure, side effects, and further procedures) all significantly explained preferences in the direction anticipated by imaging clinicians (15). Previous research suggests that patients wish to hear the scan results soon after the procedure (14). Similarly, van Dongen et al. (2011) investigated preferences for diagnostic imaging of the uterine cavity and found that short waiting time influenced patient preferences for a particular scanning modality (19). The importance of short waiting time for results on patient preference is supported by the current findings.

These results are also of potential significance to clinical practice. Although patient choice of imaging modality is limited within the UK health system (15), patient preference for the immediacy of scan results, fewer side-effects, and other features associated with the ultrasound modality may help both to facilitate patient–clinician interactions, and inform clinical decision-making processes regarding scan modalities, particularly given that CEUS has been shown to be as diagnostically effective as CE-MRI and CE-CT (25). Therefore where clinically warranted, that is where other imaging modalities would not add to the diagnostic picture, and indeed would potentially lead to patient anxiety and distress CEUS could be offered as an alternative scan option. Overall, the findings suggest that the majority of patients requiring a scan to diagnose focal liver lesions are likely to prefer CEUS over CE-MRI or CE-CT, especially if CEUS can provide shorter waiting times for the scan or results or a reduction in the chance of suffering minor side effects. This would suggest that if only one modality can be provided, then based on a consideration of patient preference alone, CEUS is most likely to be the optimal modality. However, the substantial variation in preferences suggests that this may not always be the case. Patients who are particularly averse to further procedures and who may be less averse to a body scanner procedure type may prefer CE-MRI or CE-CT. The study findings make it difficult to identify exactly what patient subgroup this may be. Whereas male patients may be less likely to be averse to a body scanner, respondents with better QoL were both less likely to be averse to further procedures but also more likely to be averse to a body scanner. Younger respondents or those with a history of hospital admission(s) were less averse to waiting and so may also be more willing to accept CE-MRI or CE-CT. Overall, the substantial variation observed in respondent preference also highlights the need to discuss the comparative advantages of available imaging modalities with individual patients if a choice of alternative modalities is available.

LIMITATIONS

In common with other DCE studies, the findings of this DCE assume that the choices respondents say they would make would actually be made in practice, were they to require liver imaging. However, the careful pilot testing and similarity between preferences estimated by the DCE and clinician expectation of preferences study provides some reassurance of validity in this regard. The preferences elicited relate only to the attributes included in the study; there may be other imaging characteristics (e.g., exposure to ionizing radiation) that may be relevant for some consumers but were not included in the choice. The

number of attributes and levels was kept to those deemed likely to be most important for consumers in the foundation work developing the DCE, to minimize respondent burden (23). The findings identified substantial variation around the characteristics of preferred scanning modalities, some of which remained unexplained in the model. Further exploration to identify specific patient sub-groups who might prefer the body scanner modality and why is of particular interest. Although the study sample was comparatively large for a health-related DCE (17), a larger study including a qualitative research component could explore this heterogeneity further. This study also elicited preferences under the assumption that all alternative imaging modalities are of similar effectiveness, in terms of longer–term patient–relevant health outcomes such as QoL and survival. Whereas the current evidence base suggests this is largely the case, it may not be so for selected indications (1). We did not explore whether health outcome would influence consumer decisions, if indeed a longer term difference in comparative health outcome were to be associated with CEUS. This is an avenue for future research.

CONCLUSION

This study extends what is known about the factors influencing patient preferences of imaging modalities, and adds new research specifically relating to CEUS as recommended in NICE Diagnostics Guidance 5 (1). This research should help inform the guideline update, particularly around the design and provision of clinical services to incorporate CEUS as an imaging modality for diagnosing focal liver lesions and guidance for clinicians in respect of the diagnostic options available. Furthermore, it provides some insights for health professionals into the likely preferences of their patients related to alternative scan modalities. Whereas CEUS appears to be preferred in general, the variation in preferences observed highlights the importance of discussing individual patient choice, where more than one modality is available. Future research should explore the issues identified in the study, such as, understanding how and in which direction preferences change in different sub–groups of the patient population. Research should examine the underlying reasons for the sub–group differences such as patient circumstances, previous experience, and, knowledge of diagnostic scanning procedures.

It appears that clinicians are intuitively aware of consumer preference and the likely direction these preferences take (15). This research demonstrates that consumer preference generally favors CEUS over CE-CT or CE-MRI for the diagnosis of liver lesions; however, healthcare providers need to consider how they will implement CEUS in their diagnostic pathway and how to routinely incorporate patient choice into clinical care.

SUPPLEMENTARY MATERIAL

Supplementary Tables 1–3
http://dx.doi.org/10.1017/S0266462315000239

CONFLICTS OF INTEREST

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